Cost Benefit Analysis to support the Proposed Chatham Islands Regional Pest Management Plan

This report has been prepared for the Chatham Islands Council as part of the preparation of a Regional Pest Management Plan

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Executive Summary

This report is a supporting document of the Chatham Islands Proposed Regional Pest Management Plan 2020 – 2040 (RPMP). It is intended to help readers understand how the plan was developed and the rationale behind the pests, objectives, and rules chosen. This assessment is required to satisfy section 70 and 71 of the Biosecurity Act 1993 (BSA) and the National Policy Direction for Pest Management (2015) (NPD).

The proposed RPMP differs from the previous Regional Pest Management Strategy 2008-18 (RPMS) in that, rather than representing the entire Chatham Islands Council biosecurity programme, it is limited to the pests for which powers under the Biosecurity Act may be required. Therefore, RPMP implementation costs comprise only a portion of the full biosecurity programme cost and it is these costs that are considered in this report.

The recommendations provided in this report are based on the information outlined in the report. They are intended to be used to support decision-making rather than provide definitive conclusions, and it is entirely appropriate that decision-makers attach different weightings to various considerations to produce an alternative conclusion.

Cost benefit analysis

Analysis is largely undertaken at a low level due to the small scale of the wider Chatham Islands biosecurity programme and the RPMP. Each pest is considered against two management options, 'do nothing' and either Exclusion, Eradication, Progressive Containment or Sustained Control.

It is considered that overall benefits exceed costs for all pests when the proposed management objective is compared with doing nothing. For two pests, Chilean rhubarb and broom, the costs outweigh benefits when considering the impacts on production values alone. However, when taking into account the impact of these pests on other values, including biodiversity, cultural and landscape values, it is regarded that overall, the benefits of control outweigh the costs.

The key outcomes derived from the analyses of benefits and costs are shown in Table 1 below.

Cost allocation

The report also provides information on each of the items that must be considered in developing a funding policy for the pest management plan and provides a recommendation on the funding options based on that information. Recommendations are shown in Table 1 below.

The Chatham Islands is a small Council and is funded from a mix of general rate, county dues and Crown Appropriation. Because of this unique funding situation and the limited capacity of rate gathering in a small community, it would be administratively inefficient to target individuals or small groups of residents with Targeted Rates. All residents, including private landowners, pay general rates and it is considered that they are contributing to the RPMP implementation through this mechanism.

In general, the recommendation is for Council to 100% fund the pest programme from general rates and Crown contribution, as most of the pests impact values that provide non-monetised benefits to the wider community, such as biodiversity. Conversely, gorse solely impacts private land occupiers, particularly farmers and growers, so it is recommended that they are responsible for funding 100% of control costs for gorse, as exacerbators.

Good Neighbour Rules

A Good Neighbour Rule is proposed for gorse as part of the Sustained Control programme. For light infestations of gorse in the source property, the benefits of the control will possibly outweigh the costs where the boundary is a minimum of 900m in length. In this situation, the costs of control for the source and receptor land occupiers are likely to be similar, which is considered to be reasonable.

For dense infestations, the benefits of the control will possibly outweigh the costs where the boundary is a minimum of 930m in length. The costs of control for source land occupiers exceeds the costs for the receptor land occupier by 40%, which is considered to be moderately reasonable. In this situation, a case-by-case judgement needs to be made by Chatham Islands Council (or a biosecurity officer with delegated authority) as to whether the costs of compliance are reasonable, relative to the costs that the adjacent land occupier would incur from the pest spreading in the absence of the rule.

Table 1 - Summary of proposed pests, management objectives and costs

Pest	Recommended objective	Annual programme cost and responsibility for delivery	Recommended cost allocation
American foulbrood (AFB) Ant (Argentine ant; Darwin's ant) Asian paddle crab Australian droplet tunicate Boneseed Chilean needlegrass Clubbed tunicate Hedgehog Mediterranean fan worm Mustelid (ferret; stoat; weasel) Plague skink Possum Pyura Rabbit Rat (kiore; Norway rat; ship rat) Varroa bee mite Wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby) Wasp (common wasp; German wasp)	Exclusion	The total expenditure on these pests is expected to be $145,000 per year, delivered by the border security programme. Council will take responsibility for delivery of programmes to manage these pests.	**100% Council funded** – the proposed pests predominantly affect values of interest to the wider community, including biodiversity, landscape, social and cultural values. The wider island community benefits from their control.
Banana passionfruit Old man's beard Reed sweet grass Wild ginger (kahili ginger; yellow ginger) Willow (crack willow; grey willow)	Eradication	The total expenditure on these pests is expected to be $26,000 per year for the first 5 years of the Plan, then reducing to $10,000 per year from year 6 onwards. Council will take responsibility for delivery of programmes to manage these pests.	

