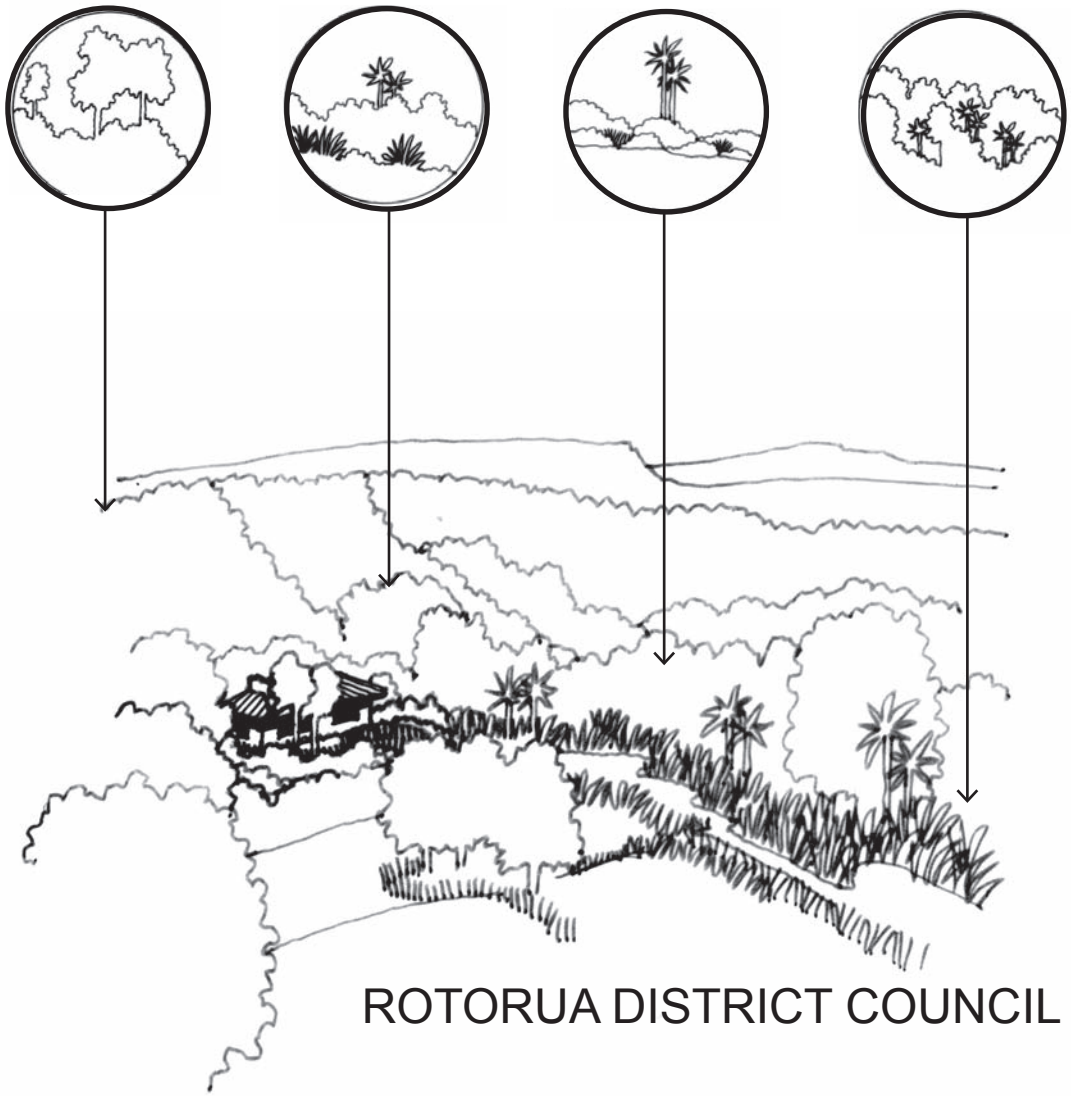

ROTORUA DISTRICT COUNCIL

LAKES A ZONE
REVEGETATION GUIDE

LAKES A ZONE
REVEGETATION GUIDE

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CONTENTS


People throughout Rotorua District working together to:
Protect natural areas; restore indigenous habitat; enhance ecosystems for birds, fish, lizards; create green linkages or corridors; restore waterways for people's enjoyment and sense of history.

This indigenous revegetation guide will assist people to actively enhance natural character.

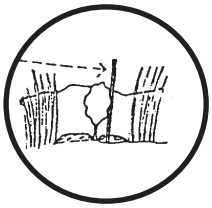
Indigenous revegetation involves:

1. developing a plan and programme for a particular area of land;

2. propagating or ordering plants grown from seed and spores from natural local vegetation;

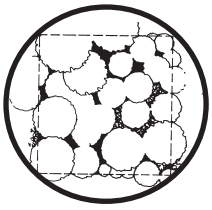
3. preparing the land, excluding domestic stock, and undertaking pest control;

4. planting eco-sourced indigenous stock;



5. maintaining the plantings and excluding exotic plants from the revegetation area;

6. monitoring the relative success of plant establishment and replacing losses;



7. after canopy closure, inter-planting with later successional species;

8. on-going pest control and stock exclusion;

9. permanent protection of the plantings and natural successional processes.

INTENT OF INDIGENOUS REVEGETATION

Bush settlement management area

Bush Settlement development is to be nestled into the landscapes on the margins of the Tarawera settlement. The effect of development on the landscape is to be considered in both visual and ecological terms. Addressing landscape enhancement, the broad interpretation of "landscape" in the Rotorua District Plan for the Lakes A Zone needs to be recognised. For example, landscape includes the natural science values and the legibility[1] values as well as aesthetic values.

Where indigenous vegetation no longer clothes sites at Lakes Tarawera, a revegetation plan is specifically required prior to subdivision in the Bush Settlement Management Area and prior to site coverage of buildings greater than specified as a permitted activity. Revegetation is intended to re-establish the local indigenous plant communities that belong on each type of landform. (Refer Section 5.18, Revegetation of Part Twenty of the District Plan (The Lakes A Zone)).

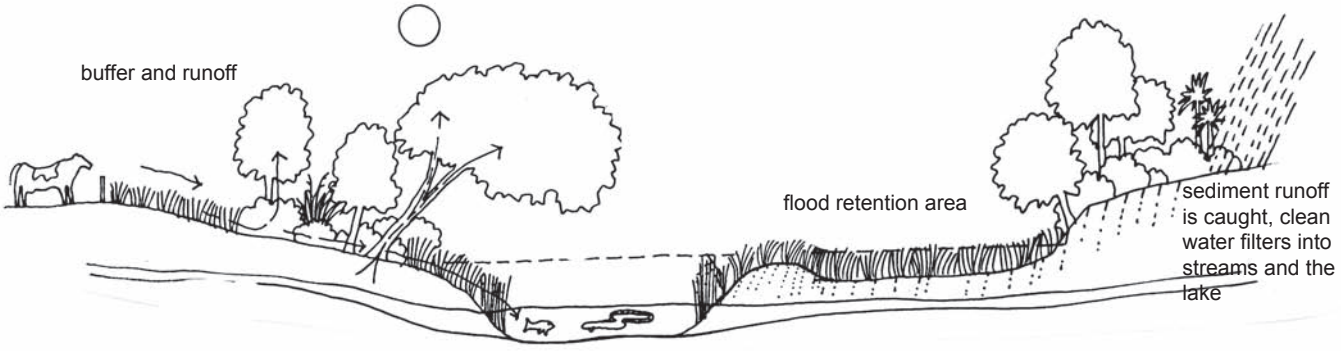
Indigenous revegetation does not involve a mere visual screen to visually mitigate development. It is intended to achieve enhanced natural character by contributing a dominant cover of natural elements, natural patterns, and natural processes to each Bush Settlement site developed. The indigenous vegetation that would naturally occur on a site is to be reinstated. Revegetation up to the 380 metre contour is in accordance with the landscape layering within the Tarawera area.

