AUCKLAND REGONAL COUNCIL GUIDELINE GD_01 THE INTEGRATION OF LANDSCAPE & ECOLOGY VALUES IN STORMWATER MANAGEMENT

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ABSTRACT

The Auckland Regional Council (ARC) Technical Publication (TP) 10 Stormwater Management Devices is being updated to become Guideline (GD) 01 and will consist of several complementary volumes. One of these volumes (to press) is entitled 'Landscape and Ecology Values within Stormwater Management'. The volume promotes the potential benefits of landscape design approaches to stormwater management for enhanced landscape and ecology values, as well as treatment function. This paper summarises the Guideline document, with specific regard to the wetland-pond chapter.

The document's structure is based on three levels of specificity:

1. Broad landscape and ecology principles - presents a sustainable approach to stormwater devices, by integrating media (planting, structures, soil, and water) to provide for multiple quality benefits
2. Technical specifications - discuss soil management, planting establishment, and structural components of devices
3. Recommendations for individual types of stormwater management devices provide specific guidance for landscape and ecology values, including habitat enhancement tables, detailed plant lists, and operation and maintenance schedules.

KEYWORDS

Low Impact Design, Technical Publication TP 10, Stormwater, Landscape and Ecology, Wetlands, Raingardens, Green Roofs, Swales

1 INTRODUCTION

Low impact stormwater design (LID) is a development approach that utilizes natural systems and processes to minimise potential effects of stormwater and erosion on the receiving environment. The Auckland Regional Council (ARC) has been instrumental in the advancement of LID in the Auckland Region and throughout the country. Their technical documents are frequently referenced as 'the standard' for stormwater management.

The most recognized of these publications is Technical Publication 10 (henceforth TP10) Stormwater Management Devices. The Auckland Regional Council TP10 was published in 2003 to "…demonstrate the ARC's preferred design approach for structural stormwater management devices". TP10 will be updated to become Guideline (GD) 01, and will consist of several complementary volumes.

ARC commissioned a volume to promote landscape design approaches to stormwater management in order to optimise ecological function, landscape values, and stormwater

treatment potential. The document's structure is based on three levels of specificity, provided as principles, specifications, and recommendations (refer figure 1).

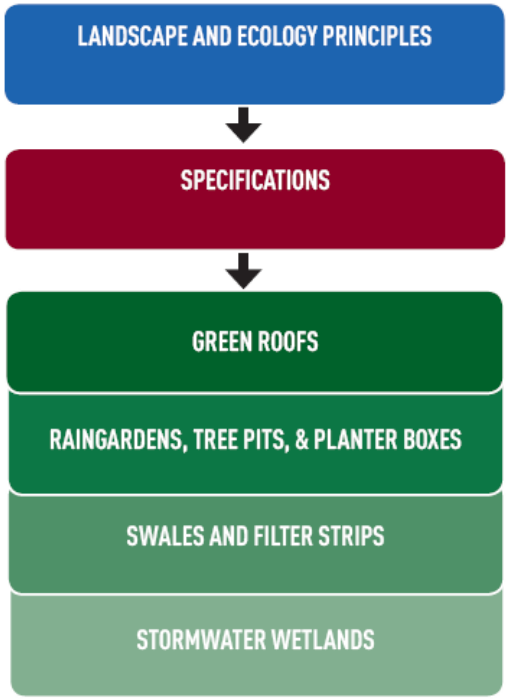

Figure 1: GD_01 V5 document structure, with three complementary layers of specificity

2 DISCUSSION

2.1 PRINCIPLES FOR LANDSCAPE AND ECOLOGY

The principles section introduces systems and material elements that contribute to landscape and ecology values within stormwater management devices. Where stormwater management devices provide appropriately for these values they are more likely to show improved operation and reduced maintenance. There is also potential for ancillary benefits, including enhanced natural character values, landscape amenity values, and corresponding economic values.

Principles are based on a sustainable approach to provide for multiple quality outcomes from infrastructure. This includes a synergistic relationship between the elements of a stormwater device, so that structures, plants, soil, and water contribute to the function of the system and its effectiveness in managing stormwater.

