Environmental Weed Control and Native Revegetation Programme for Oakley (Te Auaunga) Creek

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1.0 INTRODUCTION

Te Ngahere has been contracted by Auckland City to prepare a restoration programme for the lower section of Oakley Creek in Central West Auckland. The restoration programme covers an area bordered by Great North Road, Waterview in the north through to Harbutt Reserve. Mt Albert. Oakley Creek is a scenic waterway that holds importance within the Auckland region for a number of social, cultural and biological reasons. A restoration programme is necessary to provide coordinated management of the site with a long-term vision in mind. The following programme presents a detailed site description and discusses the cultural and social values this area holds and the different community groups involved, before proposing weed management and native revegetation recommendations. An estimate of the cost to carry out these recommendations is included as Appendix D at the end of this document.

1.1 Vision

A long-term (30 year plus) vision is essential for any ecological restoration project. The vision for Oakley (Te Auaunga) Creek is to see its environs restored and protected as a natural, native ecosystem, incorporating a range of wildlife habitats, indigenous species and recreational amenities for present and future generations.

1.2 Aim

To maintain a holistic approach to the restoration, enhancement and protection of the ecological health of Oakley (Te Auaunga) Creek and its environs.

1.3 Goals

1) To have Oakley Creek established as a place of major ecological, social and cultural
value.
2) To protect the stream banks of Oakley Creek from erosion through riparian planting.
3) To restore and enhance the water quality in Oakley Creek.
4) To provide rough surfaces and planting for stream life.
5) To have Oakley Creek established as a natural area of multiple uses and environments e.g. native forest, wetland, open space, walkway and cycleway etc.
6) For Oakley Creek to become a wildlife corridor, linking other areas of ecological importance e.g. Western Springs, Hillsborough Cemetery Reserve and Heron Park etc.
7) To have Oakley Creek re-established as a natural waterway.

1.4 Restoration Programme Objectives

In the process of fulfilling the above vision, aim and goals for Oakley Creek, this restoration programme will achieve the following objectives:

1) Help people and groups involved in Oakley Creek achieve the goals listed above by providing a long-term, step-by-step restoration programme.
2) Describe and map the existing flora landscape.
3) Depict the probable fauna within Oakley Creek
4) Collate community groups and individuals current restoration efforts
5) Propose an appropriate weed management programme including appropriate methodologies for control.

6) Recommend a riparian planting programme including a template for a typical riparian sequence.

7) Consider at all stages the wide range of issues, including stream bank stabilisation, reducing flood peaks, improving water quality, preserving views and maintaining recreational use of the area.

2.0 SITE DESCRIPTION

Oakley Creek, also known as Te Auaunga, is located in West Auckland, flowing through Mt Roskill, Owairaka, Mt Albert, Avondale and Waterview (see Figure one). The total length of Oakley Creek is approximately 15km (Mellsop, 2004). The Oakley Creek catchment has a natural variety of contours and a 6m-high waterfall (the only significant waterfall within Auckland City). The stream discharges through the Waterview inlet just south of the Waterview/Point Chevalier interchange of Northwestern Motorway into the Motu Manawa – Pollen Island Marine Reserve.

This Ecological Restoration Programme covers the section of Oakley Creek bordered by Great North Road in the north, Unitec Institute of Technology in the east and residential areas around to the west. The Southern boundary is within Harbutt Reserve before New North Road. (See Figure one for the exact boundaries this programme covers). The lower region of Oakley Creek (the focus of this current programme) follows the typical natural shape of unmodified streams. Flood plains help reduce the downstream impacts of large overflows of stormwater.

There are a variety of land uses along the Oakley Creek catchment. These include; relatively low density residential areas, roads, commercial and industrial sites and open space (including parks, schools and playing fields). The upper catchment in particular has been modified to prevent flooding, by channelling stormwater to the Waitemata Harbour during storm events. It is anticipated that restoration of the area will help reduce the volume of floodwaters entering the creek.

The creek holds historical and ecological value, however this is threatened by a number of factors. Some of these threats include the environmental weeds; urban intensification and stormwater run off contaminated with heavy metals, oils and grease, hydrocarbons and suspended solids. An example of the level of pollutants in the stream is from 1993 data collected at the mouth of Oakley Creek. Levels of zinc and lead were high enough to potentially significantly affect more than 50% of the organisms present (Lynn Green, 2004).

Current restoration efforts already in place have helped restore some areas and mitigate these threats. Along with a number of plantings, MetroWater has a floating litter trap in place at the northern end of the site. The trap allows for the removal of floating litter in the stream, and allows rubbish to be removed before reaching the estuarine outlet.

2.1 Vegetation types at Oakley Creek

The original vegetation cover through this area was likely to have been a kauri-podocarp-broadleaf forest. At present the area is largely modified and it appears that mahoe is one of the only native species remaining in any abundance that has not been planted.

Table one below lists the exotic and native species recorded during a survey throughout the area. Native and exotic herbaceous species are generally omitted from this list. Refer to Figure two and Table two for the general vegetation trends throughout the area.

Figure one: Location of Oakley Creek within Auckland Isthmus, showing the boundaries of the weed control and revegetation programme

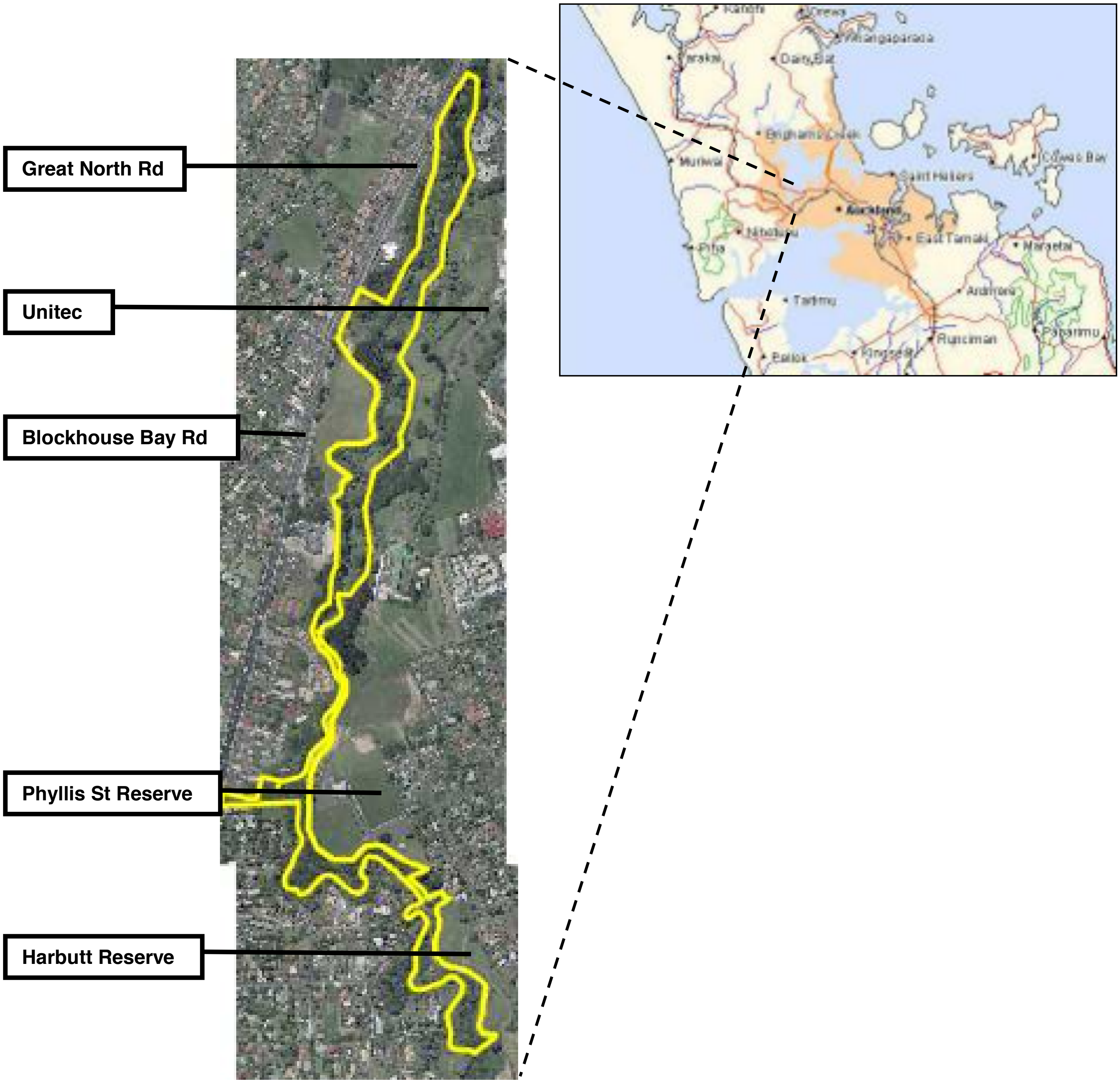

Table one: Native and exotic species within Oakley Creek
Species within the canopy are in bold

Native species	Common name	Exotic species	Common name
Alectryon excelsus	Titoki	*Acanthus mollis*	Bears breeches
Beilschmidiedia tarairi	Taraire	*Acer pseudoplatanus*	Sycamore
Carex lambertiana	Bush sedge	*Agapanthus orientalis*	Agapanthus
Coprosma robusta	Karamu	*Ageratina riparia*	Mistflower
Cordyline australis	**Ti kouka**	*Allium triquetum*	Onion weed
Corynocarpus laevigatus	Karaka	*Alocasia brisbanensis*	Elephants ear
Cyperus ustulatus	Toetoe upokotangata	*Alternanthera philoxeroides*	Alligator weed
Dacrycarpus dacrydioides	Kahikatea		
Dacrydium cupressinum	Rimu	*Anredera cordifolia*	Madeira vine
Dodonaea viscose	Akeake	*Araujia sericifera*	Moth plant
Entelea arborescens	Whau	*Arundo donax*	Giant Reed
Geniostoma rupestre	Hangehange		
Griselinea lucida	Puka	*Asparagus scandens*	Climbing asparagus
Hebe stricta	Koromiko	*Bartlettina sordida*	Bartlettina
Hoheria populnea	Lacebark	*Canna indica*	Canna lily
Kunzea ericoides	**Kanuka**	*Convolvulus arvense*	Convolvulus
Leptospermum scoparium	Manuka	*Cortadeira seallona*	Pampas
Leucopogon fasiculatus	Mingimingi	*Crocosmia x crocosmiiflora*	Montbretia
Macropiper excelsum	Kawakawa	*Cyperus eragrostis*	Umbrella sedge
Macropiper excelsum var. pustatum	Kawakawa	*Egeria densa*	Egeria
Melicytus ramiflorus	Mahoe	*Erythrina indica*	Flame tree
Metrosideros excelsa	Pohutukawa	*Eucalyptus sp.*	Eucalyptus
Myoporum laetum	Ngaio	*Euonymus japonicus*	Japanese spindle tree
Myrsine australis	Mapou	*Hedychium flavescens*	Ginger (yellow)
Olearia paniculata	Akiraho	*Hedychium gardenerium*	Kahili Ginger
Olearia furfuracea	Akepiro	*Homalanthus populifol*	Queensland poplar
Phormium tenax	Harakeke	*Hypericum androsaemum*	Tutsan
Pittosporum crassifolium	Karo	*Ipomoea indica*	Blue morning glory
Pittosporum eugenioides	Tarata	***Ligustrum lucidum***	**Tree privet**
Pittosporum tenufolium	**Kohuhu**	*Ligustrum sinense*	Chinese privet
Podocarpus totara	Totara	***Liquidambar sp.***	**Liquid amber**
Rhopalostylis sapida	Nikau Palm	*Lonicera japonica*	Japanese honeysuckle
Solanum aviculare	Poroporo	*Paraserianthes lophantha*	Brush wattle
Sophora microphylla	Kowhai		
Vitex lucens	Puriri	*Phoenix canariensis*	Phoenix palms
FERNS AND ALLIES		*Phyllostachys spp.*	Bamboo
Adiantum aethiopicum	Common maidenhair	***Pinus spp.***	**Pines**
Blechnum chambersii	Rereti	*Plectranthus ciliatus*	Plectranthus
B. membranaceum		*Polygonum persicaria*	Willow weed
B. novae-zelandiae	Kiokio	*Populus sp.*	Silver poplar
Cyathea dealbata	Ponga	***Quercis sp.***	**Oak**
Cyathea medullaris	Mamaku	*Ricinus communis*	Castor oil plant
Deparia petersenii		*Rubus fruticosus*	Blackberry
Dicksonia squarrosa	Wheki	*Rumex sagittatus*	Climbing dock
Diplazium australe		*Salix fragilis*	Crack willow

Native species	Common name	Exotic species	Common name
Doodia australis	Pukupuku	*Selaginella krausiana*	African club moss
Pneumatotpteris pennigera	Gully fern	*Senicio mikanioides*	German Ivy
Pteridium esculentum	Bracken	*Setaria palmifolia*	Palm grass
Pteris tremula	Shaking brake	*Solanum mauritianum*	Woolly nightshade
		Syzygium australe	Brush Cherry
		Tradescantial fluminsis	Wandering Jew
		Tropaeolum majus	Nasturtium
		Ulex europaeus	Gorse
		Vinca major	Periwinkle
		Zantedeschia aethiopica	Arum lily