Buildings within Bush Settlement areas are not required to be fully screened. However, revegetation must be undertaken close to building platforms. To nestle buildings into the vegetation, plantings may need to come to within a few metres around at least half of each building particularly where the land slopes away from a building platform. Only small areas of lawn or hard surfacing are appropriate. Paddocks are not appropriate and indigenous revegetation plantings are required. Revegetation for Bush Settlement development requires at least 85% of the site area (up to the 380 metre contour) to be clothed in dense indigenous vegetation.

Sensitive & less sensitive rural and protection management areas

For the Sensitive and Less Sensitive Rural and Protection Management Areas in the Lakes A Zone there is an overall intent to protect and enhance the natural and landscape character. Means of achieving this are firstly and most importantly through protection of existing indigenous vegetation, secondly through allowing the regeneration and recovery of indigenous vegetation, and, thirdly through active indigenous revegetation. Revegetation as anticipated will be undertaken for specific sites, particularly in association with development, including built development. For any such projects requiring a resource consent, a revegetation plan addressing Information Requirements and Standards

outlined in this Indigenous Revegetation Guide is suggested, along with an outline of the methods that will enable landowners to achieve revegetation relatively quickly.



Subdivision design

A comprehensive subdivision plan is to be prepared for any Bush Settlement subdivision, along with a REVEGETATION PLAN.

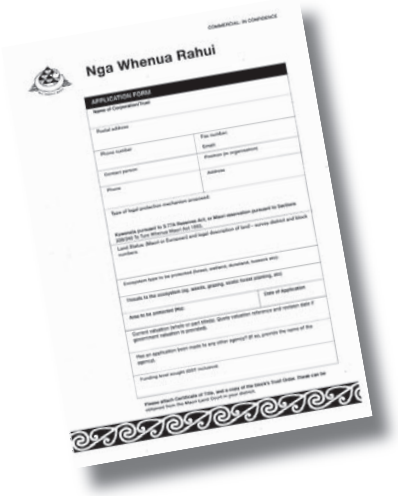
Techniques to be utilised in the subdivision design include:

- re-instatement of natural ecosystems,
- minimising earthworks for building platforms and accessways,
- minimising hard surface areas,
- minimising runoff,
- maximising rainfall percolation into soils,
- excluding domestic stock,
- managing pest plants,
- control of pest animals.

Buildings and site coverage

Consideration of building location, scale, design, and surface finish is required in order to ensure that all buildings are low rise, low key, and nestled into the indigenous vegetation. Particularly with elevated building sites, this will require that indigenous vegetation is retained or established close to, in front of, and alongside any buildings. Indigenous vegetation should be retained and established to disrupt facades and rooflines as viewed from the lake, any public reserve or public road.

Whilst areas of outdoor living, lawn, vegetable garden, fruit trees, and amenity plantings are anticipated for each site, these should not be visible from beyond the site. Enclosure by indigenous vegetation is required, so that the overall visual character is one of buildings merely glimpsed within well established indigenous bush.



Protection mechanisms

The District Plan in Part Twenty (The Lakes A Zone) specifies that areas of indigenous vegetation, either existing or reinstated in a Bush Settlement development, should be recognised with a legal mechanism to ensure that they are retained and maintained. Possible legal mechanisms include covenants, Nga Whenua Rahui kawenata, management agreements, or Protected Private Land status under the Reserves Act 1977.

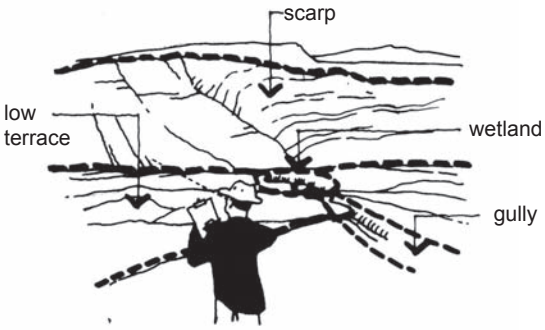
Information requirements
(For bush settlement areas and other sites where relevant)

Fulfilment of the information requirements set out below provides that basis for a REVEGETATION PLAN.

For subdivision:

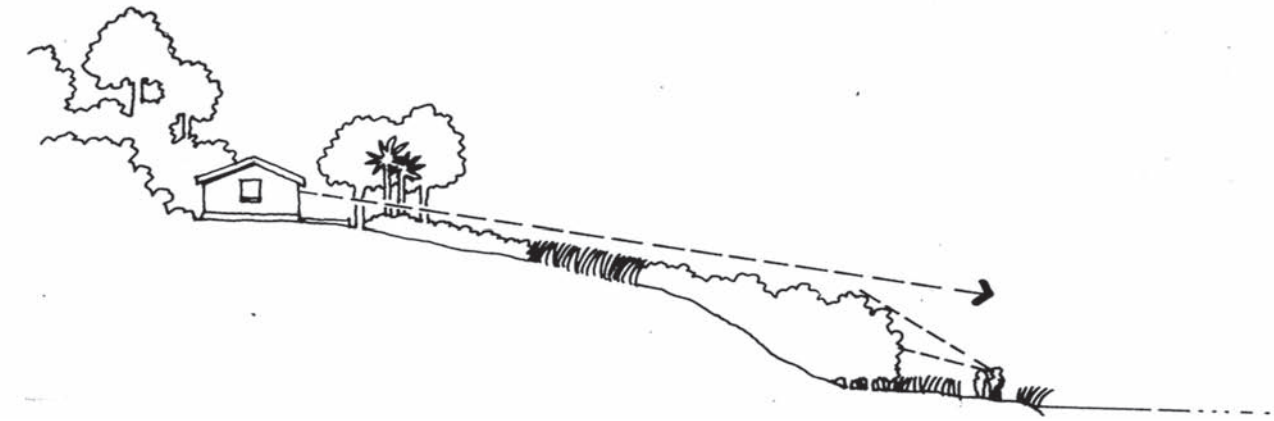
1. The required REVEGETATION PLAN (District Plan Rule B38.4.1.8) shall include plans and descriptions of the proposed subdivision.

For subdivision and site coverage:



2. Provide a map showing the existing site which includes:
   - Existing site features including landforms and watercourses.
   - Existing vegetative cover, both indigenous and exotic.
   - Existing site works including tracks, drains, platforms or buildings.

3. Provide a map showing the proposed subdivision which includes:
   - Site boundaries.
   - Areas of indigenous vegetation to be protected.
   - Areas of indigenous revegetation and the type(s) of vegetation proposed.
   - Proposed accessways, building platforms, and curtilage.



