Evaluation of vegetation and stream health within sites supported by the Hamilton City Council Plants for Gullies Programme

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Prepared for the Hamilton City Council

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Executive Summary

Between August 2012 and March 2013, the Environmental Research Institute, University of Waikato, conducted a survey of randomly selected Hamilton gully sites which had received plants from the Hamilton City Council's Plants for Gullies Programme. This survey assessed recent plantings, existing gully vegetation and stream health, along with property owner awareness and engagement with the key restoration principles.

The Plants for Gullies Programme has been extremely well received by the Hamilton community and gully owners. Survey participants were actively restoring their gully sites with the most common goal (c. 40%) being the establishment of native plant dominance within 10 years. Gully owners have a good understanding of restoration theory and practise; on average, plant placement in the gullies scored 15.7 out of 20 with consideration of plant environmental requirements and the concept of ecosourcing was understood by c. 76% of landowners surveyed. Also, most of the interviewed participants (c. 80%) were active in seeking guidance from other gullies, often through organised tours.

Current stream health was qualitatively assessed and characterised at each of the gully sites. Results provide baseline data for future monitoring. The majority of surveyed sites (c. 50%) had sand or silt substrate and the Bankwood gully had the best features for fauna habitat (e.g. debris and areas of low flow). At the time of visit, c. 60% of surveyed streams had clear water clarity. The poorest water clarity scores were in the Waitawhiriwhiri gully. When assessed on width, length and density, the average riparian buffer score was 12.8 out of 20 while the average stream shading score was 12.7 out of 20. The average bank stability score was 13.1 out of 20, reflecting an erosion problem that many gully owners talked about.

Surveyed gullies were diverse in terms of native and exotic vegetation structure and composition; native species contributed between c. 30% to 100% of surveyed trees and shrubs, whereas groundcovers were predominantly exotic. This assessment of gully sites has shown that the Plants for Gullies Programme improves native species diversity through the re-introduction of species that are not naturally regenerating. The Plants for Gullies programme is a powerful tool for engaging private landowners and making cost-effective change to Hamilton City's native biodiversity. There is now a community of willing gully owners who will continue to restore their gullies with the support of a programme or network. It is our recommendation that the Plants for Gullies Programme is reinstated before this community loses momentum.

1 Introduction

Urban streams are typically degraded systems with poor habitat and low biodiversity, though fortunately, they are more regularly becoming the focus of restoration projects (Collier at al. 2009). The Hamilton Gully Restoration Programme was established in 2002 as a partnership between Hamilton City Council and the local community. The aim of the programme is to raise public awareness and appreciation of Hamilton's gully systems, and actively promote and enable the physical restoration of this important resource. Hamilton City's gully network is a key feature of the urban landscape and is estimated to occupy around 8% of the City's total area. Reconstruction and restoration of the gully network is essential to the improvement of Hamilton's native biodiversity because gullies are the only remaining wildlands in an otherwise built-up landscape (Clarkson & Downs 2000). Benefits of the City's vegetated gullies include the provision of habitat and ecological corridors for native species and the buffering and protection of streams.

Over the past ten years, private gully owners have been working with the Hamilton City Council to clean up and plant areas of stream bank. The Plants for Gullies Programme has provided native eco-sourced plants and restoration advice to gully-owners. Plants were allocated to restorers based on proven track record in restoration, land area, and resources being committed. An evaluation undertaken by the Environmental Research Institute (Clarkson et al. 2012) indicated that the programme had been very successful over the last decade, delivering gully restoration assistance and advice to gully owners and significantly improving the biodiversity in Hamilton City's gully systems. In 2012, the Hamilton City Council provided more than 10,000 plants to gully owners through funding provided by the Waikato River Clean-up Trust. However, following the last round of funding/plants, the Plants for Gullies Programme was disestablished.

2 Objectives

The Environmental Research Institute, University of Waikato, was commissioned by the Hamilton City Council to assess and monitor the vegetation and stream health in gully sections that received plants from the Hamilton City Council through the Waikato River Clean-up Trust funding. The main objectives were to report on the success of the project, particularly the latest round of plants, and provide baseline ecological data for future investigations.

