

GUIDANCE DOCUMENT – INVASIVE WILLOW
MANAGEMENT TUKITUKI CATCHMENT

20 February 2025

1. Introduction

1.1. Willows in the Tukituki

Willows (*Salix species*) are deciduous trees and shrubs that have been a feature of the New Zealand environment for over 200 years. Introduced from Europe and Asia in the early 1800s, they were widely planted as a tool in riverbank stabilisation and erosion management. Today, New Zealand has approximately ten species of willow, as well as numerous hybrids and cultivars¹.

While willows are useful for supporting riverbanks and hillsides, not all species are beneficial to the environment. Crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*) are extremely invasive. They can live for up to 100 years, obstructing streams, altering water flow, and exacerbating local flooding. In New Zealand, propagating or planting crack willow is not permitted due to their invasive nature².



Figure 1: A willow island within the upper Tukituki catchment, diverting water flow towards productive land, leading to erosion.

Matsudana willow (*Salix matsudana*) and its hybrids, as well as other willow species (*Populus x euramericana* and *Populus deltoides x yunnanensis*), are often planted in Hawke's Bay to reduce erosion³. These species are well adapted to the Hawke's Bay location and climate; their large root systems help to maintain riverbanks, minimise erosion, and improve water quality. Willows are very valuable in flood-prone places, and they play an important role in land management by preventing soil loss and

¹ Soil Conservation Practices, Uses and Management of Willow Species - <https://www.boprc.govt.nz/media/29173/LandManagement-090526-Factsheet21.pdf>

² [National Pest Plant Accord](#)

³ Hawkes Bay Regional Council Poplar and Willows - <https://www.hbrc.govt.nz/environment/farmers-hub/managing-erosion/willow-and-poplar-poles/>

maintaining production. However, even non-invasive willows can pose problems if planted in the incorrect locations. They may choke streams, exacerbate flooding, and undermine stream banks.

Table 1: Comparison of Crack Willow, Hybrid Matsudana Willow, and Grey Willow.

	Crack willow, <i>Salix fragilis</i> ⁴ (Figure 2)	Hybrid Matsudana Willow, <i>Salix matsudana</i> ⁵ (Figure 3)	Grey Willow, <i>Salix cinerea</i> ⁶ (Figure 4)
Origin	Native to Europe and Western Asia and introduced to New Zealand for erosion control.	A hybrid of Chinese and European species and developed for improved performance in erosion control.	Native to Europe and Western Asia, introduced to New Zealand as an ornamental species.
Invasiveness	Highly invasive; spreads aggressively through broken branches that easily root in waterways	Less invasive; primarily spreads through intentional plantings rather than natural dispersal	Highly invasive; forms dense thickets, displacing native vegetation and obstructing waterways
Propagation	Propagates via broken twigs and branches that root easily, leading to uncontrolled spread.	Propagated through cuttings, controlled cultivation minimises unintended spread.	Spreads through wind-dispersed seeds and vegetative means.
Erosion control	Initially used for erosion control, it often causes blockages and exacerbates erosion due to uncontrolled growth.	Grown explicitly for effective erosion control and bank stabilisation, councils widely use it to support erosion control efforts.	Not recommended for erosion control due to its invasive nature.
Form and growth	Medium to large deciduous tree (10–20 m tall) with brittle branches that break easily.	Exhibits rapid growth with improved form and structure; specific characteristics depend on the hybrid variety.	Deciduous shrub or small tree up to 7 m tall, forming dense thickets with grey or green-grey bark.
Waterway impact	Alters stream flow causes blockages and reduces habitat quality; dense root systems can invade water channels.	Planted strategically to enhance riparian stability without causing major blockages; managed growth reduces negative impacts on waterways.	Obstructs and diverts streams, invades shallow water by layering branches, and reduces native biodiversity.
Usage	Listed on the National Pest Plant Accord, control efforts focus on preventing the spread and removing existing populations.	Promoted by councils for erosion control and managed riparian planting; valued for controlled growth and effectiveness.	Listed on the National Pest Plant Accord, control efforts focus on preventing the spread and removing existing populations.

