

# Drought resource for Waikato farmers

He rauemi tauraki





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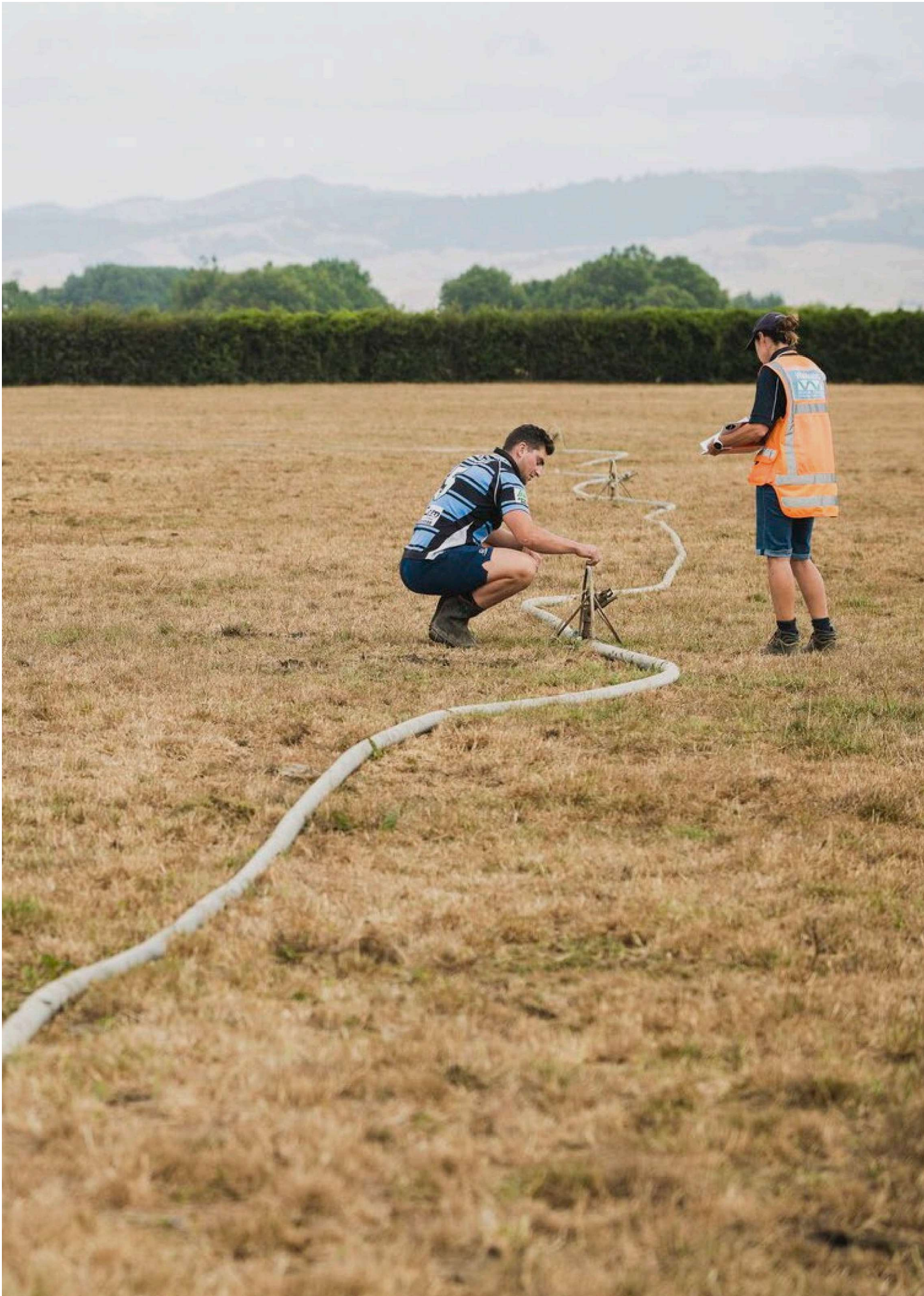
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## **The purpose of this resource**

This document aims to provide farmers with a greater understanding of drought events as well as information on various options that may help their farming operations become more resilient to this phenomenon. There are three parts to this resource:

Section 1: What is a drought?

Section 2: Drought mitigation strategies.

Section 3: Water harvesting structures (water storage).