3 Methodology

Sixty sites were randomly chosen from a Hamilton City Council database of gully owners who received plants from Waikato River Clean-up Trust funding. Selected gully sites comprised streams or tributaries within the Kirikiriroa, Bankwood, Waitawhiriwhiri, Mangakotukutuku and Mangaonua stream catchments, along the Waikato River or bordering Lake Rotoroa/Hamilton Lake (Figure 1). Participants were contacted by phone to seek permission and arrange a visitation time. In order to describe gully vegetation composition, a rapid vegetation assessment was conducted at each site. This involved semi-quantitative data collection whereby species were tallied in height tiers in variable sized quadrats. Quadrats were positioned to include recently planted natives provided by the Hamilton City Council. Field work was conducted between August and November 2012.

To provide an overview of each gully site, estimates and notes were made of native and exotic species cover, the presence of native regeneration, iconic and/or rare flora and fauna species and habitat linkage to other gully systems. Gully owners were also scored on their engagement and awareness with gully restoration concepts and suitability of plant placement (i.e. suitability of plant placement as per gully restoration guidelines).

Stream health was assessed by visually scoring a number of stream indicators that relate to the riparian buffer zone, degree of stream shading, bank stability, stream clarity and stream habitat variability and substrate (Appendix 1).

In order to assess their awareness and engagement with current restoration concepts and practices, gully owners were also asked a series of short questions (taking up to 10 minutes to complete). The following questions were asked in person or during the phone conversation if the gully owners were not present during the site visit:

1. How confident are you to put the right plants in the right places?
2. Have you visited other gullies or bush areas for inspiration?
3. Have you heard of ecosourcing?
4. How important is it to you that plants in your gully are ecosourced?
5. Do you have an idea of how you want your gully to be in 10 years' time?