⁴ Bay of Plenty regional Council Crack willow - <https://www.boprc.govt.nz/environment/pests/pest-plants/shrubs-and-trees/crack-willow/>

⁵ Hawke's Bay Regional Council Matsudana willow - <https://www.hbrc.govt.nz/assets/Document-Library/Information-Sheets/Land/LMCT6.pdf>

⁶ Bay of Plenty Regional Council – Grey Willow - <https://www.boprc.govt.nz/environment/pests/pest-plants/shrubs-and-trees/grey-willow/>



Figure 2: Crack willow, *Salix fragilis*. Sourced from Weedbusters.



Figure 3: Grey Willow, *Salix cinerea*. Sourced from Weedbusters.



Figure 4: Hybrid Matsudana Willow. Sourced from LeaflandNZ



1.2. Purpose

This guide has been created to help catchment groups in the Tukituki manage willows. The document compiles current knowledge and best practices to assist you in making informed decisions about willow and alder management.

2. Invasive willow management strategies

Before beginning with willow management, it is critical to consider the implications of control or removal. It is important to approach willow control strategically, considering timing, control zones, and control staging.

Willow removal should focus on areas where willows take over and result in challenges, such as blocking water flow, increasing flood risks, or outcompeting native vegetation. Other weedy species, such as gorse, broom, and tree lucerne, are frequently found in these riverbeds, making native plant establishment more difficult and costly.

When deciding where to remove willows, look for locations where native plants are already established or can be encouraged. If willows are getting in the way of these native plants, it's time for removal or control.

Key principles for catchment scale willow control are:

- Start at the top of the catchment and work down.
- Poison and leave to die off where they are, rather than cutting for removal. (Note: there is a potential that dead material could fall into waterways and potentially exacerbate existing issues. Any live fallen material can readily re-sprout.
- Work with manageable areas, even if they are small. Over time, the areas will add up, and the downstream spread will gradually reduce.

Table 2: Value and options, adapted from Willow and Alder Guidelines, New Zealand Landcare Trust⁷.

If you want to	River and stream margins considerations	Wetland and lake margins considerations
Keep riverbanks stable and/or protect water quality	<ol style="list-style-type: none">1. On the water's edge, leave a row or two of willows.2. Thin the foliage (e.g. remove lower branches) to create a light well, and underplant with cabbage trees, lowland ribbonwoods, etc.3. After the native trees reach maturity, poison the remaining invasive willows, and remove any trunks that might obstruct the way.4. To slow run-off, trap sediments, plant dense ground cover, (Matsudana or	<ol style="list-style-type: none">1. Maintain dense grass or sedge swards at the wetland edge to trap sediments.2. Fence out stock.3. Underplant the willow with natives then slowly remove the deciduous exotics to reduce inputs of nutrients through autumn leaf fall.

⁷ Willow and Alder Guidelines - <https://landcare.org.nz/wp-content/uploads/2024/11/Willow-Alder-Guidelines-2015-1.pdf>