Figure two: Vegetation trends throughout Oakley Creek

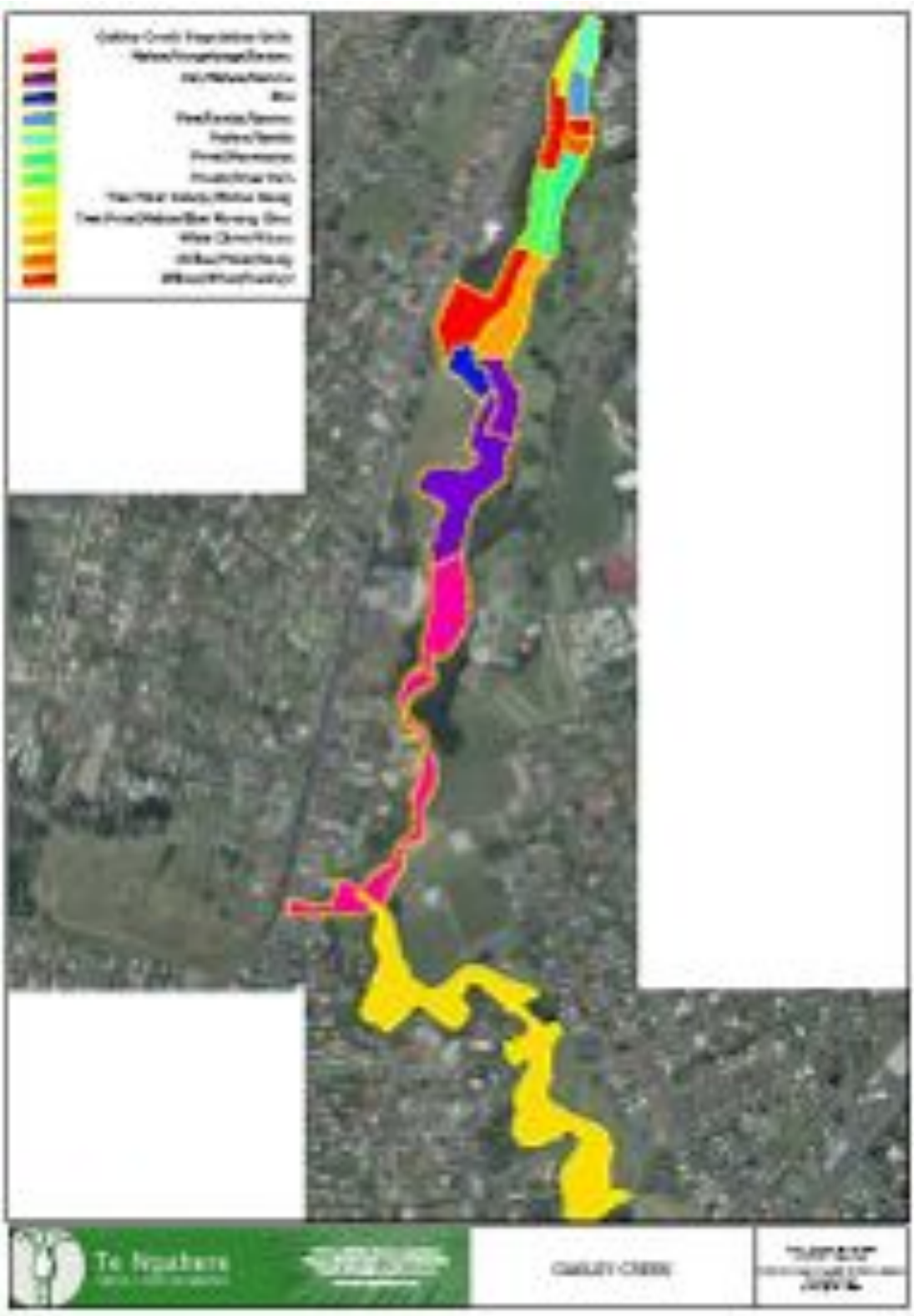

Table 2: Vegetation type, structural class and landform within Oakley Creek

	Vegetation Type	Structural Class	Landform	% of Area
1.	Willow/privet-Eucalyptus sp.	Forest	Alluvial hillslope	15
2.	*Pinus* spp.	Treeland	Volcanic/alluvial hillslope	5
3.	Tree privet/native revegetation	Shrubland	Volcanic hillslope	3
4.	Poplars/karaka	Treeland	Volcanic hillslope	3
5.	Willow/Tree privet/native revegetation	Shrubland	Floodplain/back wetland	2
6.	Tree privet/macrocarpas	Forest	Volcanic hillslope	5
7.	Tree privet/Chinese privet-Silver fern	Forest	Alluvial hillslope	2
8.	White clover-kikuyu	Grassland	Volcanic/alluvial hillslope	5
9.	*Quercis* sp./karamu/mahoe	Forest	Volcanic hillslope	10
10.	Mahoe-hangehange-karamu	Shrubland	Volcanic/alluvial hillslope	25
11.	Tree privet/mahoe/*Ipomea*	Shrubland	Volcanic/alluvial hillslope	25

2.2 Stream bank erosion/stability

Stream bank erosion and subsidence is visible throughout Oakley Creek and is occurring at a faster rate than would generally be expected within unmodified riparian ecosystems. The two main causes for this are likely to be; i) the lack of stream bank vegetation and ii) the rate at which the water flows through the stream. To reduce the occurrence of such erosion, banks should be revegetated with the appropriate plants. Vegetation can also help absorb soil water, act as a buffer zone, protect streamside vegetation and wildlife as well as reducing sediment and other pollutants within the waterway.

2.3 Geology

The Oakley Creek catchment has varied geology. In the area this ecological restoration programme covers, the stream is at the edge of the basaltic lava flow from Mt Albert, and runs through Waitemata Groups mudstone and sandy mudstone (Kermode, 1992). These substrates are revealed in some areas where bank erosion is prevalent.

2.4 Probable fauna within the Oakley Creek area

Waicare sampling has shown a diversity of macroinvertebrates present in the stream system. These include caddis fly, damselfly and snails. Native fish (kokopu) have also been sighted. Exotic fish have been sighted further upstream, including *Gambusia* and koi carp, which have the potential to outcompete and feed on native organisms within the stream.

Fantail (piwakawaka), pukeko, and tui are likely to frequent Oakley Creek. It is also possible ruru and kereru frequent the area. Exotic birds are likely to outnumber the native avifauna with species such as magpies, mynas, blackbird and song thrush.

A Unitec report by Lynn Green, 2004, lists the different species reported in the area including myna, mallard, white faced heron, sacred kingfisher, swallow, house sparrow, pukeko, North Island fantail, blackbird, thrush, pheasant and silvereye.

Rats, possums, hedgehogs and rabbits are the four most likely mammalian pests inhabiting the Oakley Creek area. These pests, along with domestic and feral cats, are likely to have significant impacts on the populations of native fauna in the area.

Native reptiles may also be in the area. Possibilities include copper and ornate skinks as well as the introduced rainbow skink. The diversity of all animals combined will be small when compared with the diversity of invertebrates in the area. A vast array of beetles, spiders and moths etc will be present both within the stream and on land.

2.5 Archaeological sites

A number of archaeological sites are situated within Oakley Creek, including Maori habitation sites, an old mill, tannery and quarry. All restoration activities should take these historically and culturally significant sites into consideration and consult the appropriate parties.

Druskovich (2009) has identified archaeological sites within and in proximity to Oakley Creek. This plan allows for recommendations made in the archaeological report directly within the boundaries of this plan (see section 7).

There is a chance that further sites will be discovered in the future, and areas have been identified as 'likely' to have such sites within Druskovich (2009). This report focuses on the identified sites only.

3.0 CURRENT RESTORATION EFFORTS

A number of groups are involved in working towards the restoration of Oakley Creek. A brief description of each group is detailed below.

3.1 Friends of Oakley (Te Auaunga) Creek

The Friends of Oakley (Te Auaunga) Creek, have monthly workdays where volunteers carry out weeding, planting and/or clean-ups along the creek. The group was established in 2004 and shares the vision of this restoration programme; to see "Oakley (Te Auaunga) Creek and its environs restored and protected as a natural ecosystem, incorporating a range of wildlife habitats, indigenous species and recreational amenities, for present and future generations." It is working closely with Auckland City Parks Department to co-ordinate and encourage activities and community involvement on the creek.

The 'Friends' group has recently carried out plantings in a number of different locations in the northern and southern ends of the project. It also carried out a major rubbish clean up at the beginning of the year.

3.2 Buchanan Rehabilitation Centre

The Buchanan Rehabilitation Centre is located close by, across the road from Unitec, and their 'Garden Group' is involved in restoration efforts on the creek. The group has adopted the flood plain area where the Wairaka Stream merges with Oakley Creek (below the Mason Clinic) and planting is currently underway.

3.3 Waicare

Waicare is a programme for community and school groups that involves monitoring and educating about water quality within the Auckland Regions. Currently there are sites above the waterfall and in Wairaka Stream that are being monitored regularly.

Results are very encouraging, with species of whitebait (kokopu) sighted recently, and a number of caddis flies and damselflies, which indicates relatively good water quality.

3.4 Unitec

Students and staff are involved at a range of levels with research, monitoring and restoration efforts on Oakley Creek. A group of resident students have expressed interest in becoming involved. They may possibly focus on some further planting in the area surrounding the bridge that joins the two hostels.

A group of Periodic Detention workers undertake regular weed management under contract to Unitec on the eastern slopes of the creek adjoining Unitec.

3.5 Gladstone Primary School

The Gladstone Primary School 'Nature Force' groups has recently been allocated a site on Oakley Creek, below the Unitec Residents bridge which they will be planting and maintaining.

3.6 Auckland City Contractors

Te Ngahere is involved in Oakley Creek as part of a larger contract with Auckland City (Weed Control in Bush Natural Areas), which is in its fourth year. Work in Oakley Creek during the four years has involved the control of the majority of weed species in the area. The current contract however does not extend through to management unit 8 and 9 of the present project.

3.7 MetroWater

MetroWater provides water and wastewater services to homes and businesses in Auckland City. Urban sustainability features as a goal of MetroWater, and they aim to achieve this by a number of ways including: i) Enhancing their environmental management capacity to lead the industry in environmental stewardship and ii) Operate their business in a manner that minimises negative impact on the environment.

MetroWater have assisted by supplying some plants for riparian revegetation in a number of places along Oakley Creek. It maintains an approximately 1 metre clear accessway along the stream bank. Once native revegetation has been undertaken, it must be made clear to the contractor that clearing of the accessway is no longer necessary due to restoration efforts.

MetroWater also recently carried our extensive riparian planting on both sides of Oakley Creek from the 'litter trap' to the tunnel at Great North Road (management unit 1a).

4.0 IMPORTANCE OF THE SITE AND ITS RESTORATION

4.1 Environmental aspects

One of the most serious threats to Auckland's natural environment is the establishment and spread of invasive weeds within remaining bush remnants and corridors. Environmental weeds replace native trees, prevent native regeneration and smother native plants. This is why it is essential to restore native areas of habitat to prevent the transformation of native forest into exotic ecosystems. Areas like Oakley Creek have been under weed invasion for a substantial period of time therefore a comprehensive weed management and native revegetation programme is essential to restoring the creeks unique ecology and landscape.

Oakley Creek is significant for a number of reasons. It is one of the only waterways in Auckland that remains above ground for the majority of its path. (Small culverts are necessary where it runs under roads.) There is also large potential for the ecological restoration of this area, as approximately 57% of the stream is bordered by reserves (Mellsop, 2004). The riparian margin along Oakley Creek is important, as it is a unique and sensitive environment that performs many important functions. Sufficient vegetation cover can help protect the stream banks from natural wind and water led erosive processes, while creating more shade for the creek, therefore reducing water temperatures to more favourable levels for stream fauna. Now more than ever, riparian vegetation within urban Auckland provides corridors between native bush remnants, facilitating the movement of native fauna and flora, while helping to sustain our biodiversity by providing essential habitat and food resources. It is also an important buffer between urban development and the creek, not only for aesthetic reasons, but also as a filter to all the pollutant and sediment laden runoff into the creek and eventually sea.

Weed infested riparian corridors pose biosecurity risks to surrounding natural areas. Seed from such areas can easily be blown across, or dropped by birds to native bush remnants and start new infestations that, if undetected, could pose serious problems to these natural areas.

Native birds, reptiles and invertebrates utilise riparian vegetation as a habitat itself or as a corridor to travel from one bush patch to another. Not only will plants be able to carry out essential ecosystem services but the local bird fauna of fantails, silvereyes, grey warblers, tuis and the occasional morepork and kereru will be able to utilise the food, nesting and roosting sites created by this newly restored and planted habitat. Native ground cover and vegetation should also encourage the establishment of native invertebrates and reptiles in the Oakley Creek area.

4.2 Social and cultural aspects

Oakley Creek walkway is widely used by the general public as an accessway to Unitec as well as a scenic walkway, therefore native plantings would be considered more aesthetically pleasing than exotic vines and weeds smothering trees and shrubs. As plantings mature and native fauna returns, restoring the area will be an excellent advocacy tool to help promote the benefits of managing our natural environment.

Local communities thrive on the recreational opportunities our unique environment provides, whether on land or amongst the ripples in the creek. With the improved aesthetics and therefore perceived value of the area, people may be less likely to dump rubbish in the creek

The environment is highly significant to local iwi as well. A number of culturally and archaeologically significant sites are located in the vicinity of Oakley Creek. Any works need to consider these significant areas including recommendations within Druskovich (2009), and the appropriate iwi and/or interested parties should be consulted before carrying out any recommendations within this programme.

4.3 Future impacts

The nature of stream habitats dictates that conditions upstream will have consequences downstream. There is evidence of large, fast water flows causing some bank erosion and scouring. This will impact water quality, vegetation and habitat diversity, therefore biodiversity within the site, estuary, harbour and coastal waters downstream. Habitat downstream of the restoration site will benefit once the area becomes a functioning ecosystem. The threat of weed invasion will reduce and the quality of water passing through is likely to improve.

On the other hand if upstream areas are subject to pollution such as an increase in sediment or pollutants in runoff, downstream impacts will be evident. It may cause a decrease in the quality of downstream habitat, however, where areas have been restored, the potential to mitigate the impacts of pollutants upstream will increase.

Urban intensification and the proposed extension of SH 20 are also potential future impacts on Oakley Creek. Both examples significantly increase the impervious surfaces in the area, which would mean an increase in the water volume and speed entering the stream. Pollutants and excess nutrients and sediment within this runoff would have negative impacts. A motorway also imposes a large visual impact on the area. The restoration of Oakley Creek could help mitigate these potential impacts.

Current and future impacts on Oakley Creek further emphasise the importance of restoring this site.

5.0 MANAGEMENT UNITS

Areas undergoing environmental management are often divided into management units. This enables clear identification of particular locations and can accommodate varying requirements for different areas within the restoration site. In the case of Oakley Creek the area is divided into management units depending on different land marks and the vegetation present (i.e. predominantly exotics vs. natives) and previous restoration work in the area (i.e. native revegetation). It is important to keep units to a relatively small size so as to be possible for small groups of volunteers to manage, and maintain. Management units for Oakley Creek are depicted in Figure three. See Appendix D for the location of the archaeological sites identified by Druskovich (2009).

The priority of management units is determined by a number of factors. The most influential of these is the density of the weed infestations, previous work in the area i.e. weed control and revegetation, and the visibility to the public. Management Unit 8 has large weed infestations that would require huge efforts to control; therefore it holds a low priority. In contrast, management unit one has low levels of environmental weeds present, therefore is a high priority for maintenance weed control and revegetation efforts. The priority ranking for a management unit does not necessarily cover the entire unit. For example management unit 9 has a priority 3 ranking, however this only covers the areas recently revegetated. The remaining areas have too high a density of weeds to justify a priority 3. See the Restoration timeline for specific tasks within management units.

It is important to note, that a significant amount of work to date has focused on the lower third of the site (i.e. MU 1 and 2). If these areas are not high priority management units then environmental weeds are likely to regrow and will eventually compromise the 2005 native revegetation efforts. Therefore the priority of each management unit focuses on the current state of each unit, rather than its position in the catchment.

Where management units are further divided into sections, it is generally to cater for the present situation (i.e. recent plantings) and to ensure units do not become an unmanageable size. In time as weed densities become low, therefore less labour intensive, boundaries between sections (e.g. 1a and 1b) can dissolve in order to manage the entire management unit as a whole.

Figure three: Management Units within Oakley Creek

5.1 Management Unit One (Priority 1):

Management Unit One is divided into three different units 1a, 1b and 1c. 1a-1c are all partially planted and bordered by the creek on the west and the Mason Clinic on the east. 1a is the most Northern end of the site. 1b covers the flood plain and 1c covers the area under tree privet canopy. The canopy should be retained until funds are available to revegetate the entire area. At this stage ⅔ of mature privet should be removed within 1c. The remaining ⅓ could be removed once plantings have established a ground cover (i.e. at least 3 years after planting).