## **Waikato Regional Council's role in drought events**

The Waikato region covers 25,000 km<sup>2</sup> of land and 10,000km<sup>2</sup> of coastal marine area. Waikato Regional Council is responsible for managing the natural and physical resources within it that comprise water, soil, air, coastal and geothermal. These resources all need protecting to meet many of our economic, cultural and recreational needs.

Part of our role in managing the region's resources is responding to immediate threats in the form of natural hazards. In most instances, natural hazards are weather related and include events such as floods and slips, but also droughts.

We gather information and work to minimise the impact of many kinds of natural hazards that could affect the region. As part of this work, we've produced hazard identification studies and risk mitigation plans for the major natural hazards in our rohe.

It is recognised that droughts are natural hazard events and our approach is to provide information and support to communities in the region to prepare for droughts and build resilience to better to respond to these events.

We have a dedicated webpage for droughts which contains useful information to help you plan ahead and know who to contact if you are experiencing hardship. If you have a resource consent to take water there is also information to help you understand your responsibilities with respect to managing water with that consent.





## What is a drought?

### He aha te tauraki?

Drought differs from other natural hazards, such as earthquakes or floods, in that it lacks any precise definition. Droughts result in environmental and economic damage that can linger for lengthy periods of time in affected areas.

That said, a drought is generally considered to be a shortage of rainfall over an extended period of time, which restricts or prevents human activity. This can lead to a reduced volume of water in waterbodies such as rivers, dry ground and lack of plant growth. Because the main impact of a drought is often on agriculture, the Ministry for Primary Industries will declare when a dry period is classed as a drought.

### 1.1 How are droughts predicted?

Scientists can predict the likelihood of a drought by careful monitoring of rainfall, river flow and soil moisture. The National Institute of Water and Atmospheric Research (NIWA) has extensive rainfall records. Some records go back to the late 1850s. This depth of information, along with historical information on El Niño and La Niña weather patterns, enables NIWA scientists to provide a comprehensive assessment of the likelihood of flood or drought in any given area of the country. Farmers, horticulturists and resource planners can then make informed decisions about land use practices.

## 1.2 What are the impacts of drought?

The impacts of a drought can be economic, environmental or social. The effects of drought mainly impact on rural (i.e. agricultural/horticultural sectors) and urban (residential and industrial) water users, and can reduce hydroelectric power supplies. Although during a drought event there is very small potential for loss of life or structural damage, the financial impact within the region can be significant.

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services.

Impacts are commonly referred to as **direct** or **indirect**. Reduced crop, pasture, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop and forest productivity may result in reduced income for farmers and agribusiness and increased prices for food and timber. Reduced income for farmers has a flow on effect to retailers and other service industries.

Even when the soil moisture returns, the impacts on pastures, stock and farm finances remain. River flows, groundwater and irrigation dams can take months to recover. Droughts exacerbate the severity of wind and water erosion of soils and lead to a reduced loss in soil quality. Drought also results in an increase in the frequency and intensity of fires which can have catastrophic consequences.

### Hydrological effects

- Lower water levels in reservoirs, lakes and ponds.
- Reduced flow from springs.
- Reduced streamflow.
- Loss of wetlands.
- Estuarine impacts.
- Increased groundwater depletion, land subsidence, reduced recharge.

- Water quality effects (e.g. salt concentration, increased water temperature, pH, dissolved oxygen, turbidity).
- Water quantity impacts.

### Damage to plant communities

- Loss of biodiversity.
- Loss of trees from urban landscapes, shelterbelts, wooded conservation areas.

### Damage to animal species

- Reduction and degradation of fish and wildlife habitat.
- Lack of feed and drinking water.
- Greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion.
- Disease.
- Increased vulnerability to predation (from species concentrated near water).
- Migration and concentration (loss of wildlife in some areas and too many wildlife in other areas).
- Increased stress to endangered species.
- Loss of biodiversity.

Drought is not solely a physical phenomenon. The way drought events impact on people's lives is an important adverse effect and will have to be considered for effective drought risk management. As part of specific drought risk management plans, Waikato Regional Council will undertake the identification of community perception and community values. This is an important process to ensure that all people who may be affected by drought are identified.



## Aspects of the Waikato region that can increase impacts or effects of drought

### ***Hydrophobicity***

Soils that repel water are considered hydrophobic. A thin layer of soil at or below the mineral soil surface can become hydrophobic after a prolonged dry spell. High p-retention soils are more prone to soil water repellency (SWR) than low p-retention soils, and in the Waikato region high p-retention soils are common.