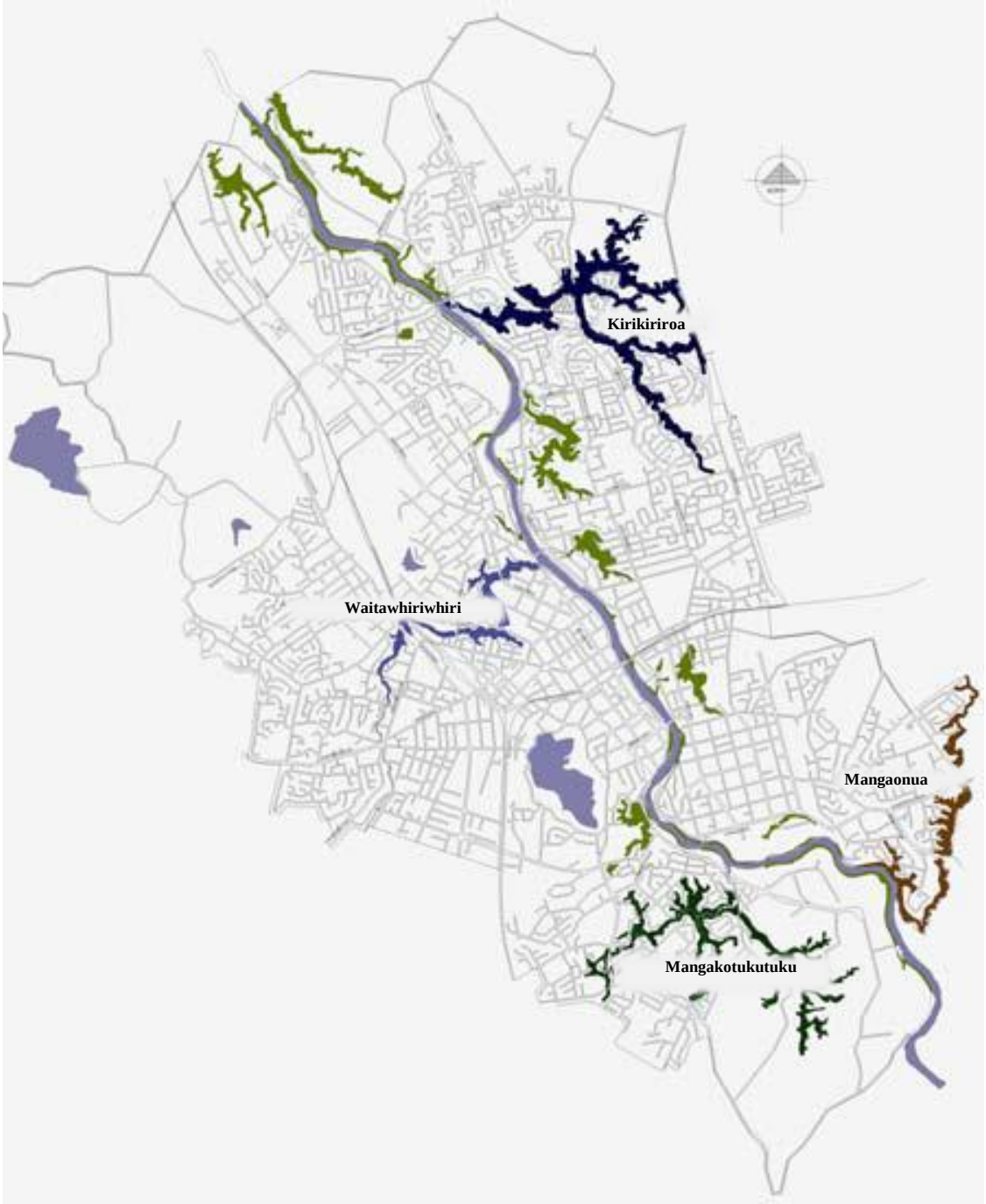

Figure 1: Major gully systems of Hamilton City. The four major systems (Kirikiriroa, Mangakotukutuku, Mangaonua and Waitawhiriwhiri) are labelled. Peat Lakes and the Waikato River are also shown in purple. The total city area is 9427 ha. Image from Clarkson & McQueen (2004).

4 Results

4.1 Awareness and engagement questionnaire

It has been shown that the prior success of the Plants for Gullies Programme, and similar programmes elsewhere in New Zealand, is largely the result of community engagement and commitment coupled with expert advice and guidance (Campbell et al. 2010; Clarkson et al. 2012). The following section addresses the awareness and engagement of the programme participants with the latest restoration concepts and best practice techniques.

Q.1 & Gully Condition Scores: Participants' confidence to place plants in suitable locations

Around half (c. 51%) of the participants surveyed had reasonable confidence to place the received plants in suitable locations, particularly with the aid of the Gully Guide booklet (Wall & Clarkson 2001) for reference. A smaller proportion (c. 22%) had little or no confidence in their own ability to adequately place plants, but often called on advice from neighbouring gully owners and council staff. A number of these participants believed they would have been more confident to strategically place plants if the plants themselves had been labelled/named at the time of consignment, thus allowing better use of the Gully Guide booklet (Wall & Clarkson 2001) and other resources. A small number of participants also noted that the plants they received differed from those they had initially requested, and as a result, were less suitable for their particular site. More than one quarter of participants (c. 27%) surveyed were very confident in their ability to place plants in suitable locations, of these participants, many where gardeners, horticulturists and ecologists, or had previously been involved in restoration projects.

During site visitation, participants' plant placement was also scored between 1 and 20, with 1 being very poor and 20 representing optimal plant placement. Scores ranged from 3–20, with 15.7 being the average. At the time of visitation, only two of the sixty gully owners had failed to plant out any of the plants received from the Hamilton City Council. In most cases, allocated scores were analogous with participants own judgement of their plant placement ability.

Q.2: Have you visited other gullies or bush areas for inspiration?