To date the majority of contracting work has been carried out within this management unit. In order to maintain the weed infestations at a low level, the site needs to be visited regularly. This area is therefore a priority.

5.2 Management Unit Two (Priority 4):

This management unit covers the western side of the creek through to the level of the privet canopy in management unit 1c. Large exotic trees (6m+), with the exception of willows and privets, should not be controlled. As in MU 4, weed control efforts seem to have been concentrated on the eastern banks of Oakley Creek. MU 2 is given a priority of 4 as it is partially planted and will complement the work in MU 1.

5.3 Management Unit Three (Priority 2):

Management unit three is divided into two sections, a and b. This management unit has a large open component and needs to be revegetated in a manner that maintains open recreational areas. The northern and southern ends of this unit are bordered by tree privet and oak canopy respectively, while the stream borders the western boundary. Planting was carried out recently (August 2005) in a section of this area, therefore will require maintenance weed control and releasing to ensure their survival. It is also adjacent to MU 1, the focus of much of the current weed control operations.

5.4 Management Unit Four (Priority 5):

Management unit four is also divided into two sections. 4a runs from management unit 2 up to Great North Rd. Continuing from here 4b is a predominantly pine canopy along a steep slope. The amount of work carried out in this management unit is low; therefore its priority ranking is low.

5.5 Management Unit Five (Priority 6):

This unit encompasses both the west and eastern banks of the creek from the bridge at the northern end of the oak canopy, through to the bridge that runs through to the Unitec accommodation. The density of weeds is relatively low in this unit, hence a higher priority. The Gladstone Primary School 'Nature Force' group has planted an area on the western side of Oakley Creek in this unit. The Unitec student residents may focus on areas within MU5 as well, so it is important to control the weeds if the group intends to revegetate some areas. It may be necessary to concentrate on these revegetation areas as an earlier priority than other management units.

5.6 Management Unit Six (Priority 7):

From the main bridge leading to the Unitec accommodation, management unit 6 runs along both sides of the creek until the next minor bridge. It encompasses the waterfall and some open grass spaces but is otherwise dominated by regenerating native shrubland. MU 6 is still significantly infested with weeds (particularly the western bank), therefore remains a low priority.

5.7 Management Unit Seven (Priority 8):

This management unit is the narrowest portion of the site. Following south from management unit six it encompasses both sides of the creek and the area surrounding the Waterview Downs Bridge and walkway leading to New North Road. Within MU 7 is the planting above the retaining wall of the old rubbish dumpsite. Control of this unit should be straightforward as weed densities are relatively low. The biggest concern for this unit is the adjacent land where weeds are not being controlled. The low priority ranking is mainly due to the fact that no plantings have been carried out in this area recently and its location i.e. it is upstream from current work and adjacent to bad weed infestations (MU 8 and 9).

5.8 Management Unit Eight (Priority 10):

MU 8 follows the eastern side of the creek. (Through MU 8 and MU 9 the western banks are not within the projects focal area.) It has large-scale weed infestations, with blue morning glory smothering the majority of trees, native and exotic, within the area so it is recommended to control this management unit once all other units are at manageable 'maintenance' levels.

5.9 Management Unit Nine (Priority 3/9):

The remaining southern portion to be restored is contained within MU 9. Weed infestations are relatively large in places with species such as climbing asparagus at high densities. Community groups have carried out a number of plantings in this unit so it is recommended that these planting sites only, be given a priority 3, while the remaining section is given priority number 9.

6.0 ENVIRONMENTAL WEED CONTROL

6.1 Principles of Weed Control

6.1.1 Control objectives

During the process of controlling weeds in an area, it is important to ensure some end objectives are established, with regard to what weed infestation level is trying to be achieved and maintained. These can be as follows:

6.1.2 Eradication

Eradication involves the complete control and removal of a weed species (Clunie, 1995). Eradication is not a feasible control option for all weed species as it depends on the size and distribution of the infestation and the likelihood of re-invasion. For species with a seed bank present, eradication is likely to take place over a longer period of time, to allow seeds to germinate and be targeted.

6.1.3 Zero density

Zero density, as with eradication, aims to completely control a weed species. However, the dispersal mechanism of many plants (e.g. by birds or wind) means that the chance of re-invasion is high and eradication may never be achieved. The plants already present at the site may be removed, but monitoring to identify re-invasion will be necessary.

6.1.4 Maintenance Control

For many weed species, neither eradication nor zero density control are feasible control options. This includes; species that are very well established at a site, with a widespread distribution and/or high density of plants; or those species that do not respond effectively to control techniques. For such species, maintenance control can be implemented to maintain or reduce the infestation size, prevent further spreading and reduce the detrimental effects on the ecosystem.

To achieve these control objectives, a number of different weed control methodologies can be employed. These include:

6.1.5 Top Down Approach

In any weed control programme it is important to consider the dispersal of weeds down stream or downhill. Most weed species use gravity and/or water flow to aid dispersal, (e.g. ginger and wandering Jew). Control of weed species that use this form of dispersal should be approached from the uphill or upstream points first. When the weed infestations in these higher altitude areas have been eradicated or controlled to at least zero density, weed control should continue progressively downstream. This approach can be applied to all weed control programmes, regardless of whether they are site or weed-led. In an ideal situation, this methodology would therefore begin where Oakley Creek arises rather than near the bottom end of the stream.

6.1.6 Satellite Infestation Approach

Weed infestations often have a primary infestation site where the density of weed species is highest and there is a concentration of older plants. The primary infestation often gives rise to several smaller and younger satellite infestations of the same weed species in close vicinity. One of the principles of weed management is the removal of these satellite infestations prior to control of the primary infestation. This works on the understanding that if you control only the major infestations, the satellite infestations will continue to spread. However, if control begins at the outlying

satellite infestations and works progressively towards the primary infestation, the species distribution is continually being reduced.

Another basic principle of weed management is to control the edges of the infestation first, gradually working into the centre, controlling the infestation to some degree until resources allow for eradication of the species to be feasible. This is particularly applicable to weed species that either take several years before sexual maturity or weeds that do not produce seed and spread only vegetatively (e.g. wandering Jew or yellow ginger). Note that this is a general rule that should be adhered to but exceptions may arise.

6.1.7 Site-led and weed-led approaches

The weed-led approach controls specific weed species over the entire control area at the same time. The objectives of weed-led control are to manage the spread of specified weed species invading or spreading beyond a limited distribution (Owen, 1998). It also manages the spread of invasive weeds beyond a limited distribution, with eradication or containment as the goal.

The site-led approach to weed control ranks sites throughout the control area in order of prioritisation according to site related values. The management units in Section 5.0 help with restoration efforts that are financially constrained.

6.1.8 Determining the priority of a weed species

Weed species present in Oakley Creek can be divided into high, medium and low priority weeds. High priority weeds include small infestations that can be eradicated in the first year of weed control. Medium priority weed species are more established exotic species that are possible to control to zero density. These species require control in the first year, but eradication may not be possible until later years. Low priority weeds do not necessarily pose a large threat to an ecosystem. These are also weeds that only require maintenance control. The abundance of weeds within each management unit at Oakley Creek is described in Table three.

The outcome of weed control in one year will affect the priority of control for that weed species in subsequent years so that the classification of a weed may change from year to year. For example: i) after a weed has been successfully eradicated it will move off the list in terms of priority for control, or ii) a weed may have a medium control priority but move to a higher control priority if eradication is possible with little cost or resources.

The actual order of targeting weed species may not strictly follow the ranked priority of individual weed species. It will largely depend on the methodology of control operations and coexistence of weed species. Refer to Table four, five and six for a list of weeds within Oakley Creek and their priority and end objective. These tables will also detail recommended methods for the control of these species

Table three: Weed species and their abundance per management unit within Oakley Creek. [I – Individual (1 plant) O – Occasional (<3%), L – Low (3%-7%), M – Medium (7% - 25%), H – High (>25%)]

Exotic species	Common name	Management Units								
		1	2	3	4	5	6	7	8	9
Acanthus mollis	Bears breeches				O	I			L	L
Acer pseudoplatanus	Sycamore						I			
Allium triquetum	Onion weed	O	O	O	O	O	O			
Alocasia brisbanensis	Elephants ear								I	
Alternanthera philoxeroides	Alligator weed				L	L	O			
Agapanthus orientalis	Agapanthus	O								
Ageratina riparia	Mistflower						I	I		
Anredera cordifolia	Madeira vine	I							M	L
Araujia sericifera	Moth plant	I		I				I	L	O
Arundo donax	Giant Reed						I	I		
Asparagus scandens	Climbing asparagus								O	L
Bartlettina sordida	Bartlettina									I
Canna indica	Canna lily				O	O			I	
Convolvulus arvense	Convolvulus				O	O	I	O	L	O
Cortadeira seallona	Pampas				O	O				
Crocosmia x crocosmiiflora	Montbretia						O	I		
Cyperus eragrostis	Umbrella sedge				O	O		O	O	
Egeria densa	Egeria									
Erythrina indica	Flame tree	I				I				
Eucalyptus	Eucalyptus								I	
Euonymus japonicus	Japanese spindle tree								I	
Hedychium flavescens	Ginger (yellow)				O	O			O	
Hedychium gardenerium	Kahili Ginger				O	O				
Homalanthus populifol	Queensland poplar			I						
Hypericum androsaemum	Tutsan			I						
Ipomoea indica	Blue morning glory								M	L
Ligustrum lucidum	Tree privet	O		O	O	L		O	M	L
Ligustrum sinense	Chinese privet			L	L	M	L	O	H	L
Lonicera japonica	Japanese honeysuckle				L	L			I	
Paraserianthes lophantha	Brush wattle						O	O	M	L
Phoenix canariensis	Phoenix palms							O	I	
Phyllostachys spp.	Bamboo	O	O	O			M			
Pinus spp.	Pines						L			
Plectranthus ciliatus	Plectranthus									I
Polygonum persicaria	Willow weed				L	L	O		O	
Populus sp.	Silver poplar	O								
Quercis sp.	Oak	M				H				
Ricinus communis	Castor oil plant							I	I	
Rubus fruticosus	Blackberry					O	I		O	
Rumex sagittatus	Climbing dock								L	L
Salix fragilis	Crack willow			L		O		L	L	L
Selaginella krausiana	African club moss						O			
Senicio mikanioides	German Ivy					O		I		
Setaria palmifolia	Palm grass					O				
Solanum mauritianum	Woolly nightshade					O	O	O	L	
Syzygium australe	Brush Cherry									I
Tradescantia fluminsis	Wandering Jew	O		L		H	L	O		
Tropaeolum majus	Nasturtium					O	L	O		
Ulex europaeus	Gorse						I			
Vinca major	Periwinkle	O								
Zantedeschia aethiopica	Arum lily	O		O						

Table four: High Priority Environmental Weed species and their recommended method of control, including the appropriate herbicide

Exotic species	Common name	End objective	Active Ingredient			Manual Methods
			Glyphosate	Metsulfuron	Triclopyr	
Acanthus mollis	Bears breeches	Eradication	CS/F			
Ageratina riparia	Mistflower	Eradication	CS/F			Hand pull seedlings
Alocasia brisbanensis	Elephants ear	Eradication	CS/F			
Anredera cordifolia	Madeira vine	Zero density		CS/F		Hand release from native plants and remove tubers.
Araujia sericifera	Moth plant	Zero density		CS/F		Hand pull seedlings and hand release from native plants.
Arundo donax	Giant Reed	Eradication	CS/F			
Bartlettina sordida	Bartlettina	Eradication	CS/F			Hand pull seedlings
Cortadeira seallona	Pampas	Eradication	F			Hand pull seedlings and grub juvenile plants.
Euonymus japonicus	Japanese spindle tree	Eradication		CS/F		Hand pull seedlings and remove from site.
Hypericum androsaemum	Tutsan	Eradication		FS		
Ricinus communis	Castor oil plant	Eradication		CS/F		Hand pull seedlings
Setaria palmifolia	Palm grass	Eradication	F			
Syzygium australe	Brush Cherry	Eradication		CS/F		Hand pull seedlings
Ulex europaeus	Gorse	Eradication		CS/F		

* Note where CS/F is in the middle of the column, this implies that both active ingredients should be combined in one formulation.

Table five: Medium priority environmental weed species and their recommended method of control, including the appropriate herbicide

Exotic species	Common name	End objective	Active Ingredient			Manual Methods
			Glyphosate	Metsulfuron	Triclopyr	
Agapanthus orientalis	Agapanthus	Zero density		F		
Allium triquetum	Onion weed	Maintenance control	F			
Alternanthera philoxeroides	Alligator weed	Zero density	F			
Asparagus scandens	Climbing asparagus	Zero density	F			Dig out tubers of seedlings and juveniles
Canna indica	Canna lily	Eradication	CS/F			Hand pull seedlings
Convolvulus arvense	Convolvulus	Zero density	F			
Crocosmia x crocosmiiflora	Montbretia	Zero density		F		Dig out or grub taking care to remove all bulbs from site.
Cyperus eragrostis	Umbrella sedge	Zero density	F			
Erythrina indica	Flame tree	Eradication		CS/Inject large specimens		Hand pull seedlings
Hedychium flavescens	Ginger (yellow)	Zero density		CS/F seedlings		Slash stem and dig out rhizomes
Hedychium gardenerium	Kahili Ginger	Zero density		CS/F seedlings		Slash stem and dig out rhizomes
Homalanthus populifol	Queensland poplar	Eradication		CS/F		Hand pull seedlings
Ipomoea indica	Blue morning glory	Zero density	CS/F			Hand pull seedlings
Ligustrum lucidum	Tree privet	Zero density		CS/F		Hand pull seedlings
Ligustrum sinense	Chinese privet	Zero density		CS/F		Hand pull seedlings
Lonicera japonica	Japanese honeysuckle	Zero density		CS/F		Hand pull or dig out seedlings.
Paraserianthes lophantha	Brush wattle	Eradication				Hand pull seedlings and cut larger plants (no herbicide is required).
Phoenix canariensis	Phoenix palms	Eradication	CS/ Inject			Hand pull seedlings
Plectranthus ciliatus	Plectranthus	Zero density	CS/F			Hand pull seedlings
Populus sp.	Silver poplar	Zero density	Ringbark, Inject			Hand pull seedlings and dispose off site
Rubus fruticosus	Blackberry	Eradication	CS/F			Grub out small plants
Rumex sagittatus	Climbing dock	Zero density	F			

Exotic species	Common name	End objective	Active Ingredient			Manual Methods
			Glyphosate	Metsulfuron	Triclopyr	
Salix fragilis	Crack willow	Eradication	CS*/F. Inject large mature specimens in spring.			*All material should be removed from site.
Selaginella krausiana	African club moss	Zero density	F			
Senicio mikanioides	German Ivy	Zero density	CS/F			Hand release vines from native plants.
Solanum mauritianum	Woolly nightshade	Eradication	CS/F			Hand pull seedlings
Tradescantia fluminsis	Wandering Jew	Zero density	F		F	
Tropaeolum majus	Nasturtium	Zero density	F			
Vinca major	Periwinkle	Zero density	F			
Zantedeschia aethiopica	Arum lily	Zero density		CS/F		Dig out tubers.