SWR is caused through the production of complex organic acids during the decomposition of organic matter. These complex organic acids are wax-like substances that form a coating over particles of soil. In permanent pasture the main cause of soil hydrophobicity is the presence of low quality carbon caused in part by slow decomposition of organic matter, hard to decompose vegetation such as brown-top and in situations where there is poor microbial activity in the soil.

A hydrophobic soil or water-repellent soil does not wet up spontaneously when a drop of water is placed upon the surface. It is common to see water pooling on the surface of dry soil rather than wetting it up. In pasture, this translates into “dry patches” or localised dry spots – irregular shaped areas where the grass or other plants suffer from drought because the repellent soil does not wet up uniformly following rain or irrigation.

For farmers, the most important factor associated with soil hydrophobicity and how it affects pasture growth is the critical water content (CWC) analysis. The phenomenon has significant implications for water storage in soil. Soil hydrophobicity is the likely reason pastures fail to respond to autumn rains, delayed pasture recovery especially after drought and the subsequent constraints to winter production. Moreover, it has an adverse effect on pasture persistence and accelerates pasture reversion.







# Drought mitigation strategies

## Ngā rautaki whakamauru tauraki

To build resilience within farming systems against drought events, research is being undertaken on the location, duration, severity and frequency of occurrence of droughts. In addition, the influence of climate change on drought events in the region is evolving. There is

a need to focus on identifying the onset of a drought event so farmers can make decisions early and be better prepared to ride the drought event out.



## 2.1 Short term mitigation strategies

Regardless of the season, it is prudent to have a plan if things do go dry at the start of the summer.

### Feed budgeting and planning

Planning is key to managing a dry summer and a good plan will reduce stress and mitigate the effects of the drought for production and productivity in the subsequent years. It may not be easy to predict when it will rain, but a plan provides the framework for what decisions need to be made and when. It is therefore critical that you have built a feed budget to identify how you are going to balance limited grass, silage and baleage supplies with grain and other feeds, and update the plan as conditions change.

Utilise feed budgeting support services such as:

- 0800 BEEFLAMB (0800 23 33 52)
- 0800 4 DairyNZ (0800 43 24 79 69).



The Ministry for Primary Industries (MPI) has appointed feed coordinators. Their role is to collect information about feed needs and, where possible, connect farmers with any feed that may be available.

### Useful links

[Extreme Dry – Management Toolkit | Beef + Lamb New Zealand](#)

[beeflambnz.com/knowledge-hub/PDF/extreme-dry-management-toolkit](http://beeflambnz.com/knowledge-hub/PDF/extreme-dry-management-toolkit)

[www.dairynz.co.nz/business/adverse-events/drought](http://www.dairynz.co.nz/business/adverse-events/drought)

## 2.2 Medium to long term strategies

- Revisit stocking rate and match to carrying capacity.
- Take a conservative approach to matching feed demand and feed supply.
- Improve feed availability.
- Work out how much feed you need. A call to an industry or levy body will get you a free stock take assessment of your feed planning needs.
- Get more advice and practical support. An advisor will help you understand what needs to be done and how you can go about it.
- Introduce shelter plantings to:
  - provide stock fodder in drought conditions
  - provide shade for stock
  - buffer the wind and reduce the moisture loss from soil and plants on the lee side of plantings.
- Manage sensitive areas e.g. seepages to provide grazing in drought conditions.



- Pay attention to soil health by improving water holding capacity and avoiding soil compaction and structural degradation, etc.
- Revisit pasture sward composition and cultivars – consider pasture species diversification.

## 2.2.1 Cultivation

### 1. Direct drilling

There are techniques that can be used to minimise the risk of grass failing to strike in dry conditions. With the correct preparation, direct drilling will produce better results when compared to conventional seeding in dry conditions than conventional seeding does.

### 2. Double spray/fallow

If moisture retention is a problem, using the double spray/fallow technique improves moisture availability. Trials have shown that up to 12 times more moisture is retained to a 20cm depth compared to unsprayed sites.

Double spray fallow involves killing the old pasture with herbicide then leaving the paddock fallow for at least six weeks. Over this time roots break down and, because the plants are not transpiring, less moisture is lost.

Double spray/fallow retains moisture due to reduced evapo-transpiration rates.

### 3. Choice of drill

Different drills are suited to different conditions. If drilling can be done when moisture conditions are good, any type of drill should give good results. If conditions are dry, different drills will perform differently.