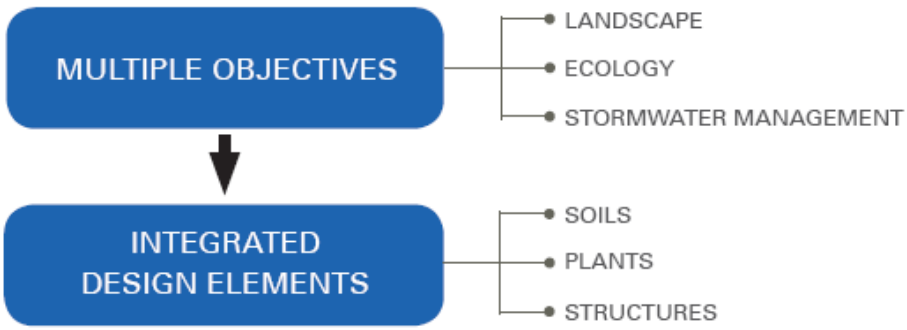

Figure 2: Broad principles of landscape and ecology applied to stormwater management

2.1.1 PROVIDE FOR MULTIPLE OBJECTIVES

Stormwater can represent a valuable resource in the landscape, providing irrigation and entrained nutrients to soil, plants, and aquatic habitats. Water is also a dynamic force, contributing to a sense of place through its elemental relationship with other media. Stormwater devices therefore have the potential to provide for multiple quality benefits for landscape and ecology values.

LANDSCAPE

If devices are constructed with landscape amenity and function in mind then they are more likely to become a permanent, well maintained feature of development, as landowners are more likely to take pride and stewardship over these facilities. Some of the discussion relevant to the guideline includes:

- How devices contribute to spaces, edges and transitions
- Integration of devices with dominant elements of the landscape
- Safety and crime prevention for the public and maintenance staff
- Cultural views including the processes by which water is treated
- Centralised vs diffuse and public vs private treatment trains
- Interpretation of treatment processes and site values
- Preventative rather than restorative landscape maintenance to optimize stormwater function and device longevity
- Financial incentives and economic cost-benefit relationships for landscape values

ECOLOGY

Stormwater management devices ultimately afford some level of protection to receiving environments by managing the quality and quantity for stormwater. There are also opportunities to represent ecological systems and habitat niches within stormwater management devices. Discussion on ecological values relevant to the devices includes:

- Responding to the quality of the receiving environment, including the protection of rare ecological communities or natural features
- Accounting for seasons, life cycles, and successional phases within devices
- Providing for structural diversity from low plants to trees to optimize habitat potential
- Ecosourcing of diverse and representative plant communities to ensure good biodiversity outcomes
- Providing for diverse instream habitat
- Providing for landscape connections and/or suitable habitat for the transfer of flora and fauna, individuals and populations as appropriate
- Limiting potential effects of construction through design, staging, controls etc

STORMWATER

The treatment performance of stormwater management devices can be improved through the optimisation of natural systems and processes and their potential to attenuate and treat stormwater, and metabolise and transform pollutants. These processes, which occur at the plant-soil-water interface, are physical, chemical and biotic in nature. Some of the processes discussed in the guideline include:

- Physical and chemical processes
- Microbial action
- Plant systems
- Hydrological processes
- System buffering
- Thermal considerations

2.1.2 INTEGRATED DESIGN ELEMENTS

Soil, plants and structures are the primary elements utilised for the construction and operation of stormwater management devices. Integrating design elements appropriately can minimise resource use and optimise quality outcomes. For example, batter slopes with appropriate planting may reduce the need for structural stability controls, provide for additional landscape amenity, and treat overland flows.

SOILS

Landform is the primary means to shape spaces and direct the flow of water. Soils are also important determinants of land-use potential, ground and surface water flow, and expected sediment loading in stormwater.

PLANTING

Ideally planting can deliver multiple benefits to stormwater devices, including stormwater management function, enhancement of ecological values, and landscape amenity.