Pest	Recommended objective	Annual programme cost and responsibility for delivery	Recommended cost allocation
Broom (common broom; white broom; Montpellier broom) Canada geese Feral goat Chilean rhubarb Chilean guava*	Eradication	The total expenditure on these pests is expected to be $95,000 per year for the first 5 years of the Plan, then reducing to $10,000 per year from year 6 onwards. Council will take responsibility for delivery of programmes to manage these pests.	**100% Council funded** – the proposed pests affect both biodiversity and production values. The wider island community and private land occupiers benefit from their eradication. The infestations are small and would require targeted control by some landowners and not others. Council will take responsibility for delivery of programmes to manage these pests to achieve a better result and it would be administratively ineffective to target a small number of landowners. Land occupiers will contribute through the General Rate.
Buddleia Ragwort Sycamore African club moss Ice plant	Progressive containment	The total expenditure on these pests is expected to be $7,000 per year throughout the life of the Plan. Council will take responsibility for delivery of programmes to manage these pests.	**100% Council funded** – the proposed pests predominantly affect values of interest to the wider community, including biodiversity, landscape, social and cultural values. The wider island community benefits from their control. Ragwort can affect production values, but infestations are small and would require targeted control by some landowners and not others. Council will take responsibility for delivery of programmes to manage these pests.
Chilean guava*	Sustained control	The total expenditure on this programme is expected to be $2,000 per year throughout the life of the Plan. Council will take responsibility for delivery of programmes to manage these pests.	
Gorse		The total Council expenditure on gorse is expected to be $40,000 per year throughout the life of the Plan. Land occupiers will take responsibility for control of Gorse on their properties, which is conservatively estimated at $150,000 each year. Council will maintain responsibility for inspection and monitoring and will offer discretionary non-regulatory support as part of the wider biosecurity programme.	For inspection and monitoring costs to prevent spread onto neighbouring properties – **100% Council funded** Control costs to prevent spread – **100% land holder-funded as exacerbators** The control of gorse primarily provides production benefits, and the prevention of any spread is of benefit to the rural land. Therefore, land occupiers should bear the majority of any costs to control it. Because land holders are able to determine whether control is worthwhile on their own property, in the absence of any wider benefit the major gains will come from preventing spread. Council will fund and provide inspection and monitoring of control actions by land occupiers.

* Note that Chilean guava is included in two management programmes, Eradication and Sustained Control, for two separate locations

Contents

1 Introduction

1.1 Purpose of the report

The Chatham Islands Council is reviewing its Regional Pest Management Plan (RPMP) to bring it in line with the requirements of the Biosecurity Act 1993 (BSA) and the National Policy Direction for Pest Management 2015 (NPD). The purpose of the RPMP is to provide the regulatory part of a wider biosecurity framework to manage harmful organisms efficiently and effectively in and around the islands. Once operative, the RPMP will empower the Council to exercise the relevant advisory, service delivery, regulatory and funding provisions available under the BSA to deliver the desired outcomes for pest management.

The report gives an overview of the cost benefit rationale behind the pests, objectives, and rules chosen. It should be read in conjunction with the Proposed Chatham Islands RPMP (the Proposal), which provides a good overview of potential pest impacts, what values may be affected in the absence of any management, and the likely significance of these impacts.

This CBA report provides information required to determine that pest management options proposed in the Chatham Islands RPMP are likely to meet the requirements of the BSA and the NPD. It assesses the impacts of plant and animal pests proposed for inclusion in the Proposed RPMP and evaluates the costs and benefits of the proposed management response.

The recommendations provided in this report are based on the information outlined in the report. They are intended to be used to support decision-making rather than provide definitive conclusions, and it is entirely appropriate that decision-makers attach different weightings to various considerations to produce an alternative conclusion.

The report has been prepared by Carina Ltd, with assistance from Environment Canterbury, in conjunction with the preparation of the proposed Plan.

1.2 Structure of the report

The report is structured as follows:

Section 2 provides some background on the Chatham Islands and presents an overview of the methodology used to assess the Proposal against NPD requirements.

Section 3 presents the results of the cost benefit analysis against Section 6 of the NPD. Pests are grouped by management programmes – Exclusion, Eradication, Progressive Containment or Sustained Control – and assessed against criteria laid out in the NPD to justify their inclusion in the Plan.

Section 4 discusses the funding analysis, as prescribed in Section 7 of the NPD.