The best results will be obtained by using cross-slot drills, or a drill that uses press wheels to close the slot and retain moisture and good soil/seed contact. Hoe coulters will give the next best results followed by older triple disk designs. New triple disk designs with small press wheels give better results than older designs.

In dry conditions, use the double spray fallow technique when using triple disk drills. Triple disk drills perform best when moisture conditions are good, or in sandy or stony soils.

If you have your own direct drill, you can quickly capitalise on any rain and get in and drill while there is moisture around.

## 2.2.2 Alternate fodder species

### Poplars and willows

The prevalence of drought highlights the importance of low cost, readily available supplementary feeds in summer-dry and drought-prone regions. Common supplements such as silage, lucerne, feed grains and summer feed crops tend to be in short supply and can be very expensive in drought times. This has led to recent research into the effectiveness of feeding poplar and willow to livestock in dry summer and drought conditions.

### Benefits from poplars and willows

- Reliable drought feed.
- Easy to grow and relatively easy to manage with minimum impact on pasture growth.
- A good pre-topping supplementary feed.
- Provides trace elements.
- May relieve grazing pressure on other pastures.
- Provides stock shelter and shade.
- Frost tolerant.
- Less shading in winter – less impact on pasture.
- A deep root system – so minimal impact on pasture.
- Rapid breakdown of litter – minimal impact on soil pH.
- Relatively fast growth rates.
- Can be used for amenity or landscape plantings.
- Popular erosion control measure for soil conservation.

### How are they utilised as stockfeed?

Poplars and willows can be pollarded for supplementary feed by removal of leaders and branches from the tree trunk above cattle grazing height. Trees will easily regrow new branches, and trees can be pollarded on a two to three year cycle. Poplar and willow leaves have 65–70 per cent dry matter digestibility, with a crude protein level of 15 per cent. Cattle eat trimmings up to 10mm diameter and sheep up to 5mm diameter.



### Tree fodder species

- Veronese poplar.
- Flevo poplar.
- Tasman poplar.
- Argyle poplar.
- Matsudana willow.
- Moutere willow.
- Tangoio willow.

### Shrub fodder species

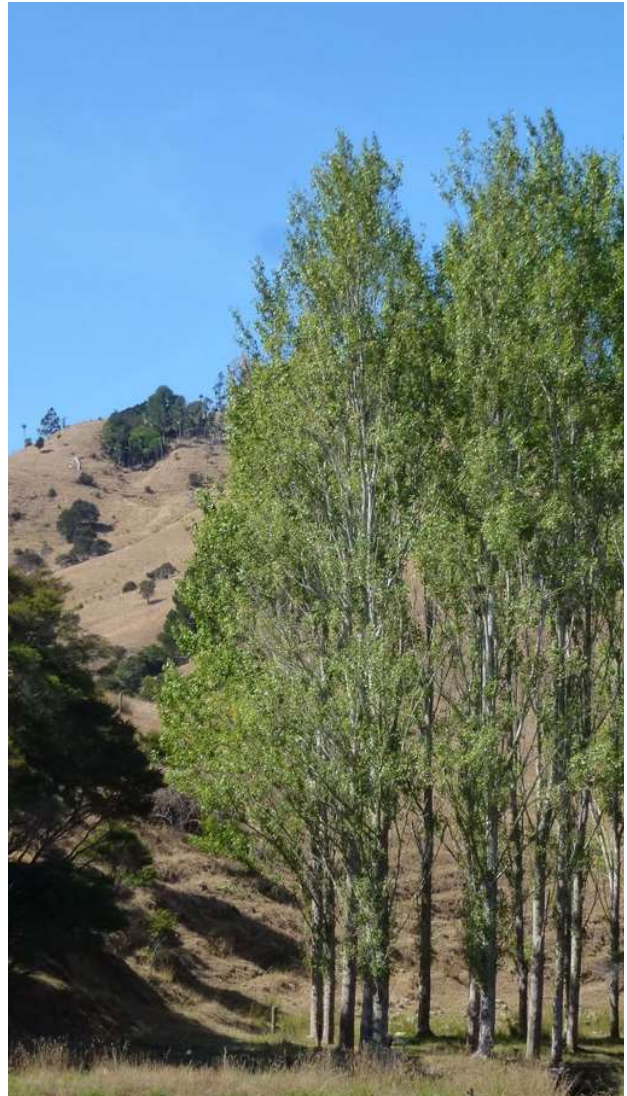
- Kinuyanagi willow (high DM yields – graze in situ).
- Other shrub willows.
- Mediterranean saltbush (*Atriplex halimus*).