STRUCTURE

Specific principles for structures relate to their relative inertness and their integration with plant and soil elements. This includes the use of bioengineering techniques to construct stormwater management devices.

2.2 LANDSCAPE SPECIFICATIONS

2.2.1 SOIL

The guideline section relating to soils is relatively specific to the Auckland Region. It is important to understand existing soil classes to provide for appropriate construction phasing to minimise and capture overland flow, treat and infiltrate to groundwater, and sustain plant growth and its associated micro-biology.

Best practices are provided for conserving priority soil classes in situ. However, where the removal or replacement of soils is required the guideline provides approaches for stripping,

stock-piling, re-spreading, and amelioration to optimise the physical structure and biological activity of soils.

2.2.2 PLANTING

Planting specifications provides for appropriate plant materials (including genetic suitability), their set-out, survivorship, stormwater function, and maintenance.

2.2.3 WEED AND PEST CONTROL

Weed and animal pest control around stormwater devices should be undertaken to protect new plantings as well as local biodiversity. During the establishment phase, new planting is particularly vulnerable to competition from weeds, as well as damage by pukeko, waterfowl, and rabbits.

For plant communities, a combination of direct weed control, suppression by native planting, and allowing for native succession provides for long term weed management, with minimal impact to native vegetation, and reduced maintenance costs.

The weed and pest control specifications focus on integrated pest management approaches. Links are provided to regional pest identification and controls.

2.3 STORMWATER MANAGEMENT DEVICES – WETLAND POND EXAMPLE

The third section of the guideline includes recommendations for landscape and ecology for each of the stormwater management devices. Recommendations for each device are accompanied by habitat enhancement tables, a detailed plant schedule, and an operation and maintenance programme.

Constructed stormwater wetland ponds are systems built to mimic the water cleansing processes of natural wetlands. Wetland pond environments represent the intersection of aquatic and terrestrial ecologies and support a wide variety of vegetation types. In this way, they can be designed as a landscape feature of significant amenity, with diverse habitat types, and opportunities for passive recreation. For stormwater wetland ponds the guide looks at the various treatment forms of these devices, namely surface flow, subsurface flow, and floating wetlands.

2.3.1 LANDSCAPE

Wetland ponds are unusually rich environments formed by interweaving elements, diverse plants communities, and sweeping landforms. The guidelines provide specific reference to these devices for:

- Context e.g. enhanced habitat potential adjacent to receiving environments vs highly structured wetland forms for specific urban environments
- Potential for passive recreation
- Ancillary benefits such as screening views, dust inception, temperature modification, and litter capture
- Interpretation and education