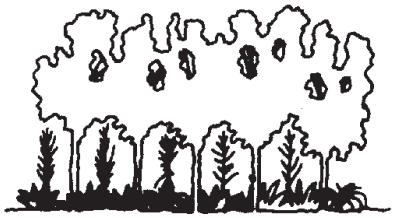
Indicate whether tall forest, low forest, tall shrubland, flaxland, or low shrubland is to be established. Lower-growing species may be appropriate in viewshafts from houses, riparian areas, and any effluent disposal areas.

Planting @ 1m centres. Mulch if accessible and not overly steep.

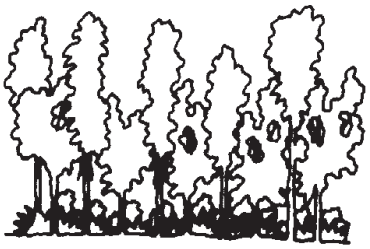
1-2 yrs later still kept well mulched

3-5 yrs later 'canopy closure' or shading ground achieved. Self-maintaining

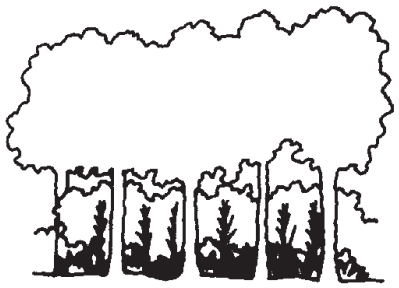
Initial planting beginning to open up. Underplant with canopy species, ferns, ground covers.



Emergent forest species push through initial first stage planting. Self seeding now underway into lush understorey.



Emergent forest species now regenerating on their own into self-maintaining ecosystem.



4. A planting schedule is required. This shall list:
   - The local indigenous species to be used for different areas within the site.
   - The spacings for each species.
   - The size of the plants to be used and the anticipated rate of maturity.
   - Enclose a completed plant order form.

5. A planting programme. This shall include:
   - Site preparation techniques.
   - The timing or staging of planting.
   - Techniques for maintaining the plantings and excluding exotic plants from the revegetation area.
   - Details of any intended inter-planting with later successional species after canopy closure.

6. A post-planting maintenance regime. This shall include:
   - A pest plant and pest animal management programme.
   - Details for permanent physical protection of the plantings and natural successional processes.
   - The legal mechanism(s) to be used to ensure that the existing or planted indigenous vegetation is formally protected.

For site coverage only:

7. Additional plantings are to be programmed to be undertaken once construction is completed, for vegetation close to any buildings, structures, curtilages and access ways, as well as inter-planting of later successional species into previously planted areas.

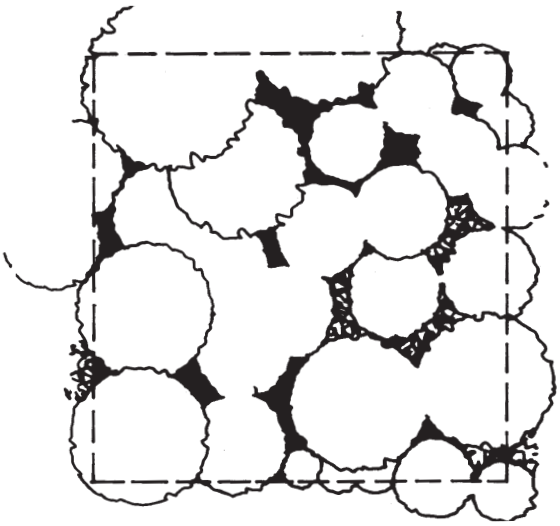
STANDARDS

1. The Revegetation Plan should enable a minimum of 85% of the Bush Settlement Management Area (below the 380m contour) to be clothed in indigenous vegetation. This 85% target is to be met for each individual site (below the 380m contour) proposed as part of a subdivision. Where site coverage is proposed above the permitted level, at least 85% of the site (below the 380m contour) shall be vegetated prior to the construction of a building[1].

2. 80% of the indigenous plants used in the Revegetation Plan shall be capable of a mature height of no less than 5 metres.

3. Any steep slope, gullies, watercourses, riparian and damp areas are to be revegetated. If there are on-site effluent treatment systems, these are to be revegetated with dense, low indigenous cover, such as flax and shrubs.

4. The plants shall only include indigenous species that occur naturally within the Lakes A Zone.



5. An independent revegetation audit is to be carried out by a suitably qualified person to certify that the indigenous planting required by the REVEGETATION PLAN has met one of the following standards:

   (i) canopy closure of 90% .

   (ii) 90 percent of the plantings are taller than 1.5 m with a maximum spacing (between stems) no greater than 2.1 m.

   Both of the above shall be subject to the general absence of problematical environmental weeds and an agreed weed monitoring and control plan until canopy closure is achieved. Examples of problematical weeds in the Tarawera Lakes area include Japanese honeysuckle (*Lonicera japonica*), old man's beard (*Clematis vitalba*), wilding conifers, climbing spindleberry (*Celastrus orbiculatus*), willow-leaved hakea (*Hakea salicifolia*), strawberry dogwood (*Dendrobenthamia capitata*), flowering cherry (*Prunus* sp.), wattles, and ginger. Lower stature plantings would need to be free of gorse (*Ulex europaeus*), blackberry (*Rubus fruticosus agg*.), broom (*Cytisus scoparius*), and other potentially damaging species.

Note:

[1] This standard is required to be met prior to either the construction of a building or the issue of a Certificate pursuant to Section 224(c) of the RMA. With good site preparation, planting and maintenance for some three years, canopy closure should be achieved within 2 to 5 years, with little requirement for ongoing maintenance.

METHODS

Careful planning is required to undertake a revegetation project. The methods below apply within and beyond the Bush Settlements and elsewhere within the Lakes A Zone. Weed threats need to be assessed, the variability of the site assessed, and the potential ecosystems and their species composition identified. Once there is an understanding of what is to be re-established, then plan for how it will be done.

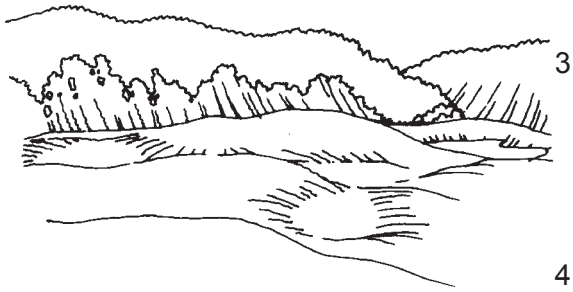
Plan the sequence of events, including plant ordering, site preparation, planting, maintenance, and monitoring. Identify the costs for each stage. An on-going commitment to the project of at least 3-5 years should be expected, and it may take longer on difficult sites.

The use of professional expertise to plan and implement the project, including maintenance and monitoring, is highly recommended to achieve efficient and effective indigenous revegetation.

Method 1. SITE DIVERSITY AND SELECTION OF SPECIES

1. Whilst comprising only a small part of the Lakes A Zone, the Bush Settlement areas include a diversity of landforms. Landform diversity means potential vegetation diversity. The Bush Settlement areas are mapped as belonging on low terraces at Tarawera. The higher areas include steeper slopes and ridges, with some gullying, and below the flatter slopes, mostly well drained but including some wetter areas.