The majority (c. 80%) of Plants for Gullies participants interviewed were actively seeking ideas and inspiration from gullies at more advanced stages of restoration than their own. This included visiting neighbours private gully sites, council owned sites (e.g., Hammond Bush)

and attending organised gully field trips. The latter were extremely well received and valued by the participants, allowing the sharing of advice and inspiration between Council staff, nursery staff and gully owners.

Q.3 & Q.4: Have you heard of ecosourcing? How important is it to you that plants in your gully are ecosourced?

Ecosourced plants are those which are grown from seeds collected from naturally-occurring vegetation in a locality close to where they are to be replanted as part of a native planting project. Ecosourcing is important because it maintains the distinctiveness of a local flora, including species appearance, physiology and genetic make-up. Ecosourced plants are suited to local conditions so typically grow better than those sourced from elsewhere (Department of Conservation 2013).

Three quarters (c. 76%) of the participants had a reasonably accurate understanding of 'ecosourcing', while the remaining quarter (c. 14%) had not heard of 'ecosourcing' before the interview process. Participants who understood what 'ecosourcing' was, had varied opinions about the use of ecosourced material in their own gullies. Approximately 70% of participants felt that the use of ecosourced material was either 'not important', or of 'low importance', while around 20% of participants believed ecosourcing was 'very important'. Only approximately 10% of participants exclusively used ecosourced material.

Participants who did not rank ecosourced plants as a high priority in their own gullies instead valued variety and diversity of plant species and life form, fast growth rates and survivability, and species which are known to attract native birds.

Q.5: Do you have an idea of how you want your gully to be in 10 years' time?

Almost all participants (c. 93%) had a long term plan or vision for their gully site. A large proportion of participants (c. 40%) were aiming to achieve a native dominated and weed-free site within 10 years. A further c. 7% of the participants were aiming to restore the original vegetation composition within their sites, with c. 12% of participants aiming for a self-sustaining and low maintenance gully. Increasing bird life by providing habitat and food sources was also found to be a key consideration (c. 14%) when participants were planning which plants to include. Other common themes included improving the stability, access and aesthetics of the site for recreation and enjoyment (c. 15%).

Summary of awareness and engagement questionnaire

Because a large proportion of Hamilton City's gully network runs through private property, community awareness and engagement is essential for the successful restoration of this resource. The Gully Restoration Programme uses various tools to achieve this, including workshops, newsletters, forums and public meetings. This investigation has shown that the Plants for Gullies Programme has been particularly successful in providing landowners with further incentives to restore their gully sites. The majority of participants were making use of the programmes resources, including the Gully Guide (Wall & Clarkson 2001), attending organised gully field trips and seeking advice from Council personnel. In most cases, participants were not only introducing the native plants supplied by the programme, but also adding large quantities of privately-sourced plants, including both natives (some ecosourced) and exotic species. However, some participants would not have cleared exotic plants from their gullies without the incentive of native plants from the programme, due to the financial costs of re-vegetating. The use of ecosourced plants has numerous ecological benefits and is encouraged by the Gully Restoration Programme, however this investigation has shown that a large proportion of participants (c. 70%) felt the use of eco-sourced material was not that important in their gully. Further education explaining the ecological benefits of ecosourced plants may benefit the programme, and would also encourage the use of local suppliers.

4.2 Stream assessment

The physical character of a stream determines the quality and quantity of habitat available for use by stream flora and fauna. Streams are spatially and temporally dynamic systems so a wide set of criteria were used to qualitatively assess and characterise the health of the streams at all but five gully sites, which had no running water at the time of visitation. Stream assessment criteria were related to the riparian buffer, stream shading, bank stability, stream habitat, water clarity and the stream substrata. This baseline data will allow easy assessment of restoration efforts on the stream networks. It is likely that restoration planting will lead to more shaded streams with cooler temperatures and increased habitat for native fish and stream fauna (Collier et al. 2008). It is also thought that improving in-stream habitat quality can reduce the abundance of nuisance introduced species such as mosquito-fish (Ling 2004).