Section 5 provides an assessment of a Good Neighbour Rule (GNR) for Gorse, as required by Section 8 of the NPD.

2 Background and methodology

2.1 Values on the Chatham Islands

The isolated nature of the Islands means that its cultural, economic, and social wellbeing is inextricably linked to the sustainable management of the natural and physical resource base, which provides, directly or indirectly, for the livelihood of the vast majority of islanders. The main economic base of the Chatham Islands is primary production – fishing and farming. The fishing industry accounts for the greatest proportion of the Islands' income as well as providing 40% of jobs. Future expansion of the shellfish industry is expected following Central Government investment in shellfish aquaculture farming. Terrestrial farming is the second highest earner, with live export of sheep and cattle for meat production the main farm export, supplemented with wool.

Ecotourism is a growing industry on the Islands, with the spectacular landscapes, rare and endemic plant and birdlife, and sustainably harvested kaimoana advertised as the main selling points to potential visitors. Recent Central Government investment in the Islands' tourism industry is hoped to lead to increased visitor numbers, with a domestic New Zealand island-holiday destination particularly attractive in a post-Covid world.

Much of the coastal environment is of cultural significance to Moriori and Ngāti Mutunga, with a number of spiritual sites located in proximity to the coast and importance for cultural harvesting practices. Protecting the rich ecosystems is critical to ensuring these practices can continue for generations to come.

The natural environment of the Chatham Islands is particularly unique and, in some cases, pristine. The Islands are home to many species that are nationally and internationally important to biodiversity. Many of the Chatham Islands' indigenous plants, native birds, and insects are found nowhere else in the world. Due to its isolation, the Chatham Islands have fewer invasive terrestrial organisms than mainland New Zealand.

The impacts to biodiversity, landscape and production values from the proposed pests are well understood due to a wealth of biosecurity sector experience and literature sourced from both the Chatham Islands and wider New Zealand. Where there is an impact on biodiversity, it can be assumed that this also impacts cultural values, due the close relationship between imi/iwi and the natural environment. There is less information available on the impacts from pests on cultural, social, and recreational values and, while touched on in this report, these are not fully qualified in the analyses. The specific values and impacts that this report considers are further detailed in Section 2.3.1 below.

2.2 NPD requirements for this analysis

The NPD sets out multiple requirements that must be addressed during the development of an RPMP.

2.2.1 NPD Section 6 – Cost benefit analysis

Section 6 of the NPD requires a consideration of costs and benefits, and risks. To summarise Section 6, this includes requirements to:

1) determine the appropriate level of analysis required for costs and benefits
2) undertake the analysis of costs and benefits
3) assess the risk of not meeting objectives
4) assess any residual risks should objectives fail to be met
5) document the analysis and any underlying assumptions

The report analyses two options for each pest based on the categories described in the NPD. These are:

- Do Nothing – where there is no intervention. The pest is allowed to continue to spread and land holders undertake control if they choose.
- A proposed management programme, either Exclusion, Eradication, Progressive Containment or Sustained Control.

2.2.2 NPD Section 7 – Funding analysis

Section 7 of the NPD sets out how an assessment of the allocation of costs for the plan is to be undertaken. This has two clauses, which can be summarised as requirements to:

1) consider how pests are grouped for the purposes of cost allocation.
2) determine the appropriate cost allocation based on beneficiaries and exacerbators.

As with Section 6 on the analysis of costs and benefits, there is a requirement to document the analysis and underlying assumptions.

2.2.3 NPS Section 8 – Good Neighbour Rules

The Good Neighbour Rule (GNR) is covered by Section 8 of the NPD. These require that the:

a) Pest would spread onto adjacent land.
b) That the pest would cause unreasonable costs for the adjacent land holder (receptor).
c) The receptor land holder is controlling the pest.
d) The requirement on the land holder from where the pest (source) is spreading is not more than is required to prevent the pest spreading.
e) The costs of compliance for the source land holder are reasonable relative to the cost that the receptor land holder would incur from the pest spreading.

A GNR for gorse has been proposed. The analysis focuses on whether the costs for the source land holder are reasonable relative to the costs caused by the spread of the pest in the absence of the rule.

2.3 Analysis methodology

2.3.1 Level of assessment

The NPD states that an appropriate level of assessment must be undertaken for each pest or groups of pests. The level of the analysis is determined by:

a) the level of uncertainty of the impacts of the subject, or an organism being spread by the subject, or of the effectiveness of measures; and
b) the likely significance of the subject, or an organism being spread by the subject, or of the proposed measures, in terms of stakeholder interest and contention, and the total costs of the proposed plan; and
c) the likely costs of the programme relative to the likely benefits; and
d) *the level of certainty and the quality of the available data.*

Three possible levels of assessment were considered for the analyses in this report:

Low level – A qualitative analysis, undertaken in situations where:

- pests, their impacts, management methods and risks are well known and understood;

- quantitative data may be lacking or difficult to source;
- the programme cost is low compared to the potential benefits of the programme;
- there is no opposition from interested parties; and/or
- it is not considered cost-effective to carry out a more in-depth quantitative assessment.