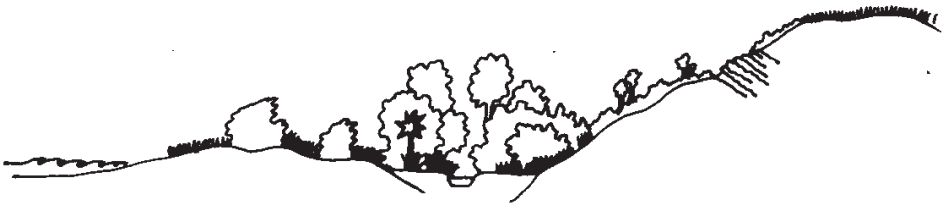
2. Steeper, exposed areas, which may have thin soils, generally have slower vegetation establishment, particularly through dry seasons. Plantings on the lower and flatter more damp and open sites are the most vulnerable to frost damage, particularly during the establishment phase.



3. Identify the diversity of indigenous vegetation that remains or is known from the site. Identify and map remaining indigenous vegetation on an aerial photograph. Include the locations and descriptions of more substantial and/or significant vegetation, as well as the locations of environmental weed infestations.

4. Identify and map the different conditions and thus the potential vegetation zones, from varying landform, aspect, soils and moisture. Consider distance from streams, how dry or wet an area is, and how water channels and flows throughout the year. Consider the varying levels of exposure to frost and to wind.

5. There is opportunity to re-establish some resemblance of the functional ecosystems that belong on particular landforms, to enhance the natural character through revegetation of previously cleared areas. Different planting mixes should be utilised to recognise particular landforms and site conditions.



6. Subdivision design and revegetation is to complement natural opportunities and natural patterns, and to expand, link, and buffer existing natural habitats.

7. In some areas it may be necessary to first restore landforms or water levels if an area has been flattened or drained, or a waterway has been straightened. Consider the potential to re-construct something of the original landform and substrate wetness. Re-creating gentle slopes, any curved alignment and marshy areas, provides opportunities for a richer diversity of indigenous species. There may be an opportunity to fill in drains, re-open springs, and remove other barriers to re-create naturally wetter areas.

Method 2. WEED AND ANIMAL PEST CONTROL

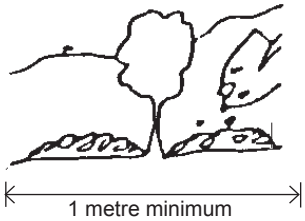
1. Plan to deal with existing and potential weeds. There is little point in planting adjacent to invasive plants that are seeding or spreading. Some seed will come in by wind, some with birds, others with water, vehicles, and people. Whilst some weeds (e.g. gorse and blackberry) will have tolerated grazing, others will thrive when grazing is removed. To plan effectively, first assess the risks.

2. A weed and pest control plan needs to be prepared as part of a revegetation plan. Weeds may affect the scale and timing of the project, or have a major bearing on the choice of species.

3. Identify weed infestations on site or in nearby areas. Identify potential major weed threats, such as old man's beard and blackberry. Undertake a weed control programme to target the threats on site and, where possible, also in adjacent areas.

4. Plan so that once weed control has been undertaken, dense plantings of vigorous indigenous species can be established to rapidly develop a closed canopy and associated shading. Most weeds (e.g. gorse, blackberry, wattle) and grasses need plenty of light to get established so the most effective management approach is to provide shade. Prevention of weeds will be assisted by the rapid establishment of a dense cover of tree and shrub species. Dense planting with fast-growing species enables the ground to be shaded completely within a few years, after which maintenance requirements will be minimal.

5. Not all weed species dislike shade. Careful removal of shade-tolerant weeds from the site and local environs is necessary to avoid or minimise future problems (e.g. holly, ivy, tradescantia).



6. Mulching is a potentially useful (but costly) method of weed control until indigenous plants are well-established and canopy closure has been achieved. Mulch is particularly useful if herbicides are not utilised, although loose mulch (e.g. bark) is not practical on steep land or riparian areas, and may not be practical for extensive areas of indigenous revegetation.

7. Following site preparation involving effective weed control, the selection of fast-growing species to plant might include:

Kanuka	*Kunzea ericoides* var. *ericoides*
Manuka	*Leptospermum scoparium*
Tarata	*Pittosporum eugenoides*
Kohuhu	*Pittosporum tenuifolium* (not cultivars)
Rautawhiri	*Pittosporum colensoi*
Harakeke, flax	*Phormium tenax*
Toetoe	*Cortaderia fulvida*
Karamu	*Coprosma robusta*
Koromiko	*Hebe stricta*

8. Identify the threats posed by pest animals. Rabbits and hares can be particularly destructive, and wallabies are also present within the Lakes A Zone.

9. If the project is not being managed by a restoration professional, then start small to make sure you have the materials and the skills to establish and to manage the planted area. A small successful restoration area is much more effective and positive than large areas over-run with weeds. For planting, begin with a trial area to test different species and planting techniques and to assess management requirements.

Method 3. SPECIES SELECTION

1. Use local species and local seed sources to ensure the protection of natural areas against invasion by species or strains that are not part of the unique local indigenous character. Local species are those that grow or grew naturally in the site or locality within the Rotorua Lakes Ecological District. Some species hybridise readily and express wide natural genetic variation and can be sourced more locally from the Tarawera area. A list of potentially suitable local species is appended.

2. Plan for hardy colonising or pioneer species to be planted densely in open or exposed areas to comprise the bulk of a revegetation area (see list below). Dry-tolerant species should be used if a site is well-drained. Less drought-tolerant species will do well on deeper soils, especially if the landform concentrates available water in hollows or gullies.

SHORT LIST of Plants Recommended for the Revegetation of Pasture

Scientific name	**Common name**	**Tolerances** ■ tolerates or requires. ☐ intolerant of. ✕ not suitable.					
		sun	**shade**	**moist**	**dry**	**wet**	**frost**
TREES & TALL SHRUBS							
Aristotelia serrata	Makomako, wineberry	☐	■	■	✕	✕	☐
Cordyline australis	Ti Kouka, cabbage tree	■	☐	■	☐	■	■
Coprosma lucida	Shining Karamu	■	☐	■	■	✕	☐
Coprosma robusta	Karamu	■	✕	■	■	■	■
Coriaria arborea	Tutu	■	☐	■	☐	✕	
Dacrydium cupressinum	Rimu	■	■	■	✕	✕	■
Dacrycarpus dacrydioides	Kahikatea	■	■	■	✕	■	■
Fuchsia excorticata	Fuchsia	■	■	■	☐	✕	
Knightia excelsa	Rewarewa	■	☐	■	☐	✕	☐
Kunzea ericoides	Kanuka	■	☐	■	■	✕	■
Leptospermum scoparium	Manuka	■	☐	■	■	■	■
Lophomyrtus bullata	Ramarama	■	☐	■	✕	✕	
Lophomyrtus obcordata	Rohutu	■	☐	■	☐	✕	
Melicytus ramiflorus	Mahoe	■	■	■	☐	✕	
Metrosideros excelsa	Pohutukawa	■	✕	■	■	✕	☐
Metrosideros robusta	Northern Rata	■	■	■	■	✕	
Myrsine australis	Mapou	■	☐	■	■	✕	■