4.2.1 Stream substrata and habitat provision

At each gully site, the proportions of stream bed substrates (bedrock/boulders, cobles/gravel, sand, silt, clay) were estimated. The dominating substrates were sand and silt, on average accounting for c. 50% of the surveyed stream beds (Figure 3). Clay accounted for c. 15%,

gravel and cobbles c. 10% and boulders/bedrock < 5% of the recorded stream bed substrate. Streams were also scored on the physical habitat they provide to potential fauna and flora in-stream conditions (e.g., substrate composition, woody debris, areas of low flow). Streams were given a score between 1 and 20, with the scale representing a continuum from very poor (e.g., not permanent or variable) to favourable (e.g., permanent and diverse) habitat (refer to Appendix 1 for more detailed scale). Stream habitat scores ranged from 5 to 19, with 14.3 as the average score (Figure 2, 3). There was not a high correlation between catchment and stream habitat; however sites within the Bankwood catchment had slightly higher habitat scores than elsewhere.

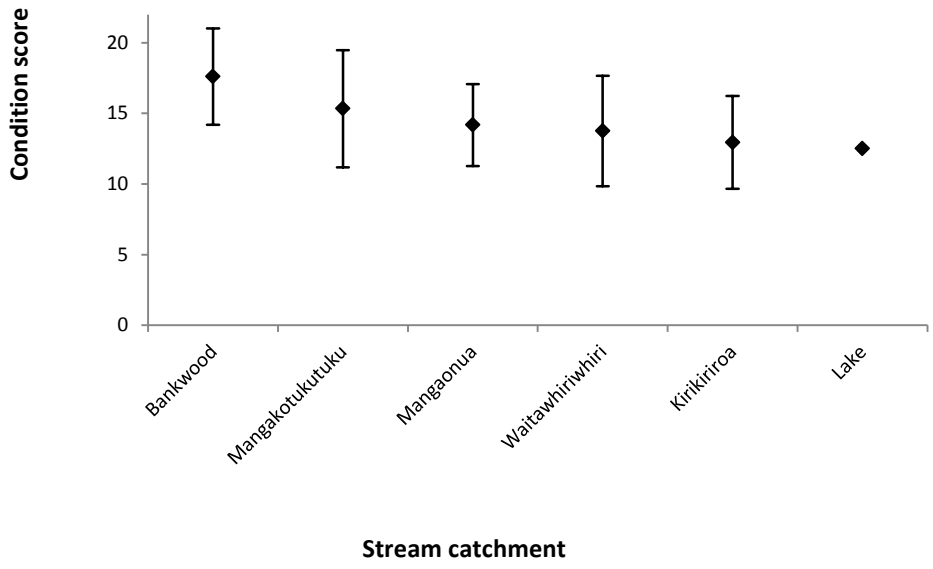

Figure 2: Stream habitat condition scores across major Hamilton City catchments. Error bars indicate standard deviation from the mean value for each catchment.

4.2.2 Water clarity

Water clarity, although highly influenced by recent rainfall events and catchment substrate, can indicate the degree that catchment wide influences are affecting stream health, bank/sediment stability and runoff. Water clarity at each site was classed as 'stained', 'highly turbid', 'slightly turbid' or 'clear'. The majority (c. 60%) of streams had clear running water at the time of visitation, whereas c. 25% of streams were considered to be slightly turbid, c.10% highly turbid and 5% stained. The latter were located within the Waitawhiriwhiri catchment where the high level of industrial land (Collier et al. 2009) may be influencing runoff and water clarity. All sites within the Bankwood (highly urbanised catchment) and c. 90% of those in the Mangaonua catchment were clear at the time of visitation.