	shrub willows) and fence out stock.	
Restore native vegetation	<ol style="list-style-type: none"> 1. Slowly replace invasive willows by taking out sections of mature trees in autumn and planting natives underneath. Note: Start upstream when removing crack willow to reduce the chance of re-invasion. 	<ol style="list-style-type: none"> 1. Either aerial spray large, dense areas or remove sections of the invasive willows and plant natives underneath. Note that there may be regulatory requirements for spraying. 2. To stop the spread, cut down and poison the trunks of saplings spreading into wetlands. 3. Hand-pull or spray young trees and fill the gaps with suitable natives.
Protect/encourage native wildlife	<ol style="list-style-type: none"> 1. Check for signs of wildlife, such as nests, bat roost holes, and Tuna/eels among submerged roots. If you see signs, leave a few rows of willows until native replacements are established. 2. Consider animal pest control. Note: Don't spray near waterways during whitebait/inanga spawning seasons (Feb-Apr). 	<ol style="list-style-type: none"> 1. Keep some cover for birds such as Bittern or Slits etc. 2. Slowly replace mature willows by planting native trees and shrubs underneath.
Harvest kai such as eels, puha, honey.	<ol style="list-style-type: none"> 1. Don't spray food plants like blackberry in harvest seasons and use bright dyes with herbicides to warn people what's been sprayed. 2. Replace willows with suitable Rongoā and kai species 	<ol style="list-style-type: none"> 1. As for rivers and streams
Provide shade/shelter for stock, reduce runoff or stabilise hill slopes	<ol style="list-style-type: none"> 1. Plant and manage fast-growing shelter trees in paddocks and non-invasive willow on steep gully slopes. 2. If the bank is unfenced, run a temporary hot wire just inside the paddock edge of the willow until the paddock trees are big enough to provide shade, then fence the riparian margin permanently and slowly replace the river-side willows with natives. 	<ol style="list-style-type: none"> 1. Plant and manage fast-growing shelter trees in paddocks away from the wetland. 2. If the wetland is unfenced, run a temporary hot wire just inside the paddock edge of the willow until the paddock trees are big enough to provide shade, then fence the wetland margin permanently and slowly replace the wetland willows with natives.

3. Control options

Once you've decided where to remove willows, it's time to consider different methods of controlling them. The best method will depend on the size of the area, how easy it is to access, and how badly the willows have taken over. For more on herbicide control and regulations, see Section 4.

3.1. Ground Methods

Willows can be controlled on the ground in smaller, more accessible areas using various approaches. These include cutting them down, logging them away, pulling them out by hand, or applying herbicide. A typical way is to cut the willows, poison the stumps, and spray any new growth the following year.

If you prefer not to use chemicals, this method will take longer and require additional labour. Note that it is nearly impossible to control willows without herbicide use unless the whole tree is pulled out. It's critical to select your sites carefully, particularly in areas with deteriorating riverbanks, unless you have communicated with HBRC.

View the below Table 3 for a detailed comparison of control methods, including best use cases, required gear, and step-by-step application guidelines.

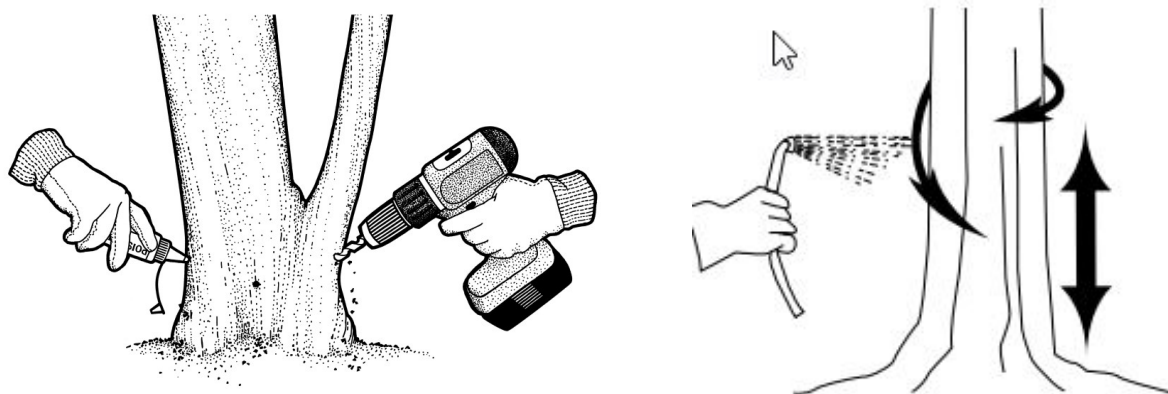


Figure 2: Examples of ground-based willow removal methods. Left: Drill and fill with a herbicide. Right: Basal bark spraying. Sourced from [Hunter Regional Weeds](#).