Table six: Low priority environmental weed species and their recommended method of control, including the appropriate herbicide

Exotic species	Common name	End objective	Active Ingredient			Manual Methods
			Glyphosate	Metsulfuron	Triclopyr	
Acer pseudoplatanus	Sycamore	No control				
Egeria densa	Egeria	No control				
Eucalyptus sp.	Eucalyptus	No control				
Liquidambar sp.	Liquid amber	No control				
Phyllostachys spp.	Bamboo	Maintenance control	CS/F			
Pinus spp.	Pines	*Mature specimens:* No control. *Seedlings/ saplings:* eradication.				Hand pull seedlings
Polygonum persicaria	Willow weed	No control				
Quercis sp.	Oak	No control (exception: seedlings)				Hand pull seedlings

6.2 Control Discussion

6.2.1 Retaining exotic canopy cover

Exotic canopy cover that does not pose an environmental threat should be left for three main reasons:

1) Retain shade requirements, and corresponding parameters within the stream
2) Maintain shelter from the sun and wind and retain moisture for future revegetation efforts (i.e. act as a nurse crop).
3) Maintain shade to inhibit the regrowth and regeneration of some weed species.
4) Provide appropriate nesting and perching sites for birds.

Removal of the canopy will become more difficult once the particular sites are revegetated with native species, however, the benefits of maintaining the canopy in the short term, is greater than removing it initially. It is proposed that ⅓ of the tree privet canopy is maintained until three to five years after the site is planted (management unit 1c). The oak canopy is not deemed a significant weed threat; therefore it is recommended this is not removed. Maintaining the oak canopy will preserve the ambience of the area until it is naturally replaced with native canopy. To ensure the oak canopy does not 'replace itself' seedlings and saplings should be controlled.

6.2.2 Timing

Weed control is best conducted during times of active growth for a number of species. Growths rates are typically high during spring; therefore herbicide is most effective during this time.

6.2.3 Neighbouring properties

Oakley Creek is surrounded by a number of private properties that are infested with various environmental weed species. Once areas within Oakley Creek are restored, adjacent properties will become a significant seed source threat. These issues need to be discussed between the various parties, and the council to help prevent the reinvasion of weeds into the restored area within Oakley Creek.

6.2.4 Stream bank stability

It is important to acknowledge that the removal of vegetation will increase the potential for stream bank erosion and subsidence. The control of exotic grass and herbaceous weeds should be avoided where possible, and stream banks should be revegetated as soon as environmental weeds have been controlled to a low level. Low priority herbaceous weeds and grass will be shaded out once a ground cover is achieved.

6.2.5 Sites of archaeological and cultural significance

It is highly recommended that interest groups (e.g. local iwi and archaeologists) are consulted prior to any weed control and/or planting operations in areas of archaeological and/or cultural significance. Archaeological sites have been identified with appropriate management recommendations made in Druskovich (2009). See Section 7 for site specific and general recommendations.

6.2.6 Public safety

Throughout all stages of weed control it is important to consider public safety. Oakley Creek is frequented by a number of people on a daily basis, therefore the appropriate signage and precautions will be necessary. This may include temporary closure of some sections of the walkway during the felling of large trees.

A community group has previously gone through and removed all rubbish within the boundaries of this programme. It is likely this needs to occur annually, if not six

monthly, as people will continually dump rubbish in the area. This rubbish will result in an increased risk to public safety, workers in the area, and the general health of the stream as rubbish decomposes releasing contaminants into the stream and surrounding soil.

A significant amount of rubbish is dumped further up the catchment, so it may be worthwhile consulting MetroWater for strategies to trap rubbish further upstream.

7.0 ARCHAEOLOGICAL SITE RECOMMENDATIONS

It is highly recommended that Druskovich (2009) be reviewed by all stakeholders.

7.1 General archaeological recommendations

General recommendations have also been described by Druskovich (2009). See Appendix D for a full description of these recommendations. The following is a summarised list only:

- It must be recognised that further undiscovered archaeological sites may exist within Oakley Creek.
- Any archaeological evidence discovered during planting, vegetation removal or other works should result in the cease of all works in the vicinity and an archaeologist called in to assess and give futher advice.
- It is important to incorporate all documents into this plan. Copies of the revised report to be distributed to all stakeholder groups identified within this plan so that all parties interested are aware of both the archaeological and environmental issues.

7.2 Site specific archaeological recommendations

Recommendations for each archaeological site as identified by Druskovich (2009) have been simplified for the purpose of this plan in Table 7. Please refer to the archaeological report for full details of each site.

The removal of seedlings (both native and exotic) could be undertaken by volunteers or contractors. Exotic and native species specified to be controlled should be controlled by suitably certified Growsafe volunteers or contractors if herbicide application is required to prevent resprouting of the cut stump.

Table seven: Archaeological site recommendations (adapted from Druskovich (2009))

Recommendations	Archaeological site reference															
	R11/521	R11/523	R11/2473	R11/2373	R11/524*	R11/2205	R11/2383	R11/2500	R11/2206	R11/2108	R11/2209#	R11/2210	R11/519*	R11/2208*	R11/2248*	R11/2209*
Recent plantings over the site should be audited for suitability	√					√	√	√	√							
Unsuitable trees or plants with large root structure should be removed at ground level	√	√		√		√	√	√	√	√						
Willow removal required				√												
Trees close to wall should be assessed and removed as necessary			√								√					
Specific plant removal and/or site maintenance required			√	√							√	√				
Any removal plan should be reviewed by an archaeologist. Possible application to the New Zealand Historic Places Trust for authority		√														
Active maintenance of the site should occur, removing any self sown seedlings (unless suitable species as specified by Jones (2007))	√	√		√		√	√			√	√ #					
Auckland City Council to determine whether this site should be visible or not – species for planting should only be low-lying if view shafts to be maintained								√	√							
Planting specifics so as not to interfere with or obscure the wall/structure (Appendix D)			√	√							√					
Mitigation riparian planting required post removal				√												
No further planting (except creek banks)				√												
No further planting					√											
Planting will require application to the New Zealand Historic Places Trust for authority	√					√	√									
Specific planting restrictions (Appendix D)		√		√									√			
Retain grass			√	√												
Maintain specified area as mown grass and/or open space				√		√	√									
Development of a site management plan recommended						√	√									
If cleared of vegetation in the future, an archaeologist should be given the opportunity to better investigate and define the site												√		√	√	
Avoid use of vehicles in wet conditions		√														
Track should be maintained for access and/or historical context			√	√												
Contact Metrowater/owner of drainage to ensure recognition of significant site						√	√									
All community groups working in this area should be made aware of the walls significance and to only plant species with small root systems by the wall										√						
Destroyed site																√

* Denotes the site is outside of Oakley Creek boundaries

# Denotes replacement trees could be planted within the vicinity if demed unlikely to cause future structural damage to the wall

8.0 MONITORING

It is important to establish some form of monitoring to gauge the effectiveness and success of weed control operations and native plantings within restoration projects. Basic monitoring can be achieved with limited resources by taking a series of photos through time from the same GPS location (i.e. photopoints). This helps record changes in the abundance and composition of exotic and native species. Sites could be established within Oakley Creek by the current contractors (Te Ngahere) then monitored by the Friends of Oakley Creek. In this way, volunteers are able to see the progress of their restoration efforts; a highly rewarding process to go through for all involved.

Monitoring also ensures the aims of weed control are being met including: eradication of specific weed species, control of specific weed species to zero or low densities, minimising their impact on the ecosystem, effective weed control allowing for successful rehabilitation plantings, native plant regeneration and what impact management of the area has had on stream bank stability and erosion.

9.0 COMMUNITY INVOLVEMENT

The volunteer and community group component forms a large portion of the anticipated labour for the restoration of this area, therefore it is vitally important to ensure a long-term focus is given to this project. A framework and communication strategy needs to be put in place between volunteers, Auckland City and contractors working in the area so that all efforts are combined and focused in similar areas. One possible way contractors and volunteer groups can work together on weed management is by contractors using herbicide techniques of weed control to support the manual methods employed by volunteers. (Contractors could also assist in native revegetation when required).

The weed control focus of volunteers should be on manual methods that do not require herbicide. This can involve:
1) The hand releasing of trees and shrubs from exotic vines
2) Pulling out weed seedlings
3) Digging out small weed infestations where feasible (note that care must be taken to ensure the entire root system is removed).
4) Possible removal of all seedlings at identified archaeological sites (Druskovich 2009).

The control of any species that can regrow from small fragments (e.g. *Tradescantia fluminesis*) should be carried out with extreme care, if not avoided entirely. In most cases it is likely that foliar spraying the weed on site would prove more beneficial.

Once a particular community group revegetates an area, where the site is not too large, that group could be responsible for maintaining weed infestations within the planted area.

10.0 REVEGETATION

Revegetation planting is to form a core component of the restoration process proposed for Oakley Creek. Through this process a number of objectives will be achieved. The primary objective is to assist and promote natural ecological processes, maintain open recreation spaces and stream bank stability and address erosion issues.

Archaeological sites should be revegetated as per each sites recommendations made by Druskovich (2009), and following Jones (2007) guidelines for the revegetation of archaeological sites (see Table 14).

Revegetation plantings shall be undertaken throughout the site in an effort to:

- Enhance the quality of habitat used by fauna within the stream.
- Filter out sediment and pollutants from runoff, therefore improving water quality.
- Provide food and habitat resources for native birds, reptiles and invertebrates, therefore attracting them into the area.
- Enhance the biodiversity within riparian margins and wildlife corridors
- Augment natural regeneration, and act as a nurse crop to provide shelter for canopy and emergent species.
- Aesthetically enhance the area, therefore increase the social value of the site
- Provide for recreational use of the natural bush areas
- Maintain open areas for significant views of the landscape, recreation and public safety concerns.
- Enhance the integrity of the creeks landscape and landforms.
- Prevent the establishment of weeds, including those that have been washed down from upper reaches of the stream.
- Reduce erosion of the stream edge, undercut banks from collapsing and land subsidence.
- Allow for unimpeded movement of flood waters by plants lying flat while flood water moves over them
- Protect the soil surface and enhance soil stability
- Protect identified archaeological sites and
- Facilitate stormwater neutrality
- Buffer vulnerable habitat and areas of ecological value

10.1 Revegetation Philosophy

There are a number of reasons why specific plants are chosen for the initial revegetation programme. The following are important guidelines to follow when revegetating riparian areas.

Ensure plants are appropriate for the specific region within the stream profile.

In order to thrive and carry out their function, plants need to be placed in the appropriate substrate, salinity levels and correct zone of a stream, whether it is directly on the stream banks, within the flood plain or further back up the slope. With the appropriate planting assemblage, a stream is more likely to perform its various functions in a similar manner to that of a stream with remnant 'natural' vegetation.

Use predominantly pioneer/ early-colonising species to achieve canopy closure and sufficient ground cover

Pioneer species specialise in growing in exposed open sites that are drier and hotter than sites shaded by trees or shrubs. The natural function of these species to act as a nurse crop that provides sheltered conditions within which other species will

establish naturally or be planted at a later stage. If the nurse crop is established from well-selected, rapid growing and closely planted native plants, it is also likely that weed seed germination will be reduced significantly on the establishment of canopy closure, or soil coverage in the case of sedges and grasses. This should occur within 3-5 years after planting.

Use only a small percentage of forest diversity species to supplement the mass plantings of pioneer species.
If there is any likelihood that forest canopy/ diversity species will regenerate within an area, this natural process should be encouraged, and the subsequent planting of large numbers of forest diversity species, especially canopy species, be kept to a minimum. With the exception of the upper slopes away from the stream, it is likely that low numbers of these species would occur in this area naturally.

Ensure all planting material is eco-sourced from naturally occurring indigenous stock growing within the Waitemata catchment/ ecological district.
Ecosourcing is a principle fundamental to the long-term success of a revegetation programme. The benefits of ecosourcing include the maintenance of local biodiversity, genetic variability therefore evolutionary potential, the plants are adapted to growing in local conditions, and subsequently the threat of disease is lessened.

Avoid planting in straight rows as this seldom happens in nature.
Plant in groups, to increase the benefit to feeding birds and other native fauna. This also creates a more natural vegetation cover.

10.2 Stream Planting Template

With the above revegetation philosophies in mind the following planting units are proposed. These units are based around a typical stream profile (see Figure five), of regions starting from the stream edge, through to the slope above the floodplain. Within each management unit this stream-planting template can be used as the overall guideline for each area, however for specific revegetation lists for each management unit please refer to table twelve below.

Original vegetation cover is likely to have been podocarp/broadleaf coastal gully forest with some lava forest elements. Species chosen to revegetate a site are not necessarily those that would be found in these areas 'naturally'. For example a stream bank would naturally be occupied by a number of plant species that prefer damp conditions. It is often the case however, that stream banks are hot and dry therefore need to be initially planted with species that can tolerate these conditions. A number of species have been shown to establish well within modified stream banks and it is from this list of species that the revegetation list has been predominantly chosen.

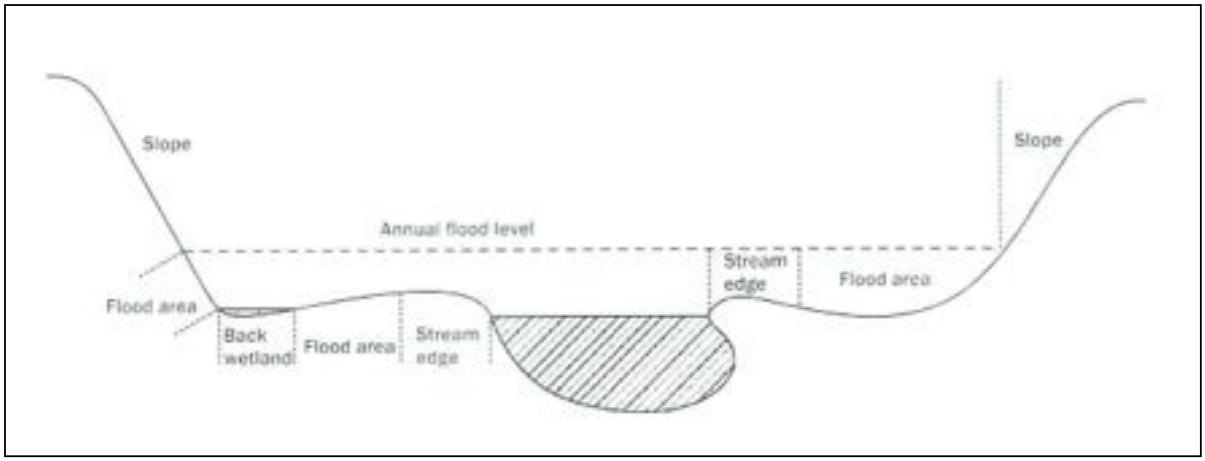

Figure four: Stream cross section showing the different areas of a riparian margin, taken from ARC, 2001.