4.2.3 Riparian buffer

The riparian buffer zone has a multitude of influences on stream habitat and health, including:

1. Stream shading
2. Producing leaf and wood input
3. Providing fish spawning/adult insect habitat
4. Retention of particulates during high flows
5. Stream bank stabilisation
6. The uptake of nutrients from groundwater
7. Filtration of particulates in surface runoff

The riparian buffer zone at each gully site was given a score which reflected buffer zone width, length, density and consistency. Potential scores were between 1 and 20, with 1 representing a buffer zone that was patchy and ineffective, and 20 representing a continuous and dense buffer zone >10 m in width. Scores ranged from 2 to 20, with the average being 12.8.

4.2.4 Stream shading

Shade plays an important role in the regulation of stream temperature and light, which in turn influences the growth and survival of in-stream fauna and flora. Stream shading was visually assessed and scored along the entire/accessible length of stream within the gully site boundaries. Streams were given a score between 1 and 20, representing a continuum from an open stream to full shade. Stream scores ranged from 2 to 20, with the average score being 12.7. Scores reflected the state (height, density, consistency) of the riparian vegetation and indicate that many streams had less than adequate cover.

4.2.5 Bank stability

Stream bank erosion is a natural geomorphic process which allows stream channels to adjust their size and shape in response to changes in discharge and sediment loads. Stream bank erosion can be problematic when it influences or poses threat to adjacent land and infrastructure (Phillips & Daly 2008). In Hamilton City, increased urbanisation within stream catchments has led to more frequent floods, rapidly changing hydrographs and higher peak flows, initiating increased channel incision and bank erosion. A participant with a gully section on River Road reported losing an approximately 2 metre wide strip to stream bank erosion in the past ten years. Riparian planting is important for stabilising stream banks and impeding water flow during floods, which reduces hydraulic stress on in-stream biota (Collier et al. 1995).

Bank stability at each gully site was visually assessed and given a score between 1 and 20, with 1 given if banks appeared unstable with visible erosion on >60% of the stream length and 20 given if streams banks were stable with no obvious erosion. Gully sites scored between 3 and 20, with the average score being 13.1. Gullies visited within the Mangaonua catchment generally had less stream bank erosion than the other catchments, with the Waitawhiriwhiri sites scoring the lowest. This catchment comprises a substantial proportion of industrial land.

Summary of stream assessment

Within Hamilton City, urban streams form a part of the City's drainage system that supplies important stream and terrestrial habitat and corridors as well as stormwater drainage and flood control functions (Collier at al. 2009). Although Hamilton City's gully network provides habitat for the threatened species e.g., giant kokopu and long-fin eel, this investigation has shown many urban streams have less than a desirable amount of vegetation cover (Figure 3). Plants supplied by the Plants for Gullies Programme will undoubtedly lead to more shaded streams, cooler stream temperatures and increased habitat for native fish and stream fauna, ultimately benefiting the wider Hamilton community.

Figure 3: Examples of Hamilton City gully streams.

4.3 Vegetation assessment

Surveyed gullies were diverse in terms of native and exotic vegetation structure and composition, reflecting the different age, location and disturbance histories at each of the sites. Across all surveyed sites >200 plant species were identified. Native species contributed between c. 30% to 100% of surveyed trees and shrubs at the gully sites. The most commonly encountered native species were harakeke/flax (*Phormium tenax*), mahoe (*Melycytus ramiflorus*), cabbage tree/ti kouka (*Cordyline australis*), wheki (*Dicksonia squarossa*), karamu (*Coprosma robusta*), kahikatea (*Dacrycarpus dacrydioides*), silver fern/ponga (*Cyathea dealbata*), lacebark (*Hoheria sexstylosa*), wineberry/makomako (*Aristotelia serrata*) and small leaved *Coprosma* species (including *C. propinqua* and *C. rhamnoides*). Groundcover species were predominantly exotic, with native groundcover species accounting for <15% of all groundcover species encountered (irrespective of the canopy species).

Native plants received from the Plants for Gullies Programme had been successfully planted at 85% of sites, while at the remaining 15% of sites visited at least some of the received plants were yet to be planted. In general, plants were suitably placed in relation to their species-specific requirements and appeared to be in good condition at the time of visitation. However, a common complaint from gully owners who lacked plant identification skills was the absence of labels on the plants they received. To ensure strategic plant placement in future, at least one plant per species should be labelled on consignment.