3.2. Aerial Spraying

For bigger areas with dense willow infestations or those that are difficult to reach, aerial chemical application from a helicopter or drone can be a quick and effective alternative. However, this approach might require resource consent and collaboration with HBRC.

3.3. Under-planting

If you're willing to wait for a longer-term solution, under-planting willow stands with native, shade-tolerant species can aid in natural regeneration. This can be combined with ground management strategies to prevent seedlings from spreading and thinning the canopy, allowing native species to thrive over time.



Figure 3: Underplanting natives under a Willow stand at Lake Waahi, Waikato, [sourced from Restoration From Willows to Indigenous Plants Through Underplanting.](#)

3.4. Specific Willow Control by Species

Tree species	Invasiveness	Management strategy
Grey Willow	Highly invasive, spreads through wind dispersal.	Hand pull seedlings and poison saplings. Begin ground-based control after seeding. Remove female trees first (white blossoms in early spring), then mark male trees as needed.
Crack willow	Highly invasive, spreads through broken shoots.	Remove by working downstream and interplanting with native plants. To safeguard banks along larger rivers, focus on smaller plants. To minimise disruption and provide bird habitat in wetlands, leave dead trees standing—but make sure they are completely dead before leaving.
Tree willow	Some willows, like shrub willow, are useful for erosion control and fodder.	Replace invasive willows with non-invasive species in erosion-prone locations. Keep an eye on tree willows and remove any that are at risk of falling into waterways.
Alders	Less commonly managed, can spread if left unchecked.	Thin and underplant with shade-tolerant native species. To prevent further spread, remove any young or scattered alders.

4. Control methods

When applying herbicides to suppress woody plants like willows near water, it is critical to select the appropriate product and application strategy. Only a few herbicides are permitted for use near or over water, and the rest require resource approval. Note that you will need a GrowSafe certificate if you are using anything other than a low-pressure backpack and maybe consenting to use certain herbicides⁸.

4.1. Which Herbicide to Use

4.1.1. Glyphosate (e.g. Round-up)

- **Effectiveness:** It should be used cautiously because it is highly effective at killing any plant it encounters, including native species. Using herbicide from the air works best on dense, older willow stands. See Table 3 for application methods for ground-based spraying.
- **Resource Consent:** Ground-based application near waterways does not require consent if the right formulation is applied. However, if the individual cannot adhere to Rules 9 and 10- small scale and widespread application of agrichemicals, resource approval may be required for aerial application or clearing broad areas⁹.

4.1.2. Triclopyr Triethylamine (e.g. Garlon 360)

- **Effectiveness:** Targets broadleaf trees, such as willows and alders, but also affects native broadleaf shrubs and trees. It's particularly useful for scattered willows especially in areas where the native vegetation consists mostly of monocots (strappy-leaved plants like flax, cabbage trees, sedges, and native grasses). Ideal for aerial application on young grey willow invasions. See Table 3 for application methods for ground-based spraying.
- **Resource Consent:** Ground-based application near waterways does not require consent if the right formulation is applied. However, if the individual cannot adhere to Rules 9 and 10- small scale and widespread application of agrichemicals, resource approval may be required for aerial application or clearing broad areas¹⁰.

4.2. When to Apply Herbicide

- Applying the spray is best done between summer and early autumn when the trees are fully leafed.
- Although cut and paste and stem injection are year-round techniques, they might not work as well in the winter. For grey willows, avoid fresh seeds settling and invading the area, and wait approximately one month after the grey willow has produced seeds before pruning or spraying.

4.3. What to Do with Dead Trees

Willows treated with herbicide should be disposed of appropriately to avoid roots or re-sprouting.

- Live trees: After receiving herbicide treatment, any trees that are still alive need to be retreated to ensure proper die off.

