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Report to Environment Committee
from Tim Porteous, Biodiversity Co-ordinator

The opportunities for increased use of indigenous plant species in river control work

1. Purpose

The purpose of this report is to examine the use of willows in river control work and the opportunities for diversifying the range of plants used to include native species.

2. Background to this Report

This report is in response to submissions on successive Council Annual Plans by the Wellington Botanical Society. In their submissions the Society has urged the Council to consider species other than willow, and in particular indigenous species, for river control work. The report has been prepared in consultation with the Council's Flood Protection staff.

3. History of Willow Use

With its steep catchments and potential for high rainfall events, the New Zealand landscape has always been dynamic. In their natural state many rivers ranged freely across their floodplains, particularly during flood events. The lack of permanent intensive development meant that the effects of this on human activity were limited.

Intensification of land development, the growth in permanent settlements and associated investment in infrastructure, particularly from the 1860s onward, resulted in a need to "tame" many of these rivers. River Boards were formed with limited financial and technical resources and set about modifying river channels by means of stopbanks and the planting of willows to prevent erosion. The willow would have been a natural choice for early settlers as they would have been familiar with its bank-holding characteristics in Europe.

4. **The Willow**

Multiple willows, with their extensive interlocking root structure, hold friable river edge gravels and protect them from being washed away by floods. Willow roots catch water borne silt, slowly rebuilding bank edges.

A band of willows slows down floodwaters, encouraging the deposition of silt to rebuild an eroded area, or build up the fertility for other plants to grow. A willow band also acts as a buffer, protecting a stopbank or farmland behind from erosive velocities, as well as catching flood borne debris.

Willows can be planted as rooted cuttings, wands, stakes, or poles, usually taken from existing stands. They are inexpensive to produce and establish quickly, providing bank edge protection within a few years. Consequently they are often regarded as a sacrificial protection, doing their job till lost and then quickly re-established.

Older willows can be partially cut and pushed over, where branches catch passing silt, take root and thicken the edge growth (layering). To protect an eroded bank edge, whole trees can be cut, laid in a trench and partially covered in gravel to quickly take root and grow. Willows are often used to complement the protection of other structures such as rock groynes and gabion baskets.

Few plants have all the willow's attributes of extensive root structure, quick growth, love of wet feet, and miraculous ability to quickly grow a whole new tree from pieces of another planted in the ground. The stands of modern hybrid willows in the Wellington Region's scheme rivers are well managed, present few if any problems, and in most cases add ecological value to riparian margins by way of shade, shelter, and filtering.

All these attributes combine to make the modern hybrid willow the least expensive and the most effective plant for river edge erosion control.

5. **Problems with Willows**

Lack of management of some of these early plantings soon revealed the downside of the willows ease of propagation. As early as 1880 there were reports of crack willow choking streams and causing flooding. The brittle branches of crack willow broke off easily and were carried away by floodwaters to later take root in silt or a gravel beach. Grey willow seeded prolifically and invaded extensive areas of swampy land. Considerable effort was required throughout the country to open up choked river channels. In the Wellington Region the problem was generally confined to smaller watercourses and the slower flowing silty rivers such as the eastern tributaries of the Ruamahanga. The steeper gravel bed rivers with their faster velocities did not suffer the same fate.

The historical problems and the need to find more suitable willows for New Zealand conditions prompted the successful willow breeding programme at Aokautere in Palmerston North. This breeding programme has developed modern hybrids which combine extensive root systems with good erect form, disease resistance,

unpalatability, and a wide site tolerance. They are all single sex to prevent breeding, and are far less susceptible to branch breakage and uncontrolled establishment.

6. Present Practices and Opportunities for Diversification

The community's expectations of protection from flooding are high and as a result our river systems have been considerably modified to reduce the risk. Many have been straightened and confined by stopbank systems with sharper flood peaks and higher velocities. While the use of more permanent and expensive materials such as rock has increased, the modern hybrid willow remains a very important biological tool in river protection work, particularly in rural based flood protection schemes.

However, willows are not the only plantings undertaken by the Regional Council on riverbanks. Recognising that in the past there has been an over reliance on willows in areas where their unique river bank holding abilities were not necessarily required, a conscious effort has been made to diversify the types of plants used. Considerable numbers of native plants are planted each year by the Flood Protection Department for aesthetic and ecological enhancement reasons. In addition, the environmental strategies for the main western rivers propose extensive future plantings of natives. The "Friends" groups associated with the rivers in the Kapiti district are planting, or propose to plant, extensive areas of river margins in native species with Council support.

It should also be acknowledged that native vegetation frequently self-establishes under willows, benefiting from the shade and shelter they offer. Seed is introduced from the droppings of birds roosting or perching in the willows or washed down and deposited in times of high flow. Where stock is excluded by fencing, as is frequently undertaken on the stopbanks of Wairarapa rivers, native vegetation quickly establishes on these sites.

However, native vegetation can never be a substitute for willows on all sites. The Hutt River Environmental Strategy (approved by Council earlier this year) makes the following pertinent comments in relation to the use of willows:

The use of willows as a flood protection method

The use of willows in riparian planting is one that has raised considerable debate over many years.