Medium level – A qualitative analysis where some aspects are quantitative or monetised, undertaken where:

- pests are generally understood, but there may be some uncertainty around pest characteristics, impacts, management methods or risks;
- sufficient quantitative data is available to conduct some quantitative analysis;
- programme costs are moderate compared to the potential benefits of the programme; and/or
- there may be some opposition from interested parties.

High level – A quantitative analysis, undertaken where:

- there is uncertainty around pest characteristics, impacts, management methods or risks;
- ample, accurate quantitative data is available to conduct a detailed analysis for costs and benefits, and risks;
- programme costs are high compared to the potential benefits of the programme; and/or
- there is opposition from interested parties.

On this basis, a *low level* of assessment is applied for the majority of pests included in the Proposed RPMP. Good qualitative information exists for these pests as they have been managed on the Chatham Islands for a number of years, pests are well known, and there is understood to be no opposition from the community. This previous work has been undertaken predominantly by the CIC in partnership with others on the Chatham Islands. There is generally a low cost for the proposed pest management programmes compared to the potential benefits.

A *medium level* of assessment is applied for the Eradication programme pests Canada geese, feral goats, Chilean rhubarb, broom (common broom; Montpellier broom; white broom), Chilean guava and gorse, as the expenditure on these programmes will be more substantial.

Section 3 provides a more detailed rationale for the level of assessment for each analysis.

2.3.1 Assessment methodology

Assessment has been undertaken in accordance with the NPD requirements. The results of each assessment are laid out against individual parts of the NPD for clarity. All assessment results are presented in table format. Pests are assessed against a 'do nothing' option and a proposed management option: Exclusion, Eradication, Progressive Containment, or Sustained Control programmes. The likely outcomes of both options are assessed.

Most pests are assessed at a *low level*, so analyses are generally descriptive in nature. Where a *medium level* analysis has been undertaken or cost and benefits have been monetised, quantified results will also be provided. The methodology used for each level of analysis are as follows:

Low level of analysis:

- Describe the costs and impacts of each option
- Describe the benefits of each option
- Monetise costs and benefits where possible
- Describe risks associated with the success of each option
- Select the most appropriate option

Medium level of analysis:

- Describe the costs and impacts of each option
- Describe the benefits of each option
- Model quantified costs and benefits for each option using the Agresearch CBA tool (see section 2.3.2)
- Describe risks associated with the success of each option
- Select the most appropriate option

Section 71 of the BSA provides a loose framework of adverse effects or impacts that should be considered when assessing the suitability of pests for their inclusion in the RPMP. This report considers the values and impacts shown in Table 2 below.

Table 2 - Assessment of values and impacts

Value affected	Potential impact on value	Type of assessment
Cultural	Māori and Moriori culture – impacts on food gathering, hunting or important cultural sites.	Qualitative for all analyses
Social	Human health – species that are known to sting or bite or carry disease. Nuisance – species that cause nuisance to people.	Qualitative for all analyses
Biodiversity	Native species diversity – impacts on the diversity, abundance, or composition of indigenous species. Ecosystem condition – capacity to affect the condition of ecosystems, e.g. coastal & marine environments.	Qualitative for all analyses
Economic	Primary production – impacts on sheep & beef farming, forestry, aquaculture or commercial fishing. Tourism – impacts on the aesthetic feel of areas of Chatham Islands.	Qualitative for *low level* analyses Quantitative for *medium level* analyses
Landscape	Visual impact – how a pest changes the way the landscape looks and feels.	Qualitative for all analyses
Recreational	Recreation – impacts on recreation or amenity values, such as recreational fishing, sailing, hunting and tramping.	Qualitative for all analyses

Where a *medium level* assessment has been conducted, costs and benefits of economic values have been quantified, but costs and benefits associated with other values are discussed in qualitative terms due to the difficulty of monetising these. Quantitative data has been sourced from either literature or from experienced Council biosecurity officers. All parameters and model results are presented in Appendix 1.

Pests have been grouped together in their proposed programmes where it is reasonable to do so, as shown in Table 3. For example, the Exclusion pests are all absent on the Chatham Islands, all have the same objective – to exclude them from the Chatham Islands – and