Scientific name	Common name	Tolerances ■ tolerates or requires. ☐ intolerant of. ✕ not suitable.					
		sun	shade	moist	dry	wet	frost
Pittosporum colensoi	Kohuhu	■	☐	■	■	✕	■
Pennantia corymbosa	Kaikomako	■	☐	■	✕	✕	■
Pittosporum eugenoides	Tarata, lemonwood	■	☐	■	☐	✕	
Pittosporum tenuifolium	Kohuhu, Rautawhiri	■	☐	■	☐	☐	■
Podocarpus totara	Totara	■	■	■	■	✕	■
Prumnopitys ferruginea	Miro	■	■	■	☐	✕	■
Prumnopitys taxifolia	Matai	■	■	■	☐	✕	■
Pseudopanax arboreus	Whauwhaupaku, fivefinger	■	☐	■	✕	✕	
Pseudopanax crassifolius	Horoeka, lancewood	■	☐	■	☐	✕	
Schefflera digitata	Pate	■	■	■	☐	✕	
Sophora microphylla	Kowhai	■	✕	■	☐	✕	
SHRUBS (less than 5 m)							
Coprosma propinqua	Mingimingi	■	✕	■	☐	■	■
Coprosma rhamnoides		■	■	■	■	✕	
Coprosma rotundifolia		☐	■	■	✕	☐	
Hebe stricta var. stricta	Korimiko	■	☐	■	■	✕	■
Solanum aviculare	Poroporo	■	☐	■	✕	✕	
Solanum laciniatum	Poroporo	■	☐	■	✕	✕	
GRASSES & FLAX							
Cortaderia fulvida	Toetoe	■	✕	■	■	■	■
Cortaderia toetoe	Toetoe	■	✕	■	■	■	■
Phormium cookianum	Whararíki, mountain flax	■	☐	■	■	✕	■
Phormium tenax	Harakeke, flax	■	✕	■	☐	■	■

3. A more extensive plant list is provided with a diverse range of trees, shrubs, grasses, ferns, and climbers that occur naturally in the Lakes A Zone. It may be impractical to use all species identified due to propagation, establishment and cost limitations. (Appendix 1)

4. Identify canopy species which would occur naturally on particular sites. Plan for strategic inclusion of long-term canopy species, to be spaced through revegetation plantings. Include canopy species in different stages of plantings depending on the conditions and vulnerability to exposure of particular species.

5. Place sensitive species in sheltered sites or microhabitats or only plant them once the species planted initially have developed sufficiently to provide shelter from sun, wind, and frost. Where there is existing cover, later successional species can be inter-planted at the same time as the initial plantings (e.g. under bracken, gorse).

6. Plants providing bird food should also be included, such as nectar and berry bearers (e.g. fivefinger, *Coprosma* species) for kereru, tui, korimako, and kaka.

7. Consideration should be given to using low flammability species, such as mahoe and karamu, especially adjacent to buildings.

Method 4. PLANT DENSITY

1. Have a close look at natural sites on similar slopes or habitats in the area. Let the natural mixes and plant spacings on these sites provide a guide for your project.

2. When aiming for naturalness, the species mixes and sites chosen for initial plantings of trees and shrubs is less important than the siting of long-term canopy trees (e.g. rimu, totara, kahikatea, and tawa) that will form the character of the forest for many generations to come. The challenge is to make it so natural that in 10, 20, 50, or 100 years no one will realise it was planted!

3. Sometimes it is beneficial to establish a very dense cover of nurse plants (e.g. manuka) to achieve rapid cover that excludes weeds.

4. Emergent tree species need to be located sparingly to achieve a natural effect and allow them plenty of room to mature. Whilst some indigenous tree species grow densely and then "fight it out" over time, trees well-spaced amongst other cover will grow faster.

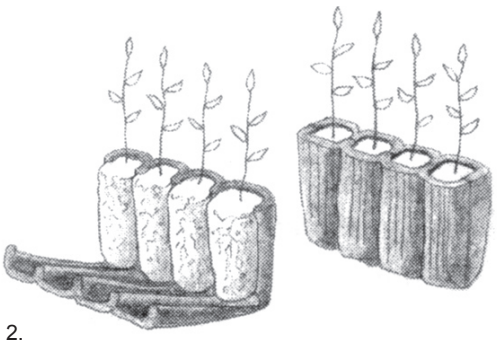
5. For revegetation plantings, allow about:
   - 1 plant every 1.2 metres (1.44 square metres) for shrubs, toetoe and flax; smaller plants (sedges, rushes, ferns) at 0.5-0.7 metre spacings (4 per square metre);
   - small-growing trees (e.g. kanuka, tree ferns) at 1 to 3 metre spacings; and,
   - large-growing trees (e.g. pohutukawa, totara) at some 5 to 10 metre spacings, with shrubs in between at the above spacings.

6. The end result should involve at least one plant every 1.2 metres, that is, 6,950 plants per hectare. Thus for a Bush Settlement site of 8,000m^2, 85% cover would involve planting some 5,900 plants – more may be required if the land is sloping.

7. With an intended plant spacing of 1.2 metres it should be noted that not all species will be planted at the outset. Allow for the later successional species to be inter-planted if necessary, although many later successional species can be planted at the outset.

8. Saturation planting is more costly initially, but it will achieve more rapid control over grass and weed competition. Dense planting of small stock will minimise costs and makes provision for losses from natural mortality. Where grass control is undertaken less frequently, lower density planting of larger grade plants may be appropriate in moist sites or deep soils.

Method 5. PLANT SOURCING



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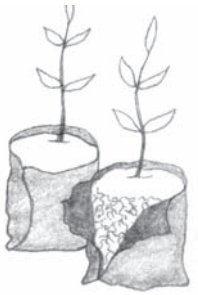


1. Order plant stocks and determine the costs and timetables for supply. A planting project may have to be deferred, staged, or changed to meet practical constraints in terms of the availability of suitable quantities of eco-sourced plants (i.e. propagated from indigenous plants present naturally in the area).

2. Natural hybrids and varieties found and sourced within the area should be propagated for revegetation plantings and used only sparingly. Non-local hybrids and varieties should not be used.

3. Plants grown from seed harvested locally are preferable to cuttings, as they produce plants with greater genetic diversity.

4. Order plants at least one year in advance, from a nursery experienced in production of hardy, eco-sourced stock for revegetation. Smaller grade, root-trainer stock are appropriate and can be contract grown in large quantities at reasonable cost.

5. Plants grown in “Rootrainers” (ideally plants 30 cms tall) provide the best value for money and are most likely to succeed when there is effective control of plant and animal pests . However, only a limited range of species can be grown sucessfully in “Rootrainers”, including Kanuka, Manuka, Koromiko, Karamu, Harakeke (flax), Toetoe, Ti Kouka and Tutu.

6. Order later successional plants at least 2 years in advance, to inter-plant once canopy closure has been achieved.

7. Use plants large enough to cope with potential competition, although site preparation and maintenance are key requirements for successful revegetation. Container-grown plants 50-100 cms tall may be useful if weed competition and pests are a concern and on particularly difficult sites. Use larger plants for the canopy tree species.