10.2.1 Stream edge

The stream edge is the most important area to revegetate to reduce stream bank erosion and subsidence. The stream bank should be a priority when revegetating all management units.

A stream edge is:

- The first 2-3m from the stream, including the lip of the bank.
- Frequently damp.
- Water is likely to reach upper levels of the bank.
- Erosive forces are considerable.

Plants within the stream bank unit perform a number of important functions; therefore it is essential species chosen are appropriate to this area (see Table seven for recommended species). Vegetation such as sedges and grasses in particular will:

- prevent the establishment of weeds that have been washed down from upper reaches of the stream.
- Stabilise banks i.e. reduce erosion of the stream edge and undercut banks from collapsing.
- enhance the quality of habitat used by fauna within the stream.
- filter out sediment and pollutants from runoff
- allow for unimpeded movement of flood waters by plants lying flat while flood water moves over them
- provide ground cover to provide adequate habitat for native invertebrates and reptiles.

Table eight: Appropriate species for stream bank plantings. Where sparingly < common < abundant

Species	Common name	Composition in planting	Planting notes
Blechnum novae-zelandiae	Swamp kiokio	Sparingly	Plant in shade where possible
Carex lessoniana	Rautahi	Common	Planted in groups as in natural riparian communities.
Carex virgata	Small swamp sedge	Abundant	
Cyathea dealbata	Ponga/sliver tree fern	Sparingly	Groups should be widely spaced.
Cyperus ustulatus	Giant umbrella sedge	Common	Plant in groups
Gahnia setifolia	Gahnia	Sparingly	Plant in shade where possible. May be difficult to source.

*Note: *Carex secta* is commonly suggested as an appropriate plant for revegetating riparian areas, however it is naturally only found in areas of standing water and not in flowing water (McKain, 2004), therefore it is inappropriate for the riparian margins of Oakley Creek if plantings are to replicate that which would occur naturally.

10.2.2 Flood area/floodplain:

- Stream flat and toe of adjacent slope.
- The stream flat that is frequently subject to flooding.
- Generally high fertility and moisture levels.
- Low erosion forces.

Plants within the flood-plain carry out important functions such as protecting the soil surface and enhancing the stability of the area. As in the stream bank, plants should have low resistance to flood waters, which in turn reduces the potential for erosion. It should be noted that plants such as flax that have a high resistance to flood waters should not be planted in the flood plain zone. A small number of trees can be planted sparingly to add diversity to the area and attract native fauna. Table eight below details appropriate species to plant within flood plain areas.

Table nine: Appropriate species for the flood area planting unit

Species	Common name	Composition in planting	Planting notes
Carex lessoniana	Rautahi	Common	Plant in groups along the stream flat.
Carex virgata	Small swamp sedge	Common	
Carpodetus serratus	Putaputaweta	Sparingly	Plant along the toe of the slope.
Cordyline australis	Ti kouka/cabbage tree	Sparingly	Plant along the toe of the slope
Cortaderia fulvida	Toetoe	Abundant	Can be the dominant species along the toe of the slope and the floodplain.
Cyperus ustulatus	Giant umbrella sedge	Common	Plant within the flood plain, close to the stream bank region
Melicytus ramiflorus	Mahoe	Sparingly	Plant on the toe of the slope
Dacrycarpus dacrydioides	Kahikatea	Sparingly	Plant on the toe of the slope

10.2.3 Back wetland or spring

- Wet for most of the year.
- Arise when a stream changes course, springs emerge or stream banks have accreted.
- Little or no erosion.

Plants in this region of the riparian margin need to be tolerant of permanently wet conditions as described in Table nine.

Table ten: Appropriate species for back wetland or spring areas

Species	Common name	Composition in planting	Planting notes
Blechnum novaezelandiae	Swamp kiokio	Sparingly	Plant on margin of wetland
Carex lessoniana	Rautahi	Common	Plant in groups
Carex virgata	Small swamp sedge	Common	Plant in groups
Cordyline australis	Cabbage tree	Common	Plant in groups
Cyperus ustulatus	Giant umbrella sedge	Common	Plant on margin of wetland
Dacrycarpus dacrydioides	Kahikatea	Sparingly	Plant on margin of wetland
Leptospermum scoparium	Manuka	Sparingly	Plant on margin of wetland
Schefflera digitata	Pate	Sparingly	Forest diversity species, can be planted on the wetland margin. Requires shelter and shade.
Syzygium maire	Swamp maire	Sparingly	Forest diversity species, can be planted once nurse crop is established. May be difficult to source.

10.2.4 Slope

Slopes of varying steepness generally arise from either the flood plain or back wetland.

Slopes are drier than stream flats, however flooding can often extend to the toe of the slope. The substrate can vary (e.g. clay, volcanic alluvial and sand) and the species composition of planting needs to vary accordingly.

Plant species on the slopes above the flood plain should primarily be chosen for their ability to establish and grow quickly to form a 'nursery crop' and to prevent the re-establishment of environmental weeds once a canopy is formed. On the upper slopes plants must be able to tolerate dry, hot conditions as opposed to the wet conditions on the flood plain and toe of the slope.

10.2.4.1 Volcanic Slope Planting (Eastern Banks)

The eastern slopes form the edge of the lava flow from Mt Albert; therefore it is recommended to use plants suitable to volcanic soils in this area (see Table ten). These plants are best placed above the area that is likely to become subject to flooding.

Table eleven: Appropriate species for the volcanic slope planting area (eastern banks)

Species	Common name	Composition in planting	Planting notes
Alectryon excelsus	Titoki	Sparingly	Canopy species
Coprosma robusta	Karamu	Commonly	Plant throughout slope
Coprosma lucida	Shining Karamu	Sparingly	Plant throughout slope. Can be difficult to source.
Melicytus raimiflorus	Mahoe	Commonly	Plant throughout slope
Myrsine australis	Mapou	Commonly	Plant throughout slope
Metrosideros excelsa	Pohutukawa	Abundant	Plant throughout slope to establish as nursery species
Corynocarpus laevigatus	Karaka	Sparingly	Plant in groups throughout the slope
Dysoxylum spectabile	Kohekohe	Sparingly	Plant in groups throughout the slope
Vitex lucens	Puriri	Sparingly	Plant throughout the slope

10.2.4.2 Alluvial Slope Planting (Western Banks)

The western banks of Oakley Creek are more suited to species appropriate for alluvial slopes. A number of areas covered by the programme (particularly upstream) are unlikely to require planting beyond the floodplain due to the nature of the boundary. Where the western boundary of the programme extends beyond the flood plain (i.e. management units 2, 4a and 5) the following alluvial slope planting list in Table eleven can be used. It should be noted that further uphill from the stream, the soil type is likely to grade into an infertile clay substrate. The clay slopes are generally outside the scope of this programme, however if encountered, an alluvial slope planting list can be incorporated. For example the plantings carried out in October 2005 within the upper slopes of MU 2 were based on the alluvial slope species list.

Table twelve: Appropriate species for the alluvial slope planting area (western banks)

Species	Common name	Composition in planting	Planting notes
Alectryon excelsus	Titoki	Sparingly	Plant throughout slope
Coprosma robusta	Karamu	Abundant	Plant throughout slope
Cordyline australis	Ti kouka	Common	Plant in groups in the lower portions of the slope
Cortaderia fulvida	Toetoe	Abundant	Plant throughout the slope
Kunzea ericoides	Kanuka	Common	Plant throughout the slope
Leptospermum scoparium	Manuka	Common	Do not plant in wet areas.
Melicytus ramilflorus	Mahoe	Common	Plant throughout the slope
Myrsine australis	Mapou	Common	Plant throughout the slope
*Phormium tenax**	Harakeke/flax	Abundant	Plant throughout the slope
Sophora microphylla	Kowhai	Sparingly	Plant in groups throughout the slope

**Phormium tenax* cultivars used for traditional purposes are also appropriate for the alluvial slope zone of Oakley Creek. The specific cultivars are to be advised by Bernadette Papa of Ngati Whatua o Orakei.

10.3 Revegetation Species List for Each Management Unit at Oakley Creek

Table twelve presents recommended plantings for each management unit. The percentages given are for each separate unit within the stream profile. For example if an area on the stream edge were to be planted within unit 1a, then the amount of *Carex lessoniana* to plant would be 30% of the total required for the stream edge only. By presenting the composition of plantings in this manner it is hoped to reinforce the idea that species need to be planted in the appropriate region of the stream profile (i.e. the stream edge, floodplain or slope above the stream).

In large grassland areas, accessible to the public (i.e. adjacent to a track), attempts should be made to layout plants in a manner that leaves open spaces. For example plant isolated groups of pohutukawa, titoki, puriri and/or karaka.

Table thirteen: Revegetation species list for each management unit in Oakley Creek

Species	Common name	Size	% of plants per management unit per planting unit										
			1a	1b	1c	2	3	4	5	6	7	8	9
Stream edge													
Blechnum novae-zelandiae	Swamp kiokio	Pb 3	6	6	6	8	6	8	6	6	6	6	6
Carex lessoniana	Rautahi	Pb 3	30	30	30	30	30	30	30	30	30	30	30
Carex virgata	Small swamp sedge	Pb 3	35	35	35	33	35	33	35	35	35	35	35
Cyathea dealbata	Ponga/silver tree fern	Pb 3	2	2	2	2	2	2	2	2	2	2	2
Cyperus ustulatus	Giant umbrella sedge	Pb 3	25	25	25	25	25	25	25	25	25	25	25
Gahnia setifolia	Gahnia	Pb 3	2	2	2	2	2	2	2	2	2	2	2
Floodplain													
Carex lessoniana	Rautahi	Pb 3	18	18	15	14	15	14	18	18	20	15	15
Carex virgata	Small swamp sedge	Pb 3	18	18	15	14	15	14	18	18	22	16	16
Carpodetus serratus	Putaputaweta	Pb 3	3	3	12	5	12	5	3	3	5	3	3
Cordyline australis	Ti kouka/cabbage tree	Pb 3	5	5	5	5	5	5	5	5	3	5	5
Corynocarpus laevigatus	Karaka	Pb 3	-	-	3	2	3	2	-	-	-	3	3
Cortadeira fulvida	Toetoe	Pb 3/4	35	35	10	35	10	35	35	35	15	35	35
Cyperus ustulatus	Giant umbrella sedge	Pb 3	15	15	10	15	10	15	15	15	20	15	15
Dacrycarpus dacrydioides	Kahikatea	Pb 5	3	3	15	5	15	5	3	3	5	3	3
Melicytus ramiflorus	Mahoe	Pb 3	3	3	15	5	15	5	3	3	10	5	5
Back wetland													
Blechnum novae-zelandiae	Swamp kiokio	Pb 3	-	10	-	-	-	-	-	-	-	-	-
Carex lessoniana	Rautahi	Pb 3	-	15	-	-	-	-	-	-	-	-	-
Carex virgata	Small swamp sedge	Pb 3	-	15	-	-	-	-	-	-	-	-	-
Cordyline australis	Ti kouka/ cabbage tree	Pb 3	-	15	-	-	-	-	-	-	-	-	-
Cyperus ustulatus	Giant umbrella sedge	Pb 3	-	15	-	-	-	-	-	-	-	-	-
Dacrycarpus dacrydioides	Kahikatea	Pb 5	-	15	-	-	-	-	-	-	-	-	-
Laurelia novaezealndiae	Pukatea	Pb 5	-	3	-	-	-	-	-	-	-	-	-
Leptospermum scoparium	Manuka	Pb 3	-	2	-	-	-	-	-	-	-	-	-
Schefflera digitata	Pate	Pb 3	-	5	-	-	-	-	-	-	-	-	-
Syzygium maire	Swamp maire	Pb 5	-	5	-	-	-	-	-	-	-	-	-
Volcanic slope							-						
Alectryon excelsus	Titoki	Pb 5	4	5	5	-	5	-	5	5	-	3	3

Species	Common name	Size	% of plants per management unit per planting unit										
			1a	1b	1c	2	3	4	5	6	7	8	9
Coprosma robusta	Karamu	Pb 3	20	20	16	-	16	-	20	20	-	20	20
Coprosma lucida	Shining Karamu	Pb 3	4	3	4	-	4	-	3	3	-	2	2
Corynocarpus laevigatus	Karaka	Pb 3	5	4	5	-	5	-	5	5	-	3	3
Dysoxylum spectabile	Kohekohe	Pb 5	4	3	5	-	5	-	5	5	-	3	3
Hebe stricta	Koromiko	Pb 3	-	-	5	-	5	-	-	-	-	5	5
Litsea calicaris	Mangeo	Pb 5	-	5	2	-	2	-	2	2	-	3	3
Melicytus ramiflorus	Mahoe	Pb 3	17	15	16	-	16	-	15	15	-	16	16
Metrosideros exclesa	Pohutukawa	Pb 3	34	30	30	-	30	-	35	35	-	30	30
Myrsine australis	Mapou	Pb 3	12	15	12	-	12	-	10	10	-	15	15
Alluvial slope													
Alectryon excelsus	Titoki	Pb 5	-	-	-	2	-	2	3	3	10	-	-
Coprosma robusta	Karamu	Pb 3	-	-	-	20	-	20	15	15	10	-	-
Cordyline australis	Ti kouka/cabbage tree	Pb 3	-	-	-	12	-	12	10	10	5	-	-
Cortadeira fulvida	Toetoe	Pb 3/4	-	-	-	25	-	25	5	5	6	-	-
Kunzea ericoides	Kanuka	Pb 3/4	-	-	-	6	-	6	15	15	5	-	-
Leptospermum scoparium	Manuka	Pb 3	-	-	-	3	-	3	8	8	5	-	-
Melicytus ramiflorus	Mahoe	Pb 3	-	-	-	5	-	5	15	15	15	-	-
Myrsine australis	Mapou	Pb 3	-	-	-	3	-	3	15	15	15	-	-
Phormium tenax	Harakeke/flax	Pb 3/4	-	-	-	20	-	20	10	10	10	-	-
Sophora microphylla	Kowhai	Pb 3	-	-	-	2	-	2	2	2	7	-	-
Laurelia novaezealndiae	Pukatea	Pb 5	-	-	-	1	-	-	1	2	5	-	-
Schefflera digitata	Pate	Pb 3	-	-	-	1	-	1	1	-	5	-	-
Syzygium maire	Swamp maire	Pb 5	-	-	-	-	-	1	-	-	2	-	-

10.4 Revegetation Species List for Archaeological Sites

Table fourteen presents recommended species for archaeological sites as adapted from Jones (2007). Planting sites are recommended by Druskovich (2009) to be audited for suitability. The listed plants are possible options for each archaeological site. If the column is grey, then planting is not optimal as recommended by Druskovich or the site is outside of Oakley Creek boundaries.