### Harvesting and feeding of poplars and willows

The method of harvest chosen will depend on your farm management, topography of the fodder area, staff availability and location of site to the grazing animals.

#### 1. Grazing in situ

- Best on easy rolling fertile land so production can be maximised.



### Useful links

More information on pruning, pollarding and safety advice can be found via these links:

- **Pollarding poplars and willows for fodder:** [poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-young-willows-in-a-fodder-block](http://poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-young-willows-in-a-fodder-block)
- **Video: pollarding fodder willows:** [poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-young-willows-in-a-fodder-block](http://poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-young-willows-in-a-fodder-block)
- **Video: pollarding older willows:** [poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-older-willows](http://poplarandwillow.org.nz/documents/managing-poplars-and-willows-pollarding-older-willows)
- **Video: High pruning poplars:** [poplarandwillow.org.nz/documents/managing-poplars-and-willows-high-pruning-poplars-with-a-mechanical-pole-saw](http://poplarandwillow.org.nz/documents/managing-poplars-and-willows-high-pruning-poplars-with-a-mechanical-pole-saw)
- **Willow management for drought fodder:** [hbc.govt.nz/assets/Document-Library/Information-Sheets/Land/fodderwil.pdf](http://hbc.govt.nz/assets/Document-Library/Information-Sheets/Land/fodderwil.pdf)



- Low growing shrub species preferred e.g. Kinuyanagi willow, which can be break fed.
- Can apply dairy effluent to maximise production (if the site is suitable).

## 2. Pruning selective branches

- Feed directly on-site where branches fall (small branches).
- Cut and carry to another feed area (labour intensive).

## 3. Pollarding

- Cut tree down at about 1.3m to 1.5m (below shoulder height) and feed set amount per day (use hot wire and break fence).
- Best after 6-8 years of growth from the initial stake or seedling.
- Ensure stem is not too large in diameter as large volume of wood will remain on-site.
- Care in post management so stock, especially cattle, do not debark the stem. Pollard again after three years or depending on growth rates.
- Alternatively, cut some of the re-growth shoots every second year.

## 4. Coppicing

- Cutting stem as above at approximately 30cm above ground.
- Feeding sheep on-site is preferred as cattle may damage the remaining stool.
- Use hot wire.
- Paint cut stems with a fungicide.
- Exclude stock for some time to ensure new shoot re-growth.

It is important to note that two species of willow – crack willow and grey willow – are pest plant species. It is illegal to plant or propagate crack willow in New Zealand, and planting willows along waterways can be problematic. Helpful guidance can be found on the Manaaki Whenua – Landcare Research website: [landcare.org.nz/file/willow-alder-guidelines-2015/open](https://landcare.org.nz/file/willow-alder-guidelines-2015/open).

### Potential feed production

Poplars and willows are equal to lucerne hay and silage in terms of their food value per kilogram of dry matter (DM). The following table provides a comparison of various foods. Poplar and willow fodder is a highly nutritious feed supplement, as it is higher in crude protein, metabolisable energy (ME) and digestibility, and lower in fibre than typical drought pasture. Tree fodder also contains condensed tannins (CT), which are known to be beneficial to livestock. Based on the current research, poplar and willow fodder comprising just 25 per cent of total dry matter intake consistently reduces live weight and body condition losses during drought and can significantly increase conception and reproductive rates.

Comparative feed value	% DM	% Digestible DM	Metabolisable energy (Mj/kg DM)
Poplars/willows	90	65	10
Lucerne hay	90	65	10
Pasture silage	30	70	10
Pasture hay	85	53	8

Measurements confirmed that poplar and willow species could produce large quantities of nutritious fodder. Prunings from nine-year-old poplars or willows planted for soil conservation produced 20kg to 50kg of leaf DM per tree (equivalent to 1-2 bales of lucerne hay). Once pruned, trees should produce 30kg to 40kg DM fodder every 3-4 years.

Willow and poplar fodder comprising 25 per cent of the total diet will reduce ewe live weight loss and loss in body condition and increase reproductive rate. The cost/benefit analysis shows that farms can regain almost half the cost of a drought by supplementing ewes with tree fodder during mating.