8. Take care to ensure good plant quality, particularly plants that have well-developed root systems, are not root-bound, and are hardened off to suit the conditions. Do not accept poor quality stock.

[2] Davis and Meurk

Method 6. SITE PREPARATION

1. Fence out and exclude stock from the entire revegetation area. For the Bush Settlement areas, this involves exclusion of stock from the entire site. Fencing advice can be sought from Environment BOP, restoration advisers, and fencing contractors.

2. There are a number of important tasks to do before planting is undertaken. If done properly, it will make planting easier and increase the likelihood of a very successful project. Good site preparation should ensure that there is minimal weed competition for light, soil moisture, and nutrients and digging of planting holes will be easier. It is pointless to completely clear a site if you are not able to manage the mass of new weeds that will quickly emerge.

3. On exposed sites, it may be wise to leave some protective shrubby cover to shelter new plantings. Utilise existing vegetation cover, such as bracken, as initial shelter for plantings. However, dense plantings at about 1 per 1.2 metres with a weed-free surround leaves little space between for shelter plants.

4. It is necessary to remove grass competition before planting. Particularly in dry sites, control of existing vegetation at planting sites is important to assist new plants, as the existing vegetation will remove all available moisture. With plantings averaging 1.2 metre spacings, usually this means grass control may be needed over the entire planting area.

5. Blanket spraying is efficient for most dense revegetation plantings in existing pasture. However, spot spraying, screefing 0.4 metre diameter planting “spots”, and/or laying dense mulch (that won’t wash or blow away) are also standard preparation techniques. If screefed spots are not planted promptly (within a week, preferably sooner), they can be mulched and perhaps spot sprayed at planting time. (Screefing is the removal of turf and roots to assist planting, and allow plants respite from weed competition.)

6. Remove all pest animal and weeds and, if possible, also manage adjacent potential weed sources. In particular, control rabbits prior to and following planting operations.

Method 7. PLANTING & LAYOUT

1. Temporarily store plants in a sheltered, partly shaded site, and avoid direct sunlight – use shade cloth if necessary. Water stored plants thoroughly on a daily basis, not just superficially.

2. Shelter plants from the wind and keep moist when transporting plants in an open vehicle.

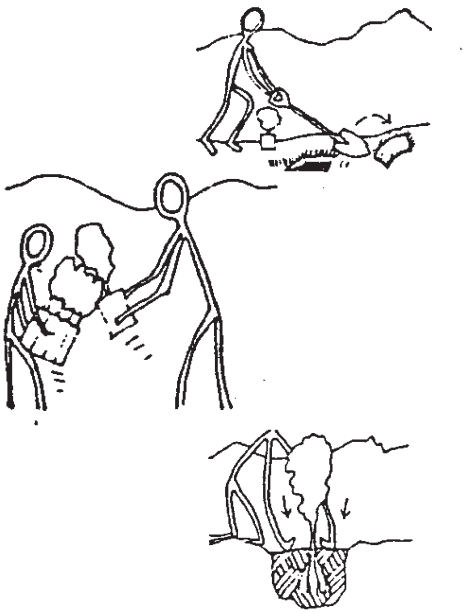
3. Based on the table above, and by observing natural vegetation, species should be grouped and mixed informally. Groups of

plants provide better protection and mimic natural patterns. Plant groups of fruit-bearing plants to attract fruit-eating birds which will assist future seed dispersal.

4. Densely position and mix appropriate species across an open site, planting them at about 1.2 metre spacings. Plant smaller-growing species near the edges.

5. Use mass plantings to create shelter and a natural setting for carefully sited canopy trees (which may be planted later).

6. Care needs to be taken NOT to plant too many of the main or canopy tree species. Well-planted, well-sited trees usually establish well so there is not normally any need to plant extras in anticipation of significant losses.



7. Overall, the most appropriate planting time is in winter through to late July or early August. Plant stream margin plants in summer when water levels are lower; hardy plants in the autumn; and, frost-tender plants in the spring.

8. Soak plants before planting, but leave to drain and keep out of direct sunlight.

9. Skim grass off the soil surface using a spade or grubber (called screefing). Don't damage other plant roots or remove too much topsoil. Turn over the cleared patch, or use the removed material as mulch. Dig a hole twice the size of the plant container, score the sides and loosen soil in the bottom of the hole. Fertilise with a slow-release product.

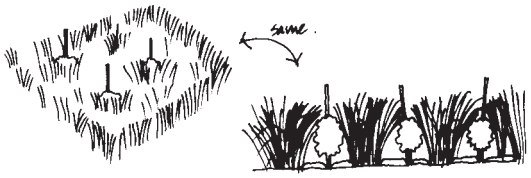
10. Carefully remove plants from containers, retaining as much soil around the roots as possible. Untangle or prune roots if necessary. Avoid root-bound plants. If they have to be used, as a last resort, severely root prune them with a sharp spade or knife.

11. Place plant in hole so its collar is 1-2 cms below the adjacent soil surface. Gradually add soil around the roots, firming each layer. After planting, the soil should be well compacted, and there should be a slight depression to catch any rain or water run-off.

12. On drier, free-draining sites planting holes should be dug deeper, with the collar up to 5 cms below the adjacent soil surface so that there is a hollow left in the ground for water to accumulate in during rainfall.

13. In heavy soils and wet sites dig a shallower hole. The top of the root mass and soil should be level with the adjacent ground surface.

14. In saturated areas, the hole should be shallower, and the collar placed 2 cms above the adjacent soil surface so that the soil level is slightly mounded.



even though planting spots have been cleared/sprayed, rampant pasture grass growth can overtop new small plants. Essential to stake so can easily hand-release later.

15. Mark smaller plants with a stake to help locate them for later maintenance, especially if grass growth is likely to be vigorous. Do not tie plants to the stakes.

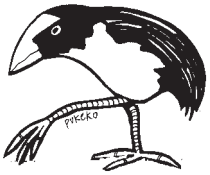
16. A high level of supervision is essential to ensure successful planting.

Method 8. MAINTENANCE & MONITORING

1. The task is not complete just because the planting has been done! Planting is the easy part. Maintenance is essential to allow plants to survive and flourish. Keeping them clear of grass and weeds for at least three years is crucial. This allows the plants to grow and form a canopy, and weeds are less likely to invade. Many of the potential weed species are light-demanding and will not invade into the shade of a canopy.

2. Pukeko can have a destructive effect on new plantings. Following planting, for a period of two months, regularly check and re-plant any of the plants that have been pulled out.

3. Plant losses will inevitably occur. If plant mortality is significant, identify and eliminate possible causes and replace dead plants to maintain planting densities, preferably in the same season. Record the reasons for plant death.



4. Committed carers are required to maintain the plants until they are well established. Funds should be retained for maintenance purposes, as unexpected problems will inevitably arise e.g. plant losses from unseasonal weather, accidental or unintended browsing by stock or pest damage. Inspect sites regularly, to identify maintenance requirements.

5. Mulch where practical to retain the moisture and suppress weeds. Steep slopes, or where the water table rises frequently, are not suitable for loose mulch. Mulching is a useful method of reducing weed competition and the need to use herbicides.