Table fourteen: Revegetation species list for archaeological sites (adapted from Jones (2007))

Species	Common name	Archaeological site reference													
		R11/521	R11/523	R11/2473	R11/2373	R11/524*	R11/2205	R11/2383	R11/2500+	R11/2206+	R11/2108	R11/2209#	R11/2210	R11/519*	R11/2208*
Acaena anserinifolia	Bidibid, piripiri	√		√			√	√	√	√	√	√	√		
Arthropodium cirratum	Rengarenga lily	√		√			√	√	√	√	√	√	√		
Blechnum penna-marina	Little hard fern	√		√			√	√	√	√	√	√	√		
Brachyglottis repanda	Rangiora						√	√	√	√	√	√			
Carex lessoniana	Rautahi				√		√					√			
Carex virgata	Small swamp sedge	√		√	√		√		√	√	√	√	√		
Coprosma propinqua	Mingimingi						√	√	√	√	√	√	√		
Cortaderia fulvida	Toetoe				√		√	√				√	√		
Gahnia lacera	Cutty grass						√					√	√		
Haloragis erecta subsp. erecta	Toatoa, haloragis			√			√		√		√	√	√		
Hebe stricta	Hebe						√		√	√	√	√	√		
Macropiper excelsum	Kawakawa	√					√	√	√	√	√	√			
Metrosideros diffusa	Climbing rata, akatea						√	√	√	√	√	√			
Metrosideros perforata	Climbing rata, akatea						√	√	√	√	√	√			
Microlaena stipoides	Meadow rice grass, patiti	√		√			√	√	√	√	√	√	√		
Phormium cookianum	Mountain flax						√				√	√	√		
Poa anceps	Broad-leaved poa	√			√		√	√	√		√	√	√		
Solanum laciniatum	Poroporo						√		√		√	√	√		
Uncinia distans	Hook grass						√	√		√	√	√	√		

* Denotes the site is outside of Oakley Creek boundaries

# Denotes replacement trees could be planted within the vicinity if demed unlikely to cause future structural damage to the wall

\+ Denotes dependent on Auckland City Council decision on visibility

10.5 Infill Planting

If there is any likelihood that forest canopy/ diversity species will regenerate within an area, this natural process should be encouraged, and the subsequent planting of large numbers of forest diversity species, and infill planting be kept to a minimum. Some areas of Oakley Creek may not naturally increase in diversity once pioneer plantings have established. If this is the case then the following species may be used once original plantings have established.

Stream bank infill plantings:
Carex dissita – This sedge is easily smothered by weeds therefore is ideal as an infill species once the majority of weeds have been controlled and shaded out.
Gully fern (*Pneumatopteris pennigera*) – Prefers damp, shaded sites.

Flood area plantings:
Carex dissita – (see stream bank infill plantings).
Pukatea (*Laurelia novae-zelandiae*) – Characteristic of wet sites, the trunk offers low resistance to flood waters.

Back wetland plantings:
Gully fern - (see stream bank infill plantings).
Pukatea (see flood area plantings).

Volcanic slope plantings:
Akepiro (*Olearia furfuracea*) – will assist in increasing species diversity within volcanic slope plantings.
Mangeo (*Litsea calicaris*) – characteristic species on volcanic substrates.

Alluvial slope plantings:
Kohekohe (*Dysoxylum spectabile*) – Provides food for birds.
Totara (*Podocarpus totara*) – Provides food for birds.
Tararie (*Beilschmiedia tarairi*) – Provides food for birds.

10.6 Revegetation Discussion

10.6.1 Plant Size Selection

The selection of the grade or size in which revegetation plants are to be supplied, is an important consideration in ensuring the success of revegetation plantings. Planting bag size (Pb) 3 has been selected for most species to allow for the quickest establishment rates, which will in turn minimise the need for ongoing follow-up maintenance. Many of the species specified can only be planted out effectively in Pb 3's, due to their clumping nature i.e. *Carex* sedges.

Pb3 grade plants are also difficult for pukeko's to pull out, an issue often faced when planting into riparian areas.

10.6.2 Plant Density and its Influence on Revegetation Planting

It is important to recognise the influence plant density has on the revegetation process. A planting density of 1m centres within the flood plain, back wetland and slope, is ideal for achieving rapid establishment of native vegetation cover, which in turn reduces competition from weed species. Along the stream bank, plantings are best carried out at 0.75m spacings.

10.6.3 Open spaces

Oakley Creek holds significant recreational value within the community. By maintaining open areas adjacent to boardwalks and paths, it is anticipated the site could continue to be utilised for a variety of recreational activities such as picnicking and exercise. This also addresses public safety issues that would arise if the entire area were to be revegetated. To ensure open spaces remain, where large grassed areas presently exist, plants need to be placed in isolated groups.

10.6.4 View shafts

The management of view shafts is another consideration that needs to be incorporated into this revegetation programme. It is important that revegetating

Oakley Creek does not compromise views of the creek or any other landmarks. It is unlikely that views from the boardwalks and various pathways within Oakley Creek will be obscured as most revegetation along these areas will be small, low growing plant species.

10.6.5 Landscape integrity

In a similar manner to the view shafts, it is also important to plant in a way that is in line with the natural contours of the land and the flow of the creek. Species chosen for plantings are naturally found in the riparian zone, which will not only help restore the biodiversity, but also improve the aesthetics and natural character of the local area.

10.6.6 Archaeological site revegetation

To assist in the preservation of the archaeological sites within Oakley Creek, it is important to utilise plant species as specified by Jones (2007) that have suitable root structure and form, and to follow the recommendations of Druskovich (2009) for the revegetation of archaeological sites.

10.6.7 The use of seed

To assist in the regeneration of native vegetation, and to prevent the reinfestation of environmental weeds, grass seed could be spread through the area. It is likely that grass will gradually colonise bare ground naturally, however spreading seed through areas prone to reinvasion and regrowth of weeds could prove beneficial. When choosing an appropriate species for sowing, care should be taken that it does not persist in shade and will not outcompete any of the native sedges etc.

10.7 Photopoint Monitoring of Revegetation

A simple way of monitoring revegetation success is by permanent photopoints. This involves returning to the same point each year and taking photos at the same bearing. Over time this will show growth of plantings and the success of weed control.

The straightforward methodology of photopoint monitoring allows for community involvement. Members of the community such as the Friends of Oakley Creek group could become responsible for taking these photos on a six monthly or annual cycle once they have been established.

Monitoring could also be incorporated into Unitec papers with an ecological restoration focus. The consequences of restoration efforts could be established such as the effect on bird communities (i.e. bird counts) and rates of native seedling regeneration. Again this form of monitoring is a possible avenue community members could pursue.

Whatever form monitoring develops, the process will help encourage ownership and appreciation of Oakley Creek by the various groups. It is important to have such a connection with the site, and passion for it's restoration if the community is to successfully partake in the ecological restoration of Oakley Creek.

10.8 Community plantings

One of the main benefits in compiling this plan is to enable the coordination of the various groups involved in restoring (in particular revegetating) the area of Oakley Creek covered by this programme. It was revealed during the vegetation survey (see Table one), that a significant number of natives within the area are planted. An outline of some plantings and the groups that are involved in revegetating Oakley Creek is detailed below in Table thirteen.

Table fifteen: Community plantings within Oakley Creek (W. John and D. Bowden pers. comm.)

Area planted	Year of planting	Participating groups	Species composition
Harbutt Reserve: above the creek and the along the edge of the reserve.	Approx. 1994-95	Community planting organized by ACC.	karamu, hoheria, putaputaweta, manuka, harakeke etc.
Phyllis Reserve: above creek and rock retaining wall.	Approx. 2000	Council contractors	Ngaio, manuka, puka, akeake, ti kouka, kowhai, harakeke, koromiko etc.
Harbutt Reserve: path entrance (leading down to stream and Craddock St. bridge).	November 2004	Friends of Oakley Creek	Pate, karo, hoheria, koromiko, kawakawa, putaputaweta, manuka, harakeke etc.
Harbutt Reserve: upstream from Craddock Street bridge.	December 2004	Friends of Oakley Creek	Kahikatea, manuka, ti kouka, harakeke, pate, totara, swamp maire, kawakawa, mahoe.
Harbutt Reserve/Phyllis Reserve, North of the waterfall	Approx 2000-2005	Members of the local community	Individual kahikatea, rimu and puriri have been randomly planted amongst revegetated areas
Area below Unitec hostel	Approx. 2002	Unitec	Manuka, hoheria, totara etc.
North Oakley Creek Walkway: below Mason clinic (where Wairaka Stream merges with Oakley Creek.	May-June 2005	Buchanan Rehabilitation Centre and Friends of Oakley Creek.	*Carex* sp., swamp maire, pukatea, oioi, toetoe, putaputaweta etc.
North Oakley Creek Walkway: Opposite the planting below the Mason Clinic.	June 2005	Friends of Oakley Creek	*Carex* sp., putaputaweta, manuka, ngaio, harakeke, ti kouka
North Oakley Creek Walkway (upstream from the Wairaka Stream convergence)	July 2005	Friends of Oakley Creek	*Carex* sp., harakeke, karaka, mahoe manuka etc.
Oakley Creek – Plane Tree Bridge	August 2005	ACC and Friends of Oakley Creek	*Carex* sp., *Cyperus* sp., toetoe.
Area surrounding bridge adjoining Unitec hostels	Not confirmed	Possibly Unitec	
Downstream of Unitec residence bridge	August 2005	Gladstone Primary School and Friends of Oakley Creek	Kowhai, *Carex* sp., harakeke, toetoe, mahoe, ti kouka etc.

As Table thirteen above shows there are a number of different community groups involved in the revegetation of Oakley Creek. These include the Buchanan Rehabilitation Centre, Unitec, Friends of Oakley Creek, Gladstone Primary School and ACC contractors. This long-term, community support in the restoration of Oakley Creek is vital for the restoration of Oakley Creek. Restoring Oakley Creek to a functioning riparian ecosystem can be accomplished by coordinated community groups, following the planting templates and adhering to management unit recommendations.

By continuing the involvement of community members in the restoration of Oakley Creek, the awareness of environmental and stormwater issues (such as the problem of allowing environmental weeds establishing in an area and the impact a compromised ecosystem has on water quality) in the area will increase.

11.0 MAINTENANCE OF THE RESTORATION PROGRAMME

11.1 Post 5 years

Oakley Creek will require continual maintenance work to control *Tradescantia*, Japanese honeysuckle and other new weeds reinvading the site. Regular assessment of the site will be necessary to establish weed maintenance requirements and the ability to reduce herbicide use at the site. In particular plantings will require regular maintenance until a canopy and substantial native ground cover is achieved. Once plantings have reached an age where the risk of being smothered by weeds is reduced, shade tolerant weeds are then likely to be the only threat. Weed control efforts will still be required annually to control the extensive seed bank that will be present in the soil for a number of years.

Beyond that control efforts can move into the stage referred to here as forest protection (see Figure six). At this point weed control is at a minimum level and is only required to maintain weeds brought in by birds and those weeds infesting the area from surrounding boundaries. If restoration efforts are coordinated to allow for long term weed maintenance, the cost, labour and herbicide requirements for Oakley Creek should eventually be reduced to a minimum level as depicted in Figure five.

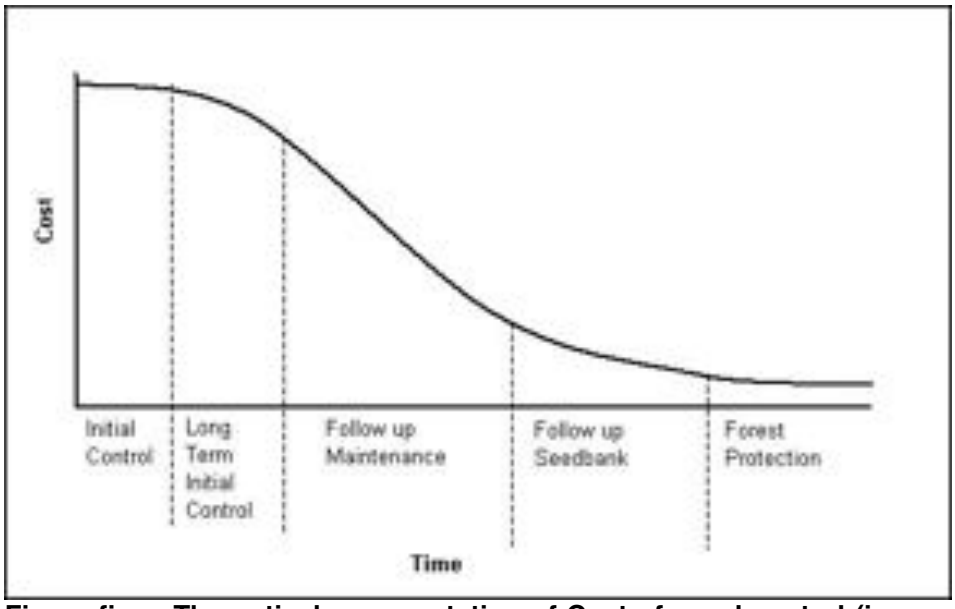

Figure five: Theoretical representation of Cost of weed control (i.e. amount of weed control required) over time, as a site moves through different weed control phases.

Regular reviews of the outcomes and methods implemented, will help to determine the success of restoration efforts. This will also provide a means of identifying areas that may require follow-up or alternative applications as a consequence of previous control efforts. Reviews should be established every six months during the initial two years of weed control and revegetation. This could be extended to annual reviews after this initial phase of restoration.

12.0 MONITORING

It is important to establish some form of monitoring within the review process to gauge the effectiveness and success of weed control operations and native plantings within restoration projects. One method is to take a series of photos through time at the same location (i.e. photopoints). This helps record the change in the abundance and composition of exotic and native species. Comparisons between years allow a qualitative assessment of the effects of weed control on weed infestations and native regeneration within a reserve, as well as the growth and survival rates of rehabilitation plantings.

Monitoring will help establish the necessity for follow-up control in the short-term, including preparation for revegetation. It also ensures the aims of weed control are being met including: eradication of specific weed species, control of specific weed species to zero or low densities, minimising their impact on the ecosystem, effective weed control allowing for successful rehabilitation plantings and native plant regeneration and what impact management of the area has had on the stability of stream banks and water quality.

13.0 RESTORATION TIMELINE

13.1 Long Term Weed Control

One of the requirements for successful environmental weed control is having a long-term approach to the programme. The characteristics of a number of environmental weed species means the site needs to be constantly re-visited after the initial control period to ensure regrowth and the germinating seed bank present in the soil is controlled. The long-term goal should be to gradually reduce the weed infestations within the reserve and therefore reduce the amount of herbicide that is required for weed control. This ongoing, constant approach substantially increases the potential of successfully restoring the area.

Below is an outline of a suggested strategy over time, placing the highest priority management units and sections within these units first. Suggested timeframes for weed control and native revegetation of the different management units are also included. Obviously the timeline will depend on the availability of labour and funds. For this reason follow up weed control is generally repeated during all seasons since all management units will not always be able to be covered. This time line is compiled with the assumption that contractors such as Te Ngahere who currently work in the area will have a low – medium involvement with this project.

It should be noted that the priority a management unit is given does not necessarily reflect the entire unit. Some units will have a small area that requires a higher priority than the rest of the management unit. These areas will be noted in the 'specific targets' below.