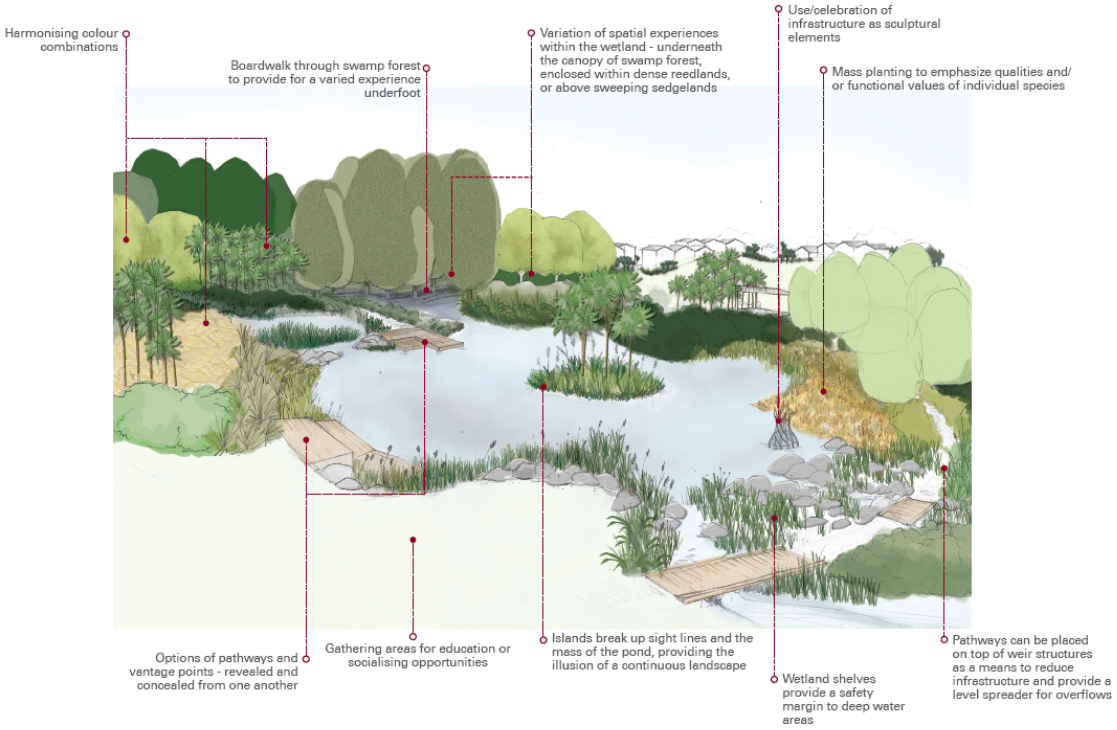

Figure 3: Typical treatments to enhance landscape amenity values and provide passive recreation opportunities for wetland ponds

2.3.2 ECOLOGY

The key factors that influence ecology values for wetland ponds are water quality, proximity to other wetland habitats, vegetation communities, and physical structure. The guideline provides specific reference to these devices for:

- Diversity of representative plant communities and appropriate sourcing of genetic plant stock
- Hydrological heterogeneity (diversity of deep pools, shallow shelves, riffles etc)
- Connections to adjacent habitat areas for the passage of flora and fauna as appropriate.
- Providing critical and representative habitat to support permanent populations as appropriate