6. Check plants regularly. Weed around them to avoid stress and competition. If herbicides are not used, this may be necessary every month in the growing season.

7. Use grubbers, slashers, sickles, and weedeaters with extreme care. Perhaps remove grasses and weeds from the base of the plant with a sharp grubber. Cutting grass and weeds with a scrub cutter is not very effective as it encourages renewed weed growth. Poorly managed weed control is a major cause of plant death. Planted trees are easily ring-barked by weedeaters or trimmers, and grubbing can damage sensitive roots.

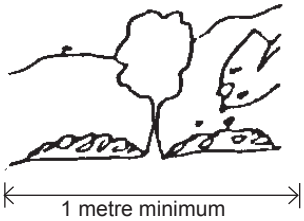
a. rank pasture grass growth.

b. sprayed twice & then planted.

c. mulch straight after planting.

d. mulch will suppress most weeds but not all.

e. 'canopy' closure will prevent light source - the best weed control



1 metre minimum spacing for trees and shrubs. Plant sedges and rushes closer.

8. Take care if using chemicals to kill weeds. Spot spray carefully with a non-residual biodegradable herbicide, if needed. Some species are very sensitive to herbicides, either applied directly or from spray drift (e.g. kowhai and ferns), and this must be avoided.

9. Apply slow release fertiliser on poor soils in the second year if plants are showing signs of nutrient deficiencies.

10. Establish the more tender later successional species once a canopy has developed. Understorey plants that require shade, such as ferns, can then be introduced as well (refer to chart above for suitable species).

11. Mark smaller plants and slow-growing or valuable species with stakes. For slower-growing species, weeding may be needed for up to 3 years and stakes help to find plants in tall grass.

12. Inter-plant later successional (longer term) and more tender species once shelter has been established using hardier species, or existing vegetation. Colonisers improve the soil and build up biomass. For forest ecosystems, plant the long-term canopy species under the first low canopy, for example tawa, mangeao, and pukatea. Also, plant species in the understorey that need the shade of the canopy, such as ferns. Order later successional species at least 2 years in advance. It is important to remember to budget for later successional species

13. To improve restoration techniques, it is important to record information about project performance. Reasons for losses include: poorly conditioned plants, poor planting techniques, using the wrong plant species for a site, grazing/browsing by domestic stock or pest animals, lack of maintenance, ring barking by weedeaters, spray drift, hare damage, and vandalism or theft. There are also natural causes such as unseasonal drought/frosts, insect epidemics (caterpillars), and disease (root rot).

14. Undertake weeding promptly, or the task may become unmanageable. Prepare a weed management strategy, so that weed control is done logically and efficiently.

15. Weed control will nearly always be needed, as weeds compete for light, space, moisture and nutrients. There is also a legislative requirement to control or eradicate weeds identified in the Regional Pest Management Strategy (produced by Environment BOP).

Method 9. EXOTIC NURSE PLANTS

1. Existing exotic vegetation should generally be removed from revegetation sites. Effective site preparation should remove or exclude pasture species, blackberry, and gorse (if the latter is not being used as nurse cover).

2. Eighty-five percent of each Bush Settlement site is required to be protected or planted in indigenous cover, the remaining 15% is to contain access ways, buildings, paving, and gardens. Exotic vegetation may also be retained or established within this residual area (15%) providing it does not have potential to spread either by seed or vegetative means into natural and planted areas of indigenous vegetation. Exotic plantings should not be of a type, stature, location or planting layout that would enable them to be particularly visible from either a lake or a public reserve.

3. A nurse role can be achieved using non-invasive exotic species. Indigenous forest often develops from gorse and broom through natural succession, though natural regeneration will be much slower on dry sites distant from potential indigenous seed sources. The shrub weeds form a dense canopy that suppresses grasses and weeds, favouring succession to indigenous shrubland and forest.

4. Gorse can provide a sheltering micro-climate, good soil litter and nitrogen, and can be a useful nurse plant for the re-establishment of taller indigenous forest. Although the seed has a long viability in the soil, it is a light-demanding plant and new, dense, indigenous shrub and tree cover will prevent the establishment of a new gorse crop. Therefore, if possible, plant in amongst gorse, perhaps in lines to provide access.

5. Property boundaries must be cleared of gorse and broom for a width of at least 10m, to meet statutory requirements in Environment BOP's Regional Pest Management Strategy.

6. Bush Settlement policies allow for the use of nurse plantings. (Refer Section 5:18 of Part Twenty of the District Plan (The Lakes A Zone)): "*To assist in the establishment of such indigenous vegetation, nurse plantings of non-invasive exotic species may be utilised, providing their removal would not adversely affect visual amenity, ecological, or soil and water values. A commercial plantation is not intended.*"

7. Nevertheless, planting of exotic nurse crops is not recommended for Bush Settlement revegetation. Care is needed to avoid the use of nurse crops that could invade natural areas and become a problem. If exotic nurse plantings are to be established, they should only augment indigenous species. For example, limited areas or low densities of tagasaste (tree lucerne, *Chamaecytisus palmensis*) might be included as fast, temporary cover on dry sites.

As well as sheltering indigenous plants during establishment, tagasaste is seasonally useful for bird food, particularly for kereru, the native pigeon. Kereru are a major seed disperser for indigenous species, and attracting them to a site can increase seed dispersal of indigenous species in droppings. However, tagasaste also spreads naturally in the Rotorua District, is persistent, and could establish and become a potential problem on open dry sites, such as cliffs and banks that are not grazed. Use of local indigenous species is therefore the preferred method of revegetation.

8. Even if good nurse plant cover is established, indigenous revegetation will not be recognised as being established until the indigenous species are dominant and have achieved adequate coverage and stature.

REFERENCES

Beadel, S.M; Shaw, W.B.; Nicholls, J.L. 1998. **Rotorua Lakes Ecological District - Natural Areas Survey**. *Wildland Consultants Ltd Contract Report No. 175*. Report prepared for Rotorua District Council and Environment BOP.

Beadel, S.M.; Shaw, W.B. 2003. **Indigenous Planting in the Lakes A Zone, Rotorua District**. Wildland Consultants Ltd. Draft report prepared for Rotorua District Council.

Davis, M.; Meurk, C. **Protecting and restoring our natural heritage – a practical guide**. Department of Conservation. Christchurch.

Ecroyd, C.E.; Clarkson, B.D.; Wilcox, M.D. 1990**. An annotated list of vascular plants in the Rotorua Lakes Ecological District**. *Rotorua Botanical society Special Issue No.1*.

Lucas Associates. 1998. **A Framework for Monitoring Ecological Integrity in the Bay of Plenty Region**. Report prepared for Environment BOP.

Lucas Associates, 2002. "LAKES A ZONE **DESIGN GUIDE for BUILDINGS**", for Rotorua District Council.

Metcalf, L.J. 1972. revised 2000. **New Zealand Trees & Shrubs. A comprehensive Guide to Cultivation and Identification.** Reed, Auckland.

Poole, A.L; Adams, Nancy M. 1994. **Trees and Shrubs of New Zealand**. Manaaki Whenua Press, Lincoln.