⁸ [Hawke's Bay Regional Council – Agrichemical and Spray Drift Rules](#)

⁹ Hawke's Bay Regional Resource Management Plan <https://www.hbrc.govt.nz/assets/Document-Library/Plans/Regional-Resource-Management-Plan/View-RRMP/New-Chapter-6.pdf>

- Dead trees: Dead trees can be left standing to provide wildlife habitat, suppress weeds, and help stabilise riverbanks. However, if they're at risk of falling near infrastructure or blocking waterways it's best to remove them.
- Mulching: Mulching live willows are not advised unless done far from water since the fragments may re-sprout and spread. However, one efficient method of removing residual willow branches and stems is to mulch dead willows.
- Unsprayed willows: Stock can be fed unsprayed willow branches to remove the leaves. To stop regrowth, pile the remaining branches and burn them.
- Hand-pulled seedlings: To prevent re-establishment, hand-pulled willow seedlings should be buried deeply in a dry location, burned, or transferred to a landfill.

Table 3: Ground based willow control options using herbicide, sourced from New Zealand Landcare Trust Willow and Alder Guidance¹¹.

Option	Best for	Pros and cons	Gear needed	General method	Notes
Leaves Foliar spray – spray the leaves	<ul style="list-style-type: none"> - Short trees (where you can reach the leaves) including regrowth from cut stumps. 	<ul style="list-style-type: none"> - Maintains habitat for wildlife until the native vegetation has grown. - Easy to apply from knapsack - Highest risk to native plants - Uses more herbicide than other methods 	<ul style="list-style-type: none"> - Knapsack - Marker dye - Herbicide and correct additives e.g. spreader, sticker, penetrant (refer to the label) 	Ground-based spraying <ul style="list-style-type: none"> - Mix up herbicide with marker dye according to the herbicide label. - Spray leaves on a calm, dry day, fully cover the foliage. - Leave trees to die and rot. - Check next spring/ summer for survivors, re-treat if necessary 	Penetrants cut through the protective coating on the leaf allowing the herbicide to get into the leaf and be transported around the whole plant more effectively. Spreaders enable a thin film of liquid to be deposited on a leaf, rather than whole droplets which may simply run off the leaf.
Trunk and Stem <ul style="list-style-type: none"> - Drill and inject <ul style="list-style-type: none"> o Drill or cut holes in the trunk and inject or paste on herbicide. - Basal spray <ul style="list-style-type: none"> o Spray herbicide in oil or diesel onto the base of thin trunks. 	<ul style="list-style-type: none"> - Tall trees with thick stems over 5 cm diameter (for drill and inject) - Trees/ stems with thin bark under 20 cm diameter (basal spray) - Where there is native understory/ valued native plants nearby 	<ul style="list-style-type: none"> - Lowest risk to other plants (some risk to nearby trees with intertwined roots) - Leaves habitat for wildlife until the native trees have grown - Every single stem must be treated - Safety risk – use of a drill - Risk of herbicide spill - Risk of herbicide moving through roots and soil into neighbouring plants 	<ul style="list-style-type: none"> - Cordless drill and 15 mm drill bit OR axe/hatchet OR chisel and mallet - Drenching gun OR syringe set to 10 ml dosage (for drill method) - Herbicide as liquid or gel and label recommended additives (some basal spray herbicides come pre-mixed) 	<ul style="list-style-type: none"> - Work in pairs – one to drill or cut, one to inject/apply the herbicide. - If drilling - make a ring of holes every 5-10 cm around the tree near the ground, drilling at a 45-degree angle into the sapwood (light coloured outer wood). Squirt 10 ml undiluted liquid herbicide into every hole within 30 seconds - If frilling – cut a series of cuts in the bark (or one all the way round) with an axe or chisel to expose the sapwood. Pour liquid herbicide just above so it runs into the cut, or squirt gel into the cuts - If spraying bark – set sprayer to low pressure (20-40 psi or 1-2 pumps) and gently spray suitable herbicide all around the lower 20-40 cm and root collar of dry stems until they are wet but not dripping - If scraping - use a chisel or knife to slice off a strip of bark about 30 cm long and squeeze herbicide gel all along the cut. - Spray a ring of dazzle paint around the tree so you know which you have done. - Leave trees to die and rot. - Check next spring/summer for survivors, re-treat if necessary 	If using a drenching gun, label it with poison and keep away from stock drenching gear.
Stump <ul style="list-style-type: none"> - Cut and paste <ul style="list-style-type: none"> o Cut down the tree and coat stump and trunk ends with herbicide 	<ul style="list-style-type: none"> - Any size – from large trees to regrowth shoots - Where there aren't valued natives underneath - Scattered trees with easy access - Experienced chainsaw operators (for larger trees) 	<ul style="list-style-type: none"> - Low risk to other plants (other than crushing) - Uses least amount of herbicide - Immediate loss of shade and roost sites - Falling trees may crush native plants - Untreated cut fragments may take root in damp areas 	<ul style="list-style-type: none"> - Chainsaw/brush cutter, folding hand saw, loppers, or secateurs – depends on stem size - Marker dye or coloured herbicide - Herbicide as liquid with spreader/ penetrant, or gel 	<ul style="list-style-type: none"> - Cut down the tree, or lop off shoots at ground level - Immediately coat the sapwood part of the cut stump and stem (within 30 seconds) with herbicide gel or liquid. - Poison the offcuts too, or haul away and burn them – untreated bits left behind can take root where they fall - Leave stump to rot down - Check next spring/summer for regrowth and re-treat (e.g. foliar spray) if necessary 	If using Vigilant gel ensure no drops are allowed to reach the ground or water. Only the light coloured outer wood (sapwood) needs to be coated with herbicide. It is an offence to leave a significant quantity of timber within the flood zone which may cause a navigation hazard or risk to downstream structures and users in the event of flooding.