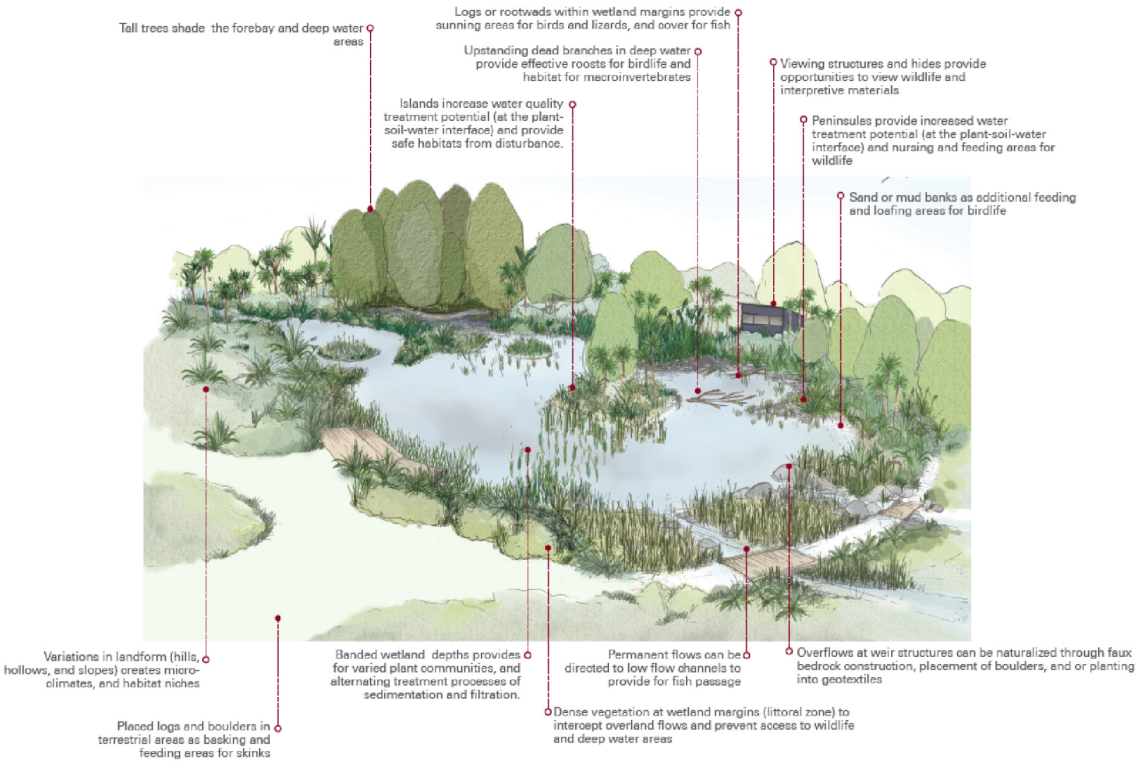

Figure 4: Typical treatments for the naturalisation of wetland ponds and enhancement of habitat areas.

TAXA	DISTRIBUTION	REFUGE	FORAGE
Bush Birds	• Canopy and emergent trees as perches, where possible adjacent and connected to street trees • Attract frugivorous birds with year round fruiting trees	• Canopy and emergent trees for roosting • Mid-canopy trees for nesting • Dense shrub environments on sunny edges for safe refuge • Consider roost and nest boxes	• Year round food supply, including overlap of native tree fruiting Structural diversity of forest areas for insectivorous birds • Dense shrub environments on sunny edges provide dense foliage and fruiting • Flowering natives for nectar feeders • Consider nectar-feeding stations with species specific access
Water Birds	• Clear flyways in line with grass loafing areas • Large bodies of water	• Dense sedge and rushland fields • Islands • Open views from loafing areas • Uninterrupted open water	• Adjacent grass loafing areas • Peninsulas, sand banks and mudbanks
Reptiles	• Provide for herpertofauna as appropriate, based on the potential to access other remnant habitat areas and the necessity to avoid a genetic bottleneck • Corridors can be as simple as a hedgerow or line of plants • Consider wooden disks placed across open space areas to provide refuge and landscape connections	• Rock piles and log stacks Dense low growing shrub environments on sunny edges • Kanuka and manuka copses • Dense grasses - flaxes and toetoe • Developed leaf litter under canopy	• Habitats that favour insects (see below) • Year round low and prostate fruiting shrubs
Invertebrates	• Planted corridors can provide links for non-flying invertebrates to complete their life cycle, especially to stream environments	• Rock piles and log stacks • Structural diversity of forest areas to optimise ecological niches and leading to dense and diverse leaf litter • Consider weta boxes	• Structural diversity of forest areas to optimise ecological niches and leading to dense and diverse leaf litter • Rock piles and log stacks
Fish	• Avoidance for perching culverts, rising manholes, and pipes within flows to provide access between receiving environments and off-line ponds • Minimise drop structures greater than 100mm or provide for wetted surfaces over any falls • Provision of resting areas above and below drop structures • Consider directing low flows through a channel rather than pipe for fish passage	• Wetland tree species for shade and refuge in root systems • Edge planting of overhanging grasses etc • Potential to insert tree root wads and branches to provide overhangs • Diverse substrates for both interstital spaces and mud bottomed refugia • Deep water pools • Floating islands provide refuge between root systems	• Wetland tree species for falling insects and detritus • Edge planting of overhanging grasses for falling insects • Substrates and cool temperatures that provide for increased diversity and biomass of freshwater invertebrates

Figure 5: Habitat enhancement table for wetland ponds

2.3.3 PLANTING

Plants are an essential component in constructed wetland ponds, with their roles including:

- Aiding in the reduction of nutrient and heavy metal concentrations

- Influencing sediment deposition and filtering sediment particles from the water column
- Influencing hydrology and hydraulics in constructed wetlands by promoting even flows
- Providing shade and decreased light to limit algae and reduce water temperatures
- Decreasing erosion by reducing wave energy and flow velocities while binding soil particles with root systems
- Providing a basis for wetland food chains and supplying shelter for invertebrates, reptiles and birds
- Enhancing visual amenity

Extensive plant lists were prepared by Boffa Miskell, Geoff Davidson from Oratia Native Plants, and Robyn Simcock from Landcare Research. These plant lists provide 'bullet proof' species for typical applications as well as enhanced biodiversity. Plant zones apply to specific levels of water inundation within the wetland pond.