Of the 60 sites visited, natural regeneration of native plant species was noted at 24 sites. Commonly regenerating species included karaka (*Corynocarpus laevigatus*), karamu, pate (*Schefflera digitata*), mahoe, lacebark, wineberry/makomako, poroporo (*Solanum aviculare*), kawakawa (*Piper excelsum* subsp. *excelsum*), wheki, koromiko (*Hebe stricta*) and red mapou (*Myrsine australis*). At gully sites where the groundcover was predominantly exotic (Figure 4) wandering Jew (*Tradescantia fluminensis*), ivy (*Hedera helix* subsp. *helix*) or green goddess (*Zantedeschia aethiopica* cv. Green Goddess) were common and regeneration of native species was rare. Other common, but less prolific exotic species included three-cornered garlic (*Allium triquetrum*), flea-bane (*Conyza bilbaoana*), aluminium plant (*Lamium galeobdolon*), montbretia (*Crocosmia* x *Crocosmiiflora*), agapanthus (*Agapanthus praecox* subsp. *orientalis*), blackberry (*Rubus fruticosus* agg.) and buttercup (*Ranunculus* spp.). If the Plants for Gullies Programme were to be re-instated the council could consider incorporating more native ground covering/low statured species in their plant provisions. This could include species such as nini (*Blechnum chambersii*), thread fern (*Blechnum filiforme*), hen and chicken fern (*Asplenium bulbiferum*), bush lily (*Astelia fragrans*), bush rice grass

(*Microlaena avenacea*), pukupuku (*Doodia media*), pepepe (*Machaerina sinclairii*) and gully fern (*Pneumatopteris pennigera*).

Commonly encountered exotic tree species included Chinese privet (*Ligustrum sinense*), tree privet (*Ligustrum lucidum*), grey willow (*Salix cinerea*), woolly nightshade (*Solanum mauritianum*), palm lily (*Yucca gloriosa*), *Prunus* spp., *Acacia* spp. and alder (*Alnus glutinosa*). Many gully owners were actively removing these species to create room for new native plantings. The vegetation survey indicates that a significant increase in native species diversity occurs following the addition of the provided plants. Particularly through the introduction of native understory species that were not found to be naturally regenerating in the gully sites.

Gully sites were at quite variable stages of restoration, some areas had received restoration work for close to 30 years. Because the Plants for Gullies Programme had been in operation for approximately 10 years, there is now a requirement for mid to late successional species to be established at some sites. Early successional/nurse species used initially to achieve native cover are generally short lived. It is therefore important to establish mid-late successional species before nurse species dieback. Although some natural regeneration was evident at the gully sites, further workshops, guidelines and plant suppliers should consider restoration in a successional framework and emphasise the importance of enrichment planting beneath nurse species. This is particularly useful for re-introducing key species that are not naturally regenerating in significant numbers (e.g., swamp maire/*Syzygium maire*, pukatea/*Laurelia novae-zelandiae*, rimu/*Dacrydium cupressinum* and marble leaf/*Carpodetus serratus*). Further site visits maybe required to monitor the long term success of current and past rounds of plantings and their associated ecological benefits.

Vegetation Summary

Vegetation assessment of gully sites has shown that the Plants for Gullies Programme significantly increases native species diversity by re-introducing species that may not be naturally regenerating due to dense exotic groundcovers, seed predation and lack of native seed sources. It also provides incentives to remove exotic species. Initial plantings have frequently incorporated fast-growing but generally short lived species (e.g., lifespan <50 years). Restoration plantings at some sites were >10 years old and now require understory enrichment with later successional species. This provides an opportunity to re-introduce the mid-late successional species that are not successfully regenerating in the majority of

Hamilton City's gullies. Groundcover species were found to be predominantly exotic so this too provides an opportunity to re-introduce natives in the ground layer.

Figure 4: Common exotic species encountered in Hamilton City gullies.