¹¹ Willow and Alder Guidelines 2015, New Zealand Landcare Trust - <https://landcare.org.nz/wp-content/uploads/2022/09/Willow-Alder-Guidelines-2015.pdf>

5. Planting options

In order to improve biodiversity in riparian areas and stop willows from growing back, planting is essential. When making plans for riparian restoration, the following choices should be taken into account.

5.1. Native planting for biodiversity

Restoring biodiversity and providing dense cover to outcompete willows are benefits of planting native species in damp or swampy environments. Shade from dense planting helps prevent the regrowth of invasive species. A phased approach is advised for willow-heavy areas. This entails progressively removing specific invasive willow tree portions, replacing them with native trees, and keeping an eye out for weed renewal until the native plants are firmly established.

5.2. Managing weeds and invasive species

The establishment of natural plants may be hampered by weeds such as tradescantia, cowgrass, etc. Before planting natives, these weeds will need to be controlled. Native plants that can withstand shade can be planted beneath the canopy once the weeds have been controlled. Sometimes, especially in areas with a healthy native understory, planting species like Pukatea can be sufficient to support the growth of other native plants.

5.3. Combining Willows and Natives

Willows can occasionally be utilised to support riverbanks, particularly when quick establishment is required. Willows shouldn't be the exclusive species utilised, though. Over time, a more sustainable option is offered by combining native plants with willows. Willows provide instant flood protection, but their lifespan is limited (they need to be replaced every 15 to 30 years) and their habitat variation is restricted.

6. What to plant?

Selecting plants that are appropriate for the site circumstances is crucial when planting in riparian zones. Plant a limited number of dependable, hardy species first. Where conditions allow, you can gradually introduce less resilient, slower-growing species.

6.1. TLC Planting Tool

TLC has developed a tool to help with planting decisions, providing guidance on species selection based on site conditions. This tool ensures you pick species that will thrive and contribute to riparian restoration. It also supports the use of native plants that benefit biodiversity, water quality, and erosion control.

For more guidance on species selection, planting techniques, and maintenance, you can refer to:

- [Riparian planting in Hawke's Bay](#)
- Consult a HBRC Land Management Staff member
- Use the TLC Planting Tool
- [Integrating native planting and flood protection](#)