GENUS	SPECIES	COMMON NAME	TYPE DESC	TRIAL	HEIGHT	SPREAD	WATER TOLERANCE	SUN / SHADE	NOTES
Whalenbergia	Albomarginata	NZ bluebell	herb	*	0.15	0.30			Attractive mauve flowers on thin stalks above a dense mound of vegetation; spreading
ADDITIONAL SPECIES WORTH TRIALING FOR ROOFTOPS.									
Anemanthele	lessoniana	Gossamer Grass	Grass		0.80	1.30			Forms large, fine-leaved tussocks. Fine pink feathery flower head.
Asplenium	haurakiense	Hauraki Asplenium	Fern		0.50	0.50			Although best in shade it is an incredibly tough fern for those hot dry sunny places that very few ferns can survive in. It loves rich guano or compost and makes a great pot plant. Coastal rock dweller it forms a dense clump of hundreds of fronds.
Asplenium	obtusatum		Fern		0.30	0.40			A coastal fern. Lush green. prefers dry dappled shade. An excellent pot plant.
Atriplex	cinerea	Silver salt bush	Ground Cover		0.70	2.00			Low spreading dense bush. Silvery grey foliage. Coastal. Keep well pruned.
Bromus	arenarius		Grass		0.40	0.40			This is a rare annual grass with glaucous leaves with soft hairs all over it. The flower heads are delicate and drooping.
Carex	hectorii		Sedge & Rush-like		0.20	0.30			An attractive alpine Carex with blue-green foliage. Shortly rhizomatous, loosely tufted sedge of open damp ground in tussock grassland, or fringing cushion bogs, tarns and ponds.
Carex	muelleri		Sedge & Rush-like		0.40	0.20			This is an attractive erect rather brick coloured sedge. Slow growing and has good landscaping potential.
Celmisia	major		Herb		0.20	0.20			Normally Celmisia are alpine plants, but this form is coastal. Full sun, rocky well drained situation. Not always available.
Centipeda	species	New Zealand sneezewort	Herb		0.01	0.30			An opportunist herb that colonisers the beds of freshly drained dams and ponds . It is shortlived but seeds rapidly to recolonise other damp areas. Recently recognised as a distinct species endemic to New Zealand.
Cheilanthes	species	Rock Fern	Fern		0.20	0.30			Small dark green fern with linear fronds. Short creeping. Frost hardy. Lives in full sun on dry rocks. Seldom available.
Chionochloa	bromoides	Coastal tussock	Grass		0.50	0.75			Northern coastal tussock with lax flower spikes. Normally hangs on cliffs in full sun or under shade of Pohutukawa.
Chionochloa	conspicua	Hunangamoho	Grass		1.00	1.00			Tall open flowering spike. Broad Toetoe-like foliage. Sun or light shade and dry to moist soils.
Crassula	ruamahanga		Ground Cover		0.04	0.50			An opportunistic species which can be expected to occur in any suitably damp, open habitat.

Figure 6: A sample of the guideline plant list accounting for description and tolerances of each plant and sorted by stature