#### Benefits of feeding poplar foliage on ewes lambing

Live weight loss (g/day)	High poplar feeding	Low poplar	Control
Scanning %	67	71	82
Lambing %	163	147	122
Docking %	155	141	122
Weaning %	126	112	97
	125	113	96

#### Notes:

- Ewes were fed poplar foliage under drought conditions during mating.
- The trial was based on ewes (57kg) split into three groups fed on typical pasture for 10 weeks, in weekly breaks, starting on 1 February 2001.
- Low rates to one group was 0.75kg of fresh poplar/ewe/day.
- High rates to the other group was 1.5kg of fresh poplar/ewe/day.
- Pre and post grazing pasture cover was similar for all three groups at 1040 and 525 kg/DM/ha.
- The high and low treatments gave a gross margin/ewe of \$13.36 and \$9.13 respectively – higher than the control group (on pasture only).
- Cartage and labour costs to cut and carry the poplar foliage were not considered.





# Water storage/ water harvesting

## He puoto wai/te tiki wai

### 3.1 Drought readiness

Careful management of water is necessary for the health of waterways, ecosystems and economics and a requirement to achieve efficient resource use which is a key concept of sustainable agriculture. Water use efficiency (WUE) is one of the key performance indicators of sustainable agriculture and is an important objective for Waikato Regional Council.

Most of the concepts described in this section will require a resource consent, and in the first instance contact us for assistance. Some may also require consents through the relevant district council.

## 3.2 What is water use efficiency?

The physiological or agronomic definition of water use efficiency is the “ratio of the amount of biomass produced to the actual amount of water evaporated and transpired” (AET) by that particular crop or pasture.

As the actual amount of water evaporated and transpired is difficult to measure, this is often modified to the ratio of biomass production to potential evapo-transpiration (PET), the estimated evapo-transpiration from a short grass sward with no soil moisture limitation.

From an economic or farm management perspective, water use efficiency is often defined as the ratio of a marketable unit of yield per unit of water used. For example, the number of kilograms of milk solids or wheat grain per millimetre of water used can refer either to the amount of irrigation water supplied to a farm or to the amount of irrigation or irrigation plus rainfall applied to a paddock.

## 3.3 Irrigation practices

The use of irrigation in farming systems has increased significantly over the past 20 years in New Zealand. There are restrictions on irrigation in the Waikato region, so if you are looking to implement irrigation or expand talk

to us in the first instance by calling 0800 800 402. If you have irrigation there is an abundance of great resources by Irrigation New Zealand to ensure farmers are adopting best practices:

 [www.irrigationnz.co.nz](http://www.irrigationnz.co.nz)

The irrigation industry has a variety of tools and applications to support farmers to improve the efficiency of irrigation and achieve good farming practice. Technology such as variable rate irrigation, which adapts irrigation to soil type, and phone apps to schedule irrigation, are examples of this.

To improve drought resilience, some pasture types or species have higher water use efficiencies. Lucerne is well known for continued growth when moisture stress stops ryegrass and clover growth. Other pasture types, such as tall fescue, are also potentially more drought tolerant. The important point to be considered here is the productivity of these alternative species under commercial situations.

### Smart strategies for water

Smart use of water can help farmers cut their pumping costs and reduce pressure on the environment by cutting demand for water and lowering the volume of dairy effluent they need to manage.





### Some examples

Water meters	Meters help farmers keep track of how much water they are using, where there are opportunities for savings and where problems are occurring.
Valves and taps	Having frequent taps or valves on water lines allows leaking sections to be isolated easily and repaired, rather than having to shut down major parts of the system to fix things.
Warning systems and leak detectors	These allow farmers to get on to problems promptly.
Recycling	Use of cooling water for washdown or stock water, reusing heated water to clean up equipment and irrigating pasture with washdown water are all good ways of recycling water.
Rainwater capture	Capturing and storing rainwater for yard washdown is another valuable option.
Automation	Automating systems – such as ensuring cooling water is only being supplied when necessary – helps reduce demand.
Good storage	Purpose built storage systems help ensure these opportunities can be exploited fully.

## 3.4 Water harvesting and storage

Water harvesting and small-storage technologies are key water-related interventions with the potential to contribute water for domestic use, livestock, fodder and pasture/crop production.