Stage 1

Objective:	Control all high and medium priority weed species within management unit (MU) 1
Season:	Spring 2005
Control method:	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets:	- FS wandering Jew, periwinkle, nasturtium and other ground covering species in order to maintain current revegetation sites. - CS ⅔ tree privet and any other exotic tree species below 5m - Control and remove all willows below 6m as funds allow.

Stage 2

Objective:	Control all high and medium priority weed species within MU 3. Maintain weeds species within MU 1
Season:	Summer 2005/2006
Control method:	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets:	- Control and remove regrowing flame tree and any other ground covering and woody (<6m) tree weed species

- Revisit MU 1 in late summer and control remaining weed infestations.

Stage 3

Objective:	Follow up control of all high and medium priority weed species within management units 1 and 3. Revegetate the remainder of MU 1a and 1b.
Season:	Winter 2006
Control method:	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets:	- Prepare MU 1 for planting - The revegetation priority should be the stream bank throughout MU 1

Stage 4

Objective:	Control all high and medium priority weed species within MU 9 Follow up control of weed infestations within MU 1 and 3
Season:	Spring 2006
Control method:	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets:	- Revisit MU 1 and 3 to control previous infestations - Control should focus on areas recently revegetated within MU 9 only. Hand releasing plantings of all vine and ground covering species and controlling with herbicide.

Stage 5

Objective:	Control all high and medium priority weed species within MU 2 and MU 5 Follow up weed control of MU 1, 3 and sections of 9.
Season:	Summer 2006/2007
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Focus on vine and ground covering species, with manual methods where possible and foliar spraying. - Focus weed control within MU 5 within areas revegetated by Gladstone Primary School only. - Follow up weed infestations within MU 1, 3 and revegetation sites within 9. Likely target weed species include wandering Jew, montbretia, climbing asparagus and periwinkle etc.

Stage 6

Objective:	Control all high and medium priority tree species within MU 2 Follow up weed control of MU 1, 3 and sections of 9 Revegetate the remaining areas in MU 1 and MU 3

Season:	Winter 2007
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Focus on completing initial control of vine and ground covering species, with manual methods where possible and foliar spraying, within MU2 - Cut and stump all tree species <6m. Targets will include tree and Chinese privet within MU 2. - Follow up weed infestations within MU 1, 3 and revegetation sites within 9 and 5. Likely target weed species include wandering Jew, montbretia, climbing asparagus and periwinkle etc. - Revegetate any remaining areas in MU 1 and revegetate the stream bank and flood plain of MU 3a and 3b.

Stage 7

Objective:	Control all high and medium priority species within MU 4 Follow up weed control of MU 1, 2, 3 and sections of 9
Season:	Spring 2007
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Infestations are relatively small within MU 4 therefore manual methods could be used for a number of small infestations, however herbicide foliar spraying and cut and stump methods will be required. The pine canopy within 4b is to be maintained. - Follow up on spring growth in MU 1, 3 5 and 9. - Follow up control on weed infestations within MU 2

Stage 8

Objective:	Ensure weed infestations within MU 1,2,3 and 4 are controlled to maintenance levels
Season:	Summer 2007/2008
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	Focus efforts on persisting weed populations within MU 1-4 including the removal of willows as funding allows.

Stage 9

Objective:	Control all high and medium priority weed species within MU 5 Revegetate MU 2 and 3
Season:	Winter 2008

Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Target weed species on the MU 5s western bank only - Follow up control of MU 2, 4 and revegetated sections of 9. - Revegetate MU 2 and any remaining areas of MU 3 ensuring some grassed areas are left open and plants are grouped to form pockets of vegetation that facilitate the recreational use of the reserve.

Stage 10

Objective:	Control all high and medium priority weed species within MU 5 Follow up weed control on MU 1-4
Season:	Spring 2008
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Complete initial control on the western bank of MU 5 and target high priority environmental weeds only on the eastern banks of MU 5. - Continue the control and removal of willows throughout MU 1-4 as funding allows. - Follow up control of MU 1-4 and revegetated sections of 5 and 9.

Stage 11

Objective:	Control all high and medium priority weed species within MU 5 Follow up weed control on MU 2-4
Season:	Summer 2008/2009
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Complete all initial weed control in MU 5. - Continue the control and removal of willows throughout MU 1-4 as funding allows. - Follow up control of MU 2 and 4

Stage 12

Objective:	Control all high and medium priority weed species within MU 6 Follow up weed control on MU 1, 3 and 5 Revegetate MU 4
Season:	Winter 2009
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies

Specific targets	- Focus on the Eastern banks of MU 6 using foliar spraying and cut and stump methodology to control high and medium priority environmental weeds. - Follow up weed control of MU 1, 3 and 5 - If funding is limited, target revegetation efforts on the stream bank and flood plain of MU 4.

Stage 13

Objective:	Control all high and medium priority weed species within MU 6 Follow up weed control on MU 2, 4 and 9
Season:	Spring 2009
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies
Specific targets	- Control all high and medium priority environmental weeds within MU 6 - Follow up weed control of MU 2, 4 and revegetated sections of 9

Stage 14

Objective:	Control all high and medium priority weed species within MU 6 Follow up weed control on MU 1, 3 and 5
Season:	Summer 2009/2010
Control method	Combination of hand releasing and removal, foliar spraying (FS) and cut and paint (CS) methodologies

Stage 15

Objective:	Control all high and medium priority weed species within MU 7 Follow up weed control on MU 2, 4 6 and 9 Revegetate the remainder of MU 4, and focus on the stream banks of MU 5.
Season:	Winter 2010

Stage 16

Objective:	Control all high and medium priority weed species within MU 7 Follow up weed control on MU 1 3, 5, and 6. Continue willow control as funding is available
Season:	Spring- Summer 2010/2011

Stage 17

Objective:	Control all high and medium priority weed species within MU 8 Follow up weed control on MU 2, 4, 7 and 9 Complete revegetation of MU 5 if necessary and revegetate MU 6 where appropriate

Season:	Winter 2011

Stage 18

Objective:	Control all high and medium priority weed species within MU 8 Follow up weed control on MU 1, 3 5 and 6
Season:	Spring 2011

Stage 19

Objective:	Control all high and medium priority weed species within MU 8 Removal of remaining ⅓ of tree privet canopy within MU 1c. Follow up weed control on MU 1-7 (Winter) Infill planting where necessary through MU 1-6 Commence revegetation of stream bank within MU 7.
Season:	Summer 2011 – Spring 2012

Stage 20

Objective:	Control all high and medium priority weed species within MU 9 Follow up weed control on MU 1-8 (Winter) Revegetate remaining areas within MU 7 (including infill planting if necessary within the retaining wall).
Season:	Summer 2012 – Spring 2013

Stage 21

Objective:	Complete initial weed control within MU 9 Follow up maintenance weed control on all management units (Winter) Revegetate MU 8 and 9 as time and funding allows.
Season:	Summer 2013- ongoing.

14.0 REFERENCES

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APPENDICES

Appendix A: Planning Map D04, No. 2. Additional Limitations. (Taken from the City of Auckland District Plan Isthmus Section).

Relevant numbers of reference:

D04-05: Interchange Control, Motorway Access. (See Rule 12.8.2.5 in district plan)

D04-07: Building line for Road Widening, Great North Rd, east side 2.5m from road boundary. (Refer to Appendix B in District Plan).

D04 -10: Concept Plan – Unitec. (Refer to Appendix B in District Plan).

D04 –14: Concept Plan – Public Health Site, Mental Health Block, Carrington. (Refer to Appendix B).

D04 – 19: Archaeological feature for protection: (From Appendix 3A - To east of Great North Road, south of North Western motorway, between Cowley Street and Fir Street. Maori habitation sites.

Appendix B: Planning Map E04, No. 2. Additional Limitations. (Taken from the City of Auckland District Plan Isthmus Section).

Relevant numbers of reference:

E04-08: Proposed reserve and accessway, 1628 Great north Rd/Oakley Creek.
E04-09: Proposed public reserve, Trent Street.
G08-05: Railway purposes, Avondale Southdown line.
H13-09: Railway purposes, North Auckland railway.

Appendix C: Costings

The following costs are estimated from the timescale detailed in section 12.0.

- All estimates are calculated from contractor rates only (i.e. does not include any volunteer hours).
- All estimates include all labour as well as supply of herbicides, plants and tools.
- Unless otherwise specified these estimates do not include arborists rates for the removal of large (6m+) exotic trees.
- The numbers of plants required are estimates only; this will largely depend on volunteer plantings.
- All costs are GST exclusive

Stage One:
Initial weed control within MU 1: **$1 300.00**.
Felling ⅔ of large privet and willow (using arborists): **$35 000.00**

Stage Two:
Control all high and medium priority weed species within MU 3 and
Maintenance weed control MU 2: **$3 800.00**

Stage Three:
Maintenance weed control MU 1 and 3: **$1 300.00**

Native revegetation of MU 1a and 1b (2000 plants): **$15 500.00**

Stage Four:
Initial weed control of planting sites within MU 9 and
Maintenance weed control of MU 1-3: **$2 500.00**

Stage Five:
Initial weed control within MU 2 and 5 and
Maintenance weed control within MU 1,3 and 9: **$11 300.00**

Stage Six:
Initial control of MU 2 (priced in stage 5) and
Maintenance weed control within MU 1,3 and 9: **$1 300.00**
Revegetation MU 1c and 3 (1500 plants): **$11 700.00**

Stage Seven:
Initial control of MU 4 and
Maintenance weed control of MU 1, 2, 3 and 9: **$8 800.00**

Stage Eight:
Maintenance weed control of MU 1, 2, 3, and 4: **$3 800.00**

Stage Nine:
Initial control of MU 5: **$5 000.00**
Revegetate MU 2 – 1500 plants (MU 3 priced in Stage 6): **$11 700.00**

Stage Ten:
Initial control of MU 5 and
Maintenance weed control of MU 1, 2, 3 and 4: **$2 500.00**

Stage Eleven:
Initial control of MU 5 (priced in stage 10 and 11) and
Maintenance control of MU 2, 3 and 4: **$2 500.00**

Stage Twelve:
Initial control MU 6 and
Maintenance weed control MU 1, 3 and 5: **$5 000.00**
Revegetate MU 4 (1000 plants): **$7 800.00**

Stage Thirteen:
Initial control MU 6 (priced in stage 12) and
Maintenance weed control MU 2, 4 and 9: **$2 500.00**

Stage Fourteen:
Initial control MU 6 (priced in stage 12) and
Maintenance weed control MU 1, 3 and 5: **$2 500.00**

Stage Fifteen:
Initial control MU 7 and
Maintenance weed control MU 2, 4 and 9: **$3 800.00**

Revegetate 4 (priced in stage 12) and 5 (1000 plants): **$7 800.00**

Stage Sixteen:
Initial control MU 7 (priced in stage 15) and
Maintenance weed control 1, 3, 5 and 6: **$3 800.00**
(Willow control is not included in this price)

Stage Seventeen:
Initial control MU 8 and
Maintenance weed control MU 2, 4, 7 and 9: **$16 400.00**
Revegetate 5 (priced in stage 16) and 6 (1000 plants): **$7 800.00**

Stage Eighteen:
Initial control MU 8 (priced in stage 17) and
Maintenance weed control MU 1, 3, 5 and 6: **$3 800.00**

Stage Nineteen:
Initial control MU 8 (priced in stage 17) and
Maintenance weed control MU 1-7: **$5 000.00**
Removal of remaining tree privet in MU 1c: **$15 000.00**
Revegetate MU 1-7 where necessary (2000 plants): **$15 500.00**

Stage Twenty:
Initial control MU 9 and
Maintenance weed control MU 1-8: **$20 200.00**
Revegetate MU 1-7 where necessary (1000 plants): **$7 800.00**

Stage Twenty One:
Initial control MU 9 (priced in stage 20) and
Maintenance weed control 1-9: **$25 000.00**
Revegetate MU 8 and 9 (4000 plants) **$31 000.00**

Appendix D: Extract from Druskovich (2009) – Section 4

4. ARCHAEOLOGICAL SITE AND MANAGEMENT UNIT RECOMMENDATIONS

This section gives recommendations for either individual archaeological site and/or management unit as appropriate. In general the current policies of the Revegetation Programme need no comment as although archaeological sites are common along the length of Oakley Creek, there are many gaps between the archaeological sites where it is unlikely that unidentified archaeological sites would be found. However the lack of comment for some management units should not be taken to read that there should be no archaeological precautions, for all management units general recommendations are included at the end of this section.

Jones (2007) should be used as a guideline for suitability of retaining vegetation already present on archaeological sites and for any plantings that may occur on, adjacent to or in the vicinity of any archaeological sites in the future.

Recommendations are presented from the northern end of the walkway first.

Figure 3 Recorded archaeological sites at the northern end of the Oakley Creek Revegetation Programme Area.

4.1 R11/521 Midden

Midden from site R11/521 is readily visible spilling onto the path and on some of the slopes within this area, shell is found subsurface on the relatively flat banks above the slopes and is spread over a considerable area in the southern half of this management unit up to the Mason Clinic fenceline (refer Figure 3 – note limits shown on figure are approximate). It is also likely to be found within the clinic grounds as well, however this is not shown on the figure as the limits are unknown.

Some recent plantings have occurred over this midden, including Puriri, which have large root systems and are likely to cause long term damage to this site. The following recommendations do not apply to the mature trees already present.

a) Recent plantings over this site should be audited for suitability.
b) Unsuitable trees or plants with large root structure should be removed, this should not be done roots and all but involve removal at ground level. Species of plants that may regrow from the roots should be poisoned.
c) Active maintenance of the site should occur, removing any self sown seedlings (unless they are of a suitable species).
d) Should any planting, involving the digging of holes for their planting occur in the future it will be necessary to apply to the New Zealand Historic Places Trust for Authority. This does not include the spreading of grass seed (or the like) over the surface of the site that is allowed to self sow.

4.2 R11/523 Midden and Management Unit 1b

This sparse midden is likely to be larger than shown on Figure 3. All indications so far suggest that the site is concentrated where it is shown, however the earlier archaeological records suggest it was spread over a somewhat wider area than it is currently visible over, though all at the top of the bank. Therefore subsurface archaeological evidence is likely to be spread over a wider area than illustrated.

e) No plantings should occur on the top of the bank through to 1.5m below it. Active maintenance of this area should occur, removing any self sown seedlings (unless they are of a suitable species).
f) Should the privets that surround this site be removed, making the assumption that vehicles are likely involved, it should only be done when the ground is hard to avoid pugging and or other damage to subsurface evidence.
g) Any trees to be removed should be cut off at ground level and their stumps and roots poisoned and allowed to rot in-situ.

h) Any removal plan should be reviewed by an archaeologist, it may be necessary to apply for an Authority to modify or damage an archaeological site with the New Zealand Historic Places Trust.

4.3 R11/2473 Dry Stone retaining wall

Currently this retaining wall is in good shape, however some trees are growing close to it. The area above it appears to still be used as an occasional vehicle track and is grassed.