Porteous, Tim. 1993. **Native Forest Restoration**. QE II National Trust, Wellington.

Salmon, J.T. 1980. **The Native Trees of New Zealand**. A.H & A.W Reed, Wellington.

Shaw, W.B.; Beadel, S.M. 1998. **Natural Heritage of the Rotorua District**. *Wildland Consultants Ltd Contract Report No. 176*. Report prepared for Rotorua District Council.

Wilson, Hugh; Galloway, Tim. 1993. **Small-leaved Shrubs of New Zealand**. Manuka Press, Christchurch.

www.bush.org.nz, New Zealand Ecological Restoration Network.

End notes

1. Legibility refers to the expressiveness of the landscape, how easy it is to understand in terms of past events - both natural and cultural. The landscape can thus provide a geography lesson and "tell stories". Past geological processes that formed the landscape can be clearly evident, such as the natural processes of volcanic activity, streams cutting down through ash layers, steep slopes slumping, and, the response of vegetation and wildlife to these geological processes. Cultural legibility recognises that the landscape can exhibit a record of social change, such as former land use patterns, key sites and historic events, and, tangata whenua relationships.

2. Davis, M. and Meurk, C. 2001. *Protecting and restoring our natural heritage, a practical guide*. Department of Conservation, Christchurch.

LOCAL SPECIES POTENTIALLY SUITABLE FOR REVEGETATION PLANTING

Large Trees

Alectryon excelsus var. excelsus	Titoki
Beilschmiedia tawa	Tawa
Corynocarpus laevigatus	Karaka
Dacrycarpus dacrydioides	Kahikatea
Dacrydium cupressinum	Rimu
Elaeocarpus dentatus	Hinau
Hedycarya arborea	Porokaiwhiri, pigeonwood
Knightia excelsa	Rewarewa
Laurelia novae-zelandiae	Pukatea
Litsea calicaris	Mangeao
Metrosideros excelsa	Pohutukawa
Metrosideros robusta	Northern rata
Phyllocladus trichomanoides var. trichomanoides	Tanekaha
Podocarpus hallii	Hall's Totara
Podocarpus totara	Totara
Prumnopitys ferruginea	Miro
Prumnopitys taxifolia	Matai
Weinmannia racemosa var. racemosa	Kamahi

Small Trees and Large Shrubs

Aristotelia serrata	Makomako, Wineberry
Carmichaelia australis	Makaka, Maukoro
Carpodetus serratus	Putaputaweta
Coprosma grandifolia	Kanono
Coprosma lucida	Karamu
Coprosma propinqua	Mingimingi
Coprosma rhamnoides	
Coprosma robusta	Karamu
Coprosma rotundifolia	
Coprosma tenuicaulis	Hukihuki
Cordyline australis	Ti Kouka
Cordyline banksii	Ti Ngahere, forest cabbage tree
Coriaria arborea var. arborea	Tutu
Dodonaea viscosa	Akeake
Fuchsia excorticata	Kotukutuku
Griselinia lucida	Puka
Hebe stricta var. *stricta*	Koromiko
Helichrysum lanceolatum	Niniao
Kunzea ericoides var. ericoides	Kanuka
Leptospermum scoparium	Manuka
Leucopogon fasciculatus	Mingimingi
Lophomyrtus bullata	Ramarama
Lophomyrtus obcordata	Rohutu
Macropiper excelsum var. excelsum	Kawakawa
Melicytus lanceolatus	Mahoe-wao
Melicytus ramiflorus subsp. ramiflorus	Mahoe
Mida salicifolia	Mida
Myrsine australis	Mapou
Myrsine salicina	Toro
Nestegis cunninghamii	Black Maire
Nestegis lanceolata	White Maire
Olearia furfuracea	Akepiro

Olearia rani	Heketara
Pennantia corymbosa	Kaikomako
Pittosporum colensoi	Rautawhiri
Pittosporum eugenoides	Lemonwood
Pittosporum tenuifolium	Kohuhu
Pseudopanax arboreus var. arboreus	Whauwhaupaku, five-finger
Pseudopanax crassifolius	Horoeka, lancewood
Quintinia serrata (incl. *Q.acutifolia* & *Q.elliptica*)	Tawheowheo
Raukaua edgerleyi	Raukawa
Schefflera digitata	Pate
Solanum aviculare	Poroporo
S.laciniatum	Poroporo
Sophora microphylla	Kowhai
Streblus heterophyllus	Turepo
Syzygium maire	Maire Tawake
Toronia toru	Toru

Shrubs

Brachyglottis repanda s.s.	Rangiora
Gaultheria antipoda	Tawiniwini
Gaultheria oppositifolia	Kama
Gaultheria paniculata	Koropuka
Pimelea prostrata s.s	Pinatoro
Pimelea tomentosa	

Tree ferns

Cyathea dealbata	Ponga, silver fern
Cyathea medullaris	Mamaku
Dicksonia fibrosa	Wheki-ponga
Dicksonia squarrosa	Wheki

Climbers, Scramblers

Clematis cunninghamii	Ngakau-kiore
Clematis forsteri	Poananga
Clematis paniculata	Puawananga
Metrosideros diffusa	White climbing Rata, Akatea
Metrosideros fulgens	Autumn/winter flowering Rata, Akatea
Metrosideros perforata	climbing Rata, Akatea
Parsonsia capsularis	Akakiore, NZ jasmine
Parsonsia heterophylla	Akakaikiore, NZ jasmine
Passiflora tetrandra	Kohia

Ground Ferns

Asplenium bulbiferum	Mouku, hen and chicken fern
Blechnum novae-zelandiae (swamp form)	Swamp Kiokio
Blechnum novae-zelandiae (lowland form)	Kiokio
Marattia salicina	Para, kingfern

Sedges, Rushes, Grasses, Flaxes and Other Monocots

Astelia solandri	Kowharawhara
Astelia trinervia	Mauri
Baumea articulata	jointed twig rush
B.rubiginosa	jointed twig rush
B.tenax	jointed twig rush
B.teretifolia	jointed twig rush
Carex geminata	Purei, sedge
C. maorica	Purei, sedge

Carex secta	Purei, sedge
C. virgata	Purei, sedge
Cortaderia fulvida	Toetoe
C.toetoe	Toetoe
Cyperus ustulatus	Toetoe Upokotangata
Dianella nigra	Turutu
Eleocharis sphacelata	Kuta, bamboo spike-sedge
Gahnia pauciflora	Takahikahi
Gahnia setifolia	Mapere
Hierochloe redolens	Karetu
Juncus edgarae (*J. gregiflorus*)	Wi (rush)
Lepidosperma australe	square sedge
Libertia grandifolia	Mikoikoi, NZ iris
Morelotia affinis	
Phormium cookianum	Whararikí, mountain flax
Phormium tenax	Harakeke, flax
Poa cita	Silver tussock
Schoenoplectus tabernaemontani	Kapungawha
Uncinia uncinata	Kamu, Matau a Maui, hook grass

Plant Order Form

Name of Client_____ Job Number:_____ Nursery/Supplier:_____ Date:_____

Species	Source[1]	Delivery Date (specify month and date)	Grade (PB/RT)	Number of Plants

[1] Specify area from which plant material should be ecosourced, eg Rotorua Lakes Ecological District

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