Water harvesting is the collection of rainfall runoff for subsequent beneficial use. Farmers have been using it for centuries to both reduce erosion and increase crop yields and production reliability. A wide range of water harvesting techniques are available and applicable in various geographical conditions.

Runoff may be harvested from roofs and ground surfaces as well as from intermittent or ephemeral watercourses. Various classifications of water harvesting techniques exist, but at the broadest level the term “rainwater harvesting” is applied to those techniques that harvest runoff from roofs or ground surfaces (overland flow). “Floodwater harvesting” is applied to those that collect discharges from watercourses (channel flow).

Water harvesting enables farmers to store water when it is plentiful and make it available when it is scarce. Three categories of small-scale storage can be distinguished:

1. Soil moisture storage.
2. Groundwater storage.
3. Surface storage.

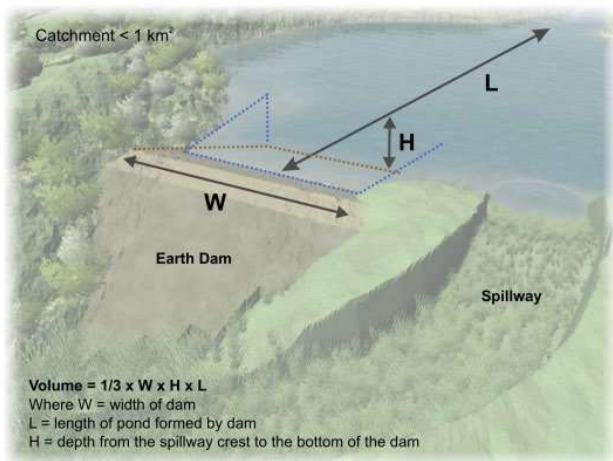


Water harvesting techniques that store water as soil moisture work by preventing (or significantly reducing) water runoff from an area using structures to hold water. This encourages infiltration and increases the proportion of rainfall entering soil storage, where it can later be used directly by plants. Water that infiltrates past the root zones of crops may percolate into aquifers and be stored as groundwater. Some water harvesting techniques collect runoff to encourage infiltration to increase groundwater storage, and others store water at the surface in natural or constructed ponds or tanks.

Given the anticipated impacts of climate change on long term recharge patterns, it is imperative the agriculture sector manages demand. In many situations, a shift from a reliance of groundwater to increased surface water storage capacity is more appropriate.

### Designing dams or ponds

By integrating water storage structures and water harvesting in landscapes in a planned and systematic manner, it is possible to create a “water buffer” that helps reduce vulnerability to drought and seasonal variations in rainfall. The structures can be used for multiple purposes, such as agriculture, livestock watering and domestic use.



The key to a farm pond design is proper initial planning. Contact us and your local district council for advice, as some works can be permitted but you will need to check if resource consent and/or building consent is required prior to construction.

A good starting point for information is the Waikato Regional Council website:

 [waikatoregion.govt.nz/dams-safety-requirements-and-building-consents](https://www.waikatoregion.govt.nz/dams-safety-requirements-and-building-consents)

 [waikatoregion.govt.nz/forfarmers](https://www.waikatoregion.govt.nz/forfarmers)







Any dams in a river or stream will need a resource consent. However, under the *Waikato Regional Plan* you can construct, reconstruct, alter or extend a dam as a permitted activity on:

- any off-stream area on your property – including artificial waterbodies, dry gullies or depressions
- any ephemeral stream or river – that is, a stream or river on your property that flows for at least three months between March and September but doesn't flow all year.

Poorly designed dams can cause erosion, contribute to flooding and pose a hazard to downstream landowners. To reduce the adverse effects and be a permitted activity, you must ensure:

- the catchment area draining into your dam is less than 1km<sup>2</sup> (100ha)
- the water depth in the pond is no more than 3m
- that your dam holds no more than 20,000m<sup>3</sup> of water

- the dam doesn't affect any significant geothermal features
- the dam isn't constructed in a cave system.

There are a number of other conditions that are required to be met in the *Waikato Regional Plan*, so it is advisable to check with us by calling 0800 800 402.

By integrating water storage structures and water harvesting in landscapes in a planned and systematic manner, it is possible to create a “water buffer” that helps reduce vulnerability to drought and seasonal variations in rainfall. The structures can be used for multiple purposes, such as agriculture, livestock watering and domestic use.





**He taiao mauriora**

Healthy environment

**He ōhanga pakari**

Strong economy

**He hapori hihiri**

Vibrant communities

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