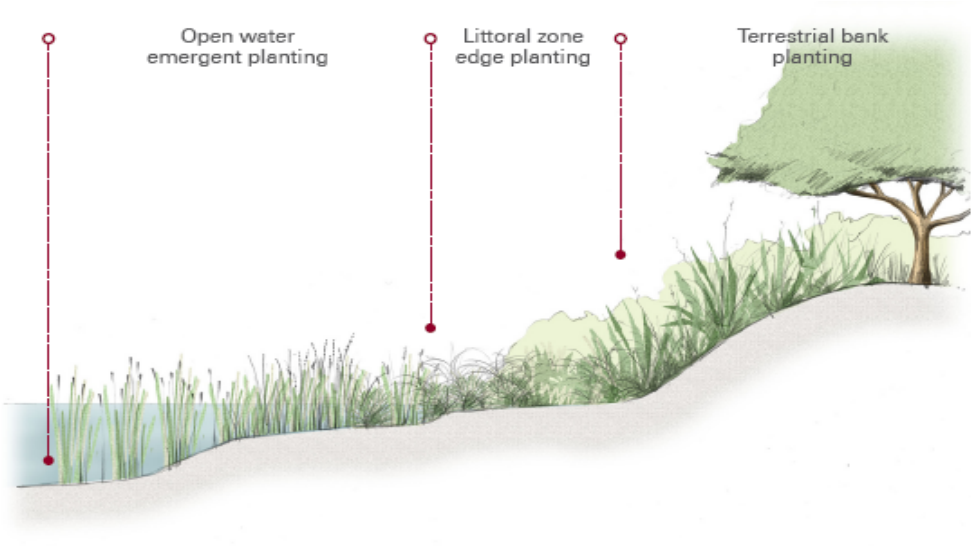

Figure 7: The planting zones adjacent to the wetland pond

2.3.4 OPERATION AND MAINTENANCE

Once wetland ponds have been established, they require intensive maintenance over the first year including watering, physical repairs, mulch, weed removal, and possible replanting.

An emphasis on preventative monitoring and maintenance will ensure wetland ponds establish, and their aesthetic appearance and functional operation is secured. Corrective maintenance may also be required including slope and erosion repairs. A typical operation and maintenance programme is provided for each of the devices to trigger timing and frequency of maintenance tasks.

WETLAND-POND													
"SOFT" LANDSCAPE MAINTENANCE SCHEDULE													
MAINTENANCE (AS REQUIRED)	GROWING SEASON												AT COMPLETION
	SPRING			SUMMER			AUTUMN			WINTER			
	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	
PLANTS													
STAKING	MONTHLY												
TRIMMING AND PRUNING													
HEDGE TRIMMING													
WEED CONTROL													
WATERING				TWICE WEEKLY									
REPLACEMENT													
WETLAND REPLACEMENT													
OVER SOWING													
GRASS AREAS													
MOWING	TWICE MONTHLY			MONTHLY			MONTHLY			MONTHLY			
FERTILISER													
WEED CONTROL													
MULCH REPLENISHMENT													
OTHER													
LITTER REMOVAL	MONTHLY												
MULCH REPLENISHMENT													
REPAIR EROSION													
DRAINAGE													
PET WASTE REMOVAL	MONTHLY												

Figure 8: An example operation and maintenance table form the guideline

3 CONCLUSION

ARC's Guideline GD_01, Volume 5 (to press) develops chapter 14 of the original ARC TP10 document to explain and illustrate aesthetics, landscape amenity, and natural character values in relation to stormwater devices. The guideline also provides for habitat enhancement within stormwater devices. Aspects of landscape design are discussed in detail for soil management, planting establishment, and structural components of devices.

The document's outline provides for three levels of specificity. Broad principles present a sustainable approach to stormwater devices, by integrating media (planting, structures, soil, and water) to provide for multiple quality benefits.

Specifications provide for best practice approaches to soil management, planting, and weed and pest operations.

Each device is also provided with specific guidance for landscape and ecology values, including habitat enhancement tables, detailed plant lists, and operation and maintenance schedules.

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Viewpoints expressed in this paper are those of the authors and do not reflect policy or otherwise of the Auckland Regional Council.

REFERENCES

Lewis et al (to press) Landscape and Ecology Values within Stormwater Management. Auckland Regional Council Guideline 01, volume 5 DRAFT, October 2009

Shaver et al. (2003). Stormwater Management Devices: Design guidelines manual, Auckland Regional Council Technical Publication 10, second edition, May 2003.