Plate 9. R11/2473 illustrating close proximity of a tree.

i) Trees close to this wall should be assessed as to whether their roots are likely to compromise the site, and removed if necessary.
j) That the track above the wall is maintained as an occasional access route so that the wall is kept in its historical context.
k) That the area above the wall is kept in grass, and should any items be planted below the wall they are planted so as not to obscure the wall from the path and R11/2373. Any trees planted in this vicinity should be done so at sufficient distance so their root systems do not interfere with the wall stability.

Figure 4. Archaeological site locations, Oakley Creek, Waterview.

4.4 R11/2373 Dry Stone retaining wall, track and bridges.

This site is compromised by both recent and historic plantings, and/or self sown plants. Some of these plants should be removed to ensure that they don't further compromise structure stability.

l) That vegetation (other than grass) is removed from above or adjacent to the stone structures. This includes the toetoe on the western bank. Their removal could be mitigated by planting the creek bank (within 500mm where adjacent to the site) where stone and other works aren't present in the immediate vicinity.

m) That the willows and recently planted seedlings are removed from the track below the retaining wall so that the site historical context is retained. The area surrounding the site (on the eastern side of Oakley Creek) should be maintained as open space and in mown grass to assist in illustrating its past farming context. No more plantings should occur in this vicinity (creek banks excepted).

Plate 10. Toetoe above the stone bridge foundations, willows (background) over approach track to bridge, eastern side, these should be removed.

n) That the poplar on the western side of the creek is retained, it is of some age and is clearly part of the historical plantings related to the site, however new growth should be routinely trimmed so that it does not further damage the bridge foundations that it is already partially growing over.

Plate 11. New growth from the poplar amongst stone bridge foundations, R11/2373.

4.5 R11/524 Midden, pits?

This site (refer Figure 4 – the area marked is an indication only, the limits shown should be viewed as a minimum extent of the site) is outside the management area, however related community planting has occurred on it and maybe ongoing. All community plantings should cease in this area. An Authority to modify an archaeological site should be sought if planting is to continue. Some of the plantings, if they are of trees with large root systems should be reviewed. I note that as it lies outside the area addressed by Habgood (2005) it maybe necessary to establish who has ownership of the land here and what body should take responsibility for its implementation.

4.6 R11/2205 Mill?/Pumping Station? R11/2383 Hole in bank

This site is complex and contains a number of elements (refer site record forms). Some parts of the site have been revegetated, others have been left to grow wild. The main recommendation for this site is that a site management plan is drawn up specifically to address the many issues that exist with it. Whilst I am personally in favour of opening up the site to public knowledge including signage, it maybe that parts of the site, to avoid damage and/or fossicking, are kept under a vegetative cover. These are issues for Auckland City officers, possibly in consultation with the New Zealand Historic Places Trust, to resolve and give direction towards. This would be a separate project in itself and would require archival research to attempt to identify the age and purpose of the site. Therefore the following recommendations should be viewed as provisional, until such time as a site management plan is implemented.

o) That a site management plan be implemented for these sites (R11/2205, R11/2383).
p) Recent plantings over this site should be audited for suitability.
q) Unsuitable trees or plants with large root structure should be removed, this should not be done roots and all but involve removal at ground

level. Species of plants that may regrow from the roots should be poisoned.

r) Active maintenance of the site should occur, removing any self sown seedlings (unless they are of a suitable species).

s) Should any planting, involving the digging of holes for their planting occur in the future it will be necessary to apply to the New Zealand Historic Places Trust for Authority. This does not include the spreading of grass seed (or the like) over the surface of the site and being allowed to self sow.

t) Those areas currently in grass should be maintained and mown to dissuade self seeding occurring (It appears that this has occurred until recently)

u) There is modern drainage through parts of the site. Metrowater (presuming that they are the owner of it) should be informed of the site significance so that no further damage to the site occurs due to the maintenance or expansion of their network.

4.7 R11/2500 Drystone Wall

Currently this wall is in very good condition with some recent plantings in its general vicinity.

v) Recent plantings near this site should be audited for suitability.

w) Unsuitable trees or plants with large root structure should be removed.

x) Consideration should be given to as whether Auckland City wish for this site to stay visible from the path, if yes then new plantings in the vicinity of the wall should be of low species only.

4.8 R11/2206 Drystone wall

The location (refer Figures 4 and 5) of this is the most approximate of the sites illustrated on the locational figures, as its location is not readily visible on

aerial photographs. Currently this wall is in very good condition with some recent plantings in its general vicinity.

y) Recent plantings near this site should be audited for suitability.

z) Unsuitable trees or plants with large root structure should be removed.

aa) Consideration should be given to as whether Auckland City wish for this site to stay visible from the path, if yes then new plantings in the vicinity of the wall should be of low species only.

Figure 5. Archaeological site locations, in the vicinity of the waterfall and walkway access between Unitec and Great South Road.

4.9 R11/2108 Drystone wall

This drystone wall is adjacent to, and has the walkway pass through it, and is generally in good condition. There are a number of trees growing adjacent to

and on/over it, these trees are of a vast variation in age and size and likely to have varying effects upon the structural integrity of the wall.

Plate 12. Large historic planting amongst the stones of R11/2108 near the southern end. This tree should not be removed as it is part of the history of the site, however other smaller trees that may also grow to such proportions should be removed if they threaten the integrity of the wall.

bb) Unsuitable trees or plants with large root structure should be removed from the near vicinity of the wall.

cc) Active maintenance of the site should occur, removing any self sown seedlings (unless they are of a suitable species).

dd) As it is an area (management unit 5) where active revegetation is taking place, all community groups working in this area should be made aware of the walls historical significance and any plantings near the wall should only be of species with small root systems.

4.10 R11/2209 Stone wall, Farm(?) Crossing and stone wall.

This is an area based around the top of the waterfall and the creek and environs immediately below it. These features have been lumped together as one site however they may be of disparate ages rather than contemporaneous.

The stone wall acts as a retaining wall, back from the eastern bank of Oakley Creek, it is of drystone construction and has recent and semi-distant past plantings in its general vicinity. Many of these appear to be of large specie trees, Plane and Puriri, and may not be suitable, for the continued structural integrity of the wall to be situated here.

ee) Trees growing near the wall should be audited for suitability. Trees that are, or are likely to damage the structural integrity of the wall should be removed and their root systems allowed to rot in place. Species of plants that may regrow from the roots should be poisoned.

ff) Active maintenance of the site should occur, removing any self sown seedlings (unless they are of a suitable species). Replacement trees could be planted within the vicinity as long as they are unlikely to cause future structural damage to the wall.

Plate 13. Young saplings growing in close proximity to the drystone retaining wall.

On both sides of the creek the remains of a structure, presumably a rudimentary crossing are present (another possibility is that it was a dam – refer view in Plate 14). Those remains on the western side are in a better state of preservation than those on the east. This structure is unlikely to pre-date 1900, and therefore would not qualify as an archaeological site under the Historic Places Act legislation. It is not so clear whether it could be defined as an archaeological site under the Resource Management Act, which legislates to protect archaeological sites but does not define them. Nevertheless I believe it should be retained as it is a rare historic artefact in the urban setting that illustrates the make do, no 8 wire mentality that New Zealand farmers have been credited with.

Plate 14. Remains of the crossing (dam?), showing relatively intact western side, the eastern side is discernibly collapsed on the right.

gg) Creekside plantings should be kept away from the crossing feature.

The other evidence of R11/2209 are the cuts in the bedrock above and below the falls. These include steps above and below the falls, posthole cuts across the top of the falls and a channel cut into the western side of the top of the falls to divert water around the side of the dam.

Plate 15. Steps on western bank below the waterfall.

Plate 16. Western bank of waterfall with cut channel in bedrock visible with fern growing within it.

hh) Earth and vegetation should be removed from the cut channel and the channel maintained to keep it clear of debris.

ii) Vegetation should be trimmed or kept clear of the step features so that they remain visible (this does not include the informal steps cut into the earth, as opposed to the bedrock created below the fall by people using the “mudslide”).

Plate 17. Top of waterfall with cut channel in bedrock visible with fern growing within it (blue arrow), cuts for posts across top of falls (red arrows) and steps cut into bedrock (orange arrow).

4.11 R11/2210 Pit and terraces (?)

The pit is well defined, however the terraces are more difficult to define as vegetation, including fallen trees obscure the ground surface in this vicinity. Whereas the terrace that the pit is located upon is almost definitely real, it cannot be certain that the other is. It may be a result of slumping, part of an old track (as it appears to slope towards the old tracks south of the waterfall or possibly caused by past tree falls). Planting has occurred in this vicinity, though none are close to the pit. The area marked on Figure 5 should be looked upon as indicative only, it maybe slightly further west than shown.

jj) No plantings of vegetation should occur on, in or around the pit and selective maintenance of self sown species should be maintained so that unsuitable species do not grown within or adjacent to the pit.

kk) If in the future the area is cleared of vegetation an archaeologist should be given the opportunity to better investigate and define the site and questionable terraces.

4.12 Management Unit 7

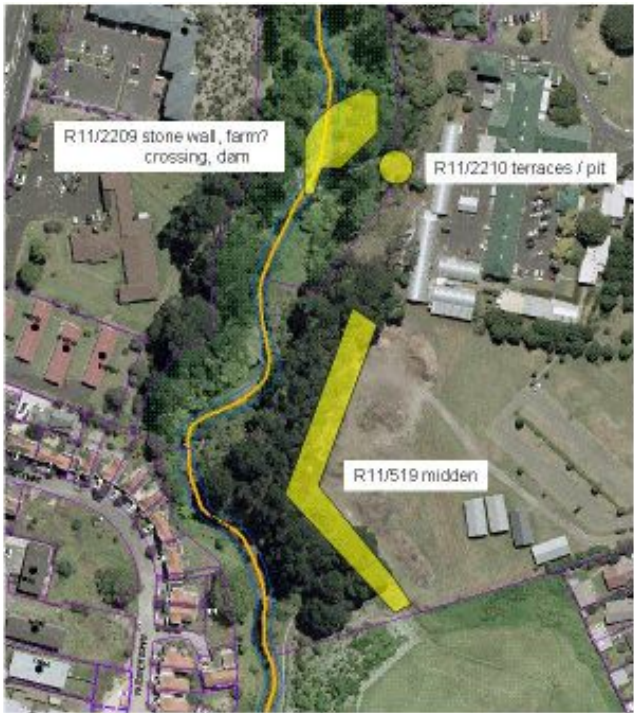

Figure 6. Archaeological site locations adjacent to Management Unit 7.

The long midden site R11/519 is located beneath and adjacent to the pines on the Unitec grounds to the east of MU 7 (Figure 6.) Probing and visual survey indicates that this midden is confined to the top of the bank and the first 3m below it (occasional slopewash individual shells excepted). No archaeological evidence was found within the Management Unit. It is understood however that outside the boundaries of the MU, volunteers are planting higher on the banks and should they continue planting towards the top of the bank they may encounter archaeological evidence.

ll) That the volunteer group(s) planting in this area be informed of the middens at the top of the bank and that they should not carry out planting within 3m of the top of the bank without New Zealand Historic Places Trust approval.

Further along the walkway, beneath the Albie Turner Fields (refer figure 7), R11/2109 has been recorded. This site may have been a continuation of R11/519, however it has been destroyed by past quarrying, landfill and other earthworks activities. It is extremely unlikely that any intact deposits relating to this site have survived. It should not be viewed as an archaeological constraint.

mm) Unless a distinct deposit of midden including shell and ash, as opposed to a few displaced shells, is found during revegetation or other works it can be ignored as it is likely to have been displaced by past works. If a distinct deposit is found in Management Unit 7 an archaeologist should be called on site to assess whether it is likely to be in-situ or not.

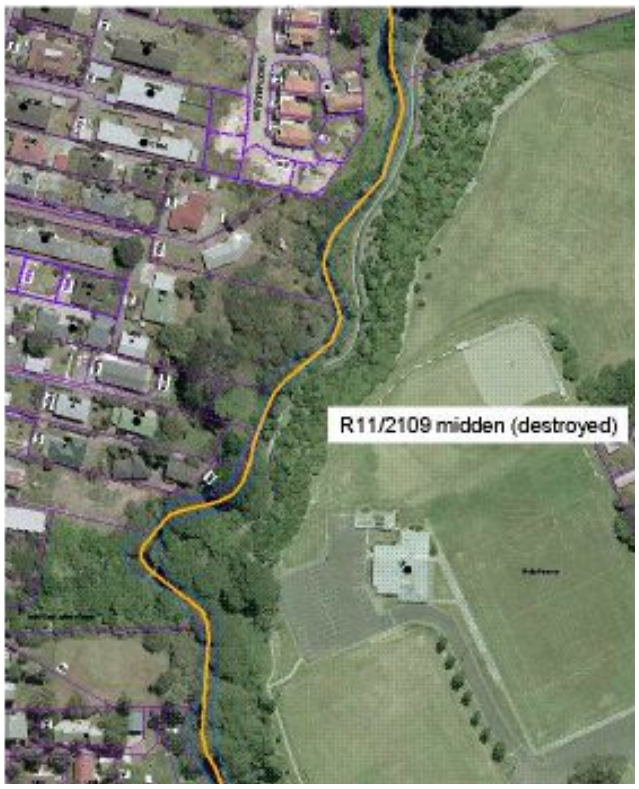

Figure 7. Locations of destroyed site R11/2109 adjacent to Management Unit 7.

4.13 Management Units 8 and 9

No archaeological sites have been recorded within these management units, however evidence of both Maori occupation (R11/2109 and R11/2248) and historic farming practices (R11/2208) have been recorded nearby (Figures 7 and 8). No archaeological evidence has been found on or immediately adjacent to the walkways and grassed areas, or Oakley Creek itself. All of the vegetated banks in these management units are steep, and in places impossible to adequately survey. It would appear unlikely, but possible that archaeological evidence maybe found on these slopes, the most likely being midden deposits thrown down the slopes. It is therefore recommended that;

nn) If in the future the banks are cleared of vegetation an archaeologist should be given the opportunity to resurvey these areas.

Figure 8. Archaeological sites recorded in the vicinity of Management Units 8 and 9.

4.14 General Recommendations

The following recommendation are made for all management units and for any volunteer plantings that may occur outside the management units, and recognises that it is possible that other undiscovered archaeological sites may exist within any of the management units. These recommendations should be passed onto all stakeholders who are involved in the revegetation of Oakley Creek and maintenance of the infrastructure that runs along and across it.

oo) That if any areas of shell, drystone walling, or other evidence that may be archaeological evidence is discovered during planting, vegetation removal or other works, all works in that vicinity should cease and an archaeologist called in to assess and give further advice.

pp) That the Te Ngahere report (Habgood 2005) is revised to reflect the findings and recommendations of this report and reissued. It is important that the unique heritage landscape that surrounds the Oakley Creek walkway is protected within the revegetation programme. By being incorporated into one document the likelihood of accidental damage to archaeological sites would be significantly lessened than if the environmental and archaeological reports are kept as separate stand alone documents.

qq) Copies of the revised report should be distributed to the stakeholder groups identified within the environmental report (ibid 2005: section 3) so that they are aware of both the archaeological and environmental issues.