5 Conclusions and Recommendations

By bringing together ecological understanding and the best-practice techniques of pest management, native plant propagation, planting and animal recovery programmes, successful city-wide restoration is achievable in Hamilton. This long-term restoration goal is best attained through a series of smaller, manageable tasks (Clarkson & McQueen 2004) and for this reason, the Plants for Gullies Programme is an extremely valuable and powerful tool. The combinations of high volunteer hours, community wide public involvement and the provision of expert guidance have resulted in the ecological benefits of the programme far exceeding the financial outlay. The programme has initiated strong partnerships between the Hamilton City Council and private gully owners, allowing restoration efforts to extend beyond council reserves and onto privately owned land.

The Plants for Gullies Programme had previously been in operation for ten years and throughout this time has provided gully owners with the tools and knowledge to restore their section of the Hamilton City gully network. Results are very encouraging; a previous report has shown the number of native species in private gullies utilising the Plants for Gullies Programme is approximately nine times greater than equivalent sites that are not in the programme (Clarkson et al. 2012). It is our recommendation that the Hamilton City Council seriously consider reinstating the Plants for Gullies Programme while community involvement is still high. With the support of the programme many gully owners have achieved native dominated canopies and there is now a requirement for guidelines or workshops to incorporate a successional framework, with a larger focus on mid to late successional species and enrichment planting. This could include a supplementary document to the Gully Guide (Wall & Clarkson 2001) that targets gully sites where native plant dominance has already been achieved. In such locations, restorers may be ready to introduce specialised or rare plant groups e.g., epiphytes, lianas, orchids and herbaceous species.

A lack of native groundcover species was apparent throughout surveyed gullies and even beneath native dominated canopies with vigorous weed control. If the Plants for Gullies Programme were to be re-instated the council could consider incorporating more native ground covering species in their plant provisions.

Stream assessment criteria were used to qualitatively characterise the physical character and available habitat of the streams. It is the intention this baseline data will allow long term stream health to be monitored. The straightforward method could be repeated at regular

intervals, 3-6 years apart. It is predicted that stream condition will improve as vegetation develops and deciduous exotics are replaced with native species.

6 Acknowledgements

This report would not have been possible without the willing participation of a large number of Hamilton gully owners, all of which readily answered the questionnaire and provided access onto their properties. The high level of enthusiasm for gully restoration which we observed within the community is encouraging, and gully owners should be proud of their enduring efforts which have undoubtedly improved the biodiversity of Hamilton City. We greatly appreciate assistance from Maire Brown and Toni Cornes for their contribution to field work and interviewing.

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Appendix 1

Landowner
& address:

Photo ID:

Date:

Site Number:

Times:

OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
Owner awareness & engagement			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
good understanding of key principles* keen & active	keen but lacking some understanding or vise versa	room for improvement	multiple errors & W.A.
Plant placement			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
RPRP	<10% out	~25% out	>25% out
Riparian buffer			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
>10 m width, continuous and dense, mature	<10 m width, mostly continuous, not mature	narrow, inappropriate species, patchy	very patchy, not likely to be effective
Stream shading			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
well shaded	~50% shaded	~25 % shaded	open
Bank stability			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
stable, minimal erosion	moderately stable, 5-30% of bank is eroding	moderately unstable, 30-60% of bank is eroding	unstable, >60% eroding
Stream habitat			
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
>50% favourable for fauna, permanent & variable	30-50% favourable, mod. permanent &/or variable	10-30% favourable, somewhat permanent &/or variable	<10% favourable, not permanent or variable

*key principles: right plant in the right place, ecosourcing, native dominance, succession

Water clarity			
clear	slightly turbid	highly turbid	stained
Stream substrata			
bedrock/boulder %	cobble/gravel %	sand/silt %	clay %

Notes (overall condition, channelised, neighbouring gully sections):

Vegetation Quantification:	
native %	exotic %

Notes:

Vegetation				
tier	species	height (m)	count	% cover