Put simply, we have used willows in the past as a management tool, for example, to help minimise bank erosion. We have used certain characteristics of willows (such as their quick growth and ability to regrow after being layered or tethered) for managing river-bank edges. If we want to stop using willows within our river margins, then we need to change our management approach. We could look at the way in which we manage the river margins and whether our current approach is the most appropriate. We should also look into the suitability of Kahikatea, Totara and Mahoe for using as replacements for willows.

The following reasons support the use of willows rather than native species:

- *Native plant species cannot replace willows, as front line bank edge protection in either the short or long term. Native species may provide sufficient bank-edge protection in less modified catchments. However, flood flow volumes and velocities in the Hutt River corridor have been significantly increased because the river has been confined within a much narrower channel. The stronger bank protection provided by the willows is needed to counter these increased velocities and volumes.*
- *The interwoven root structure of willows makes them a superior form of bank edge protection. The root mass holds willows in place, protecting the bank-edge in flood flows that would undermine large established indigenous trees.*
- *Also, unlike most native species, willows can be layered when they become old or ineffective. This involves partly cutting the trunk so that the tree lays in the edge of the river flow. This reduces flow and builds up silts along the river edges, allowing the willows to sucker new root systems and re-establish themselves. This is very useful for bank edge protection.*
- *Willows are faster growing and significantly cheaper than native species, allowing them to be used as sacrificial bank edge protection that can be replaced relatively quickly. In contrast the loss of native species planted for bank edge protection would be a much greater setback because of the time and cost involved in replacing them.*
- *Willows do provide limited habitat, as a source of food, shelter and shade. This is very limited as willows are generally planted in such a way that a “monoculture” effect is created and biodiversity is significantly reduced.*

These arguments are given for using willows; however, there are ways of reducing the impacts of willows:

- *A native understorey can be established beneath willows. This can develop naturally or be planted.*
- *Use sterile willow clones so that they do not spread and become a “weed” as crack willows (*Salix fragilis*) have done extensively in the past along other rivers in the Wellington Region.*
- *Use *Matsudanae moutere* or similar clones. When fully grown *Matsudanae* stand up to 10m tall with around 1.7m clearance between the ground and the lowest overhanging branches. This provides access through the willows to the river.*
- *Leave gaps or breaks in the willow band of up to 10m for access purposes.*

- *Willows are not needed in areas where the river edge has been rock lined; where the river hits a natural hard surface (e.g. rock face); or on the inside corner of a permanent river bend where water velocities are reduced. These areas provide opportunities for either open space or native vegetation to be extended to the river's edge.*
- *Generally only the first 15m of vegetation buffer needs to be willows. Native species can be planted behind this frontline 15m, to give the required buffer width, e.g. if a 30m vegetation buffer is needed, then the first 15m have to be willows, but the remaining 15m can be natives.*

Limited trials with native species (particularly in the saline reaches of the rivers where willows do not grow well) have been undertaken in the past. In most cases natives have not fared well, for a variety of reasons. The natives planted at Elbow Bend (upstream of Maoribank on the Hutt River) were all washed out during a flood soon after they were planted. We did have limited success with salt tolerant sedges and grass trials by Sladden Park where timber groynes provided bank edge protection.

Unless a change in approach to bank edge management happens then the use of native tree species along the edge of the banks is restricted within the Hutt River environment.

(Hutt River Environmental Strategy: February 2001, Section 13.4)

While it is clear willows will remain the primary bioengineering tool in flood protection, there are opportunities for enhancement of riverbanks by the use of native plants. Some of these opportunities have been identified but undoubtedly others exist. There may be benefit in the Council working in partnership with organisations like the Royal Forest and Bird Protection Society and the Wellington Botanical Society to identify further potential sites.

In addition there may be benefit in working with the above organisations to establish trial areas to test the effectiveness of native plants for edge protection. The resulting two-way flow of information and views would be of benefit to both parties and result in a more co-operative approach to this significant issue.

7. **Summary**

- a) Willows play an invaluable role in providing a cost-effective bioengineering solution to riverbank protection. Without them the community's expectations in relation to flood protection could not be met.
- b) In recent years the Council's plans and programmes have advocated, and are resulting in, increasing numbers of native plants being established on river banks either by planting or allowing natural regeneration.
- c) Opportunities exist to work in partnership with organisations interested in ecological restoration to increase the level such work on our rivers and to trial

native species as “front line defence” species. Such opportunities should be taken up to increase mutual understanding.

8. **Communication**

Opportunities to publicise the Council's restoration activities and partnerships with the community will be taken where appropriate.

9. **Recommendation**

- (a) *That the report be received and its contents noted.*
- (b) *That trials involving the use of native species in "front line defence" situations be established.*

Report prepared by:

Approved for submission:

TIM PORTEOUS
Biodiversity Co-ordinator

WAYNE HASTIE
Manager, Resource Policy

JANE BRADBURY
Divisional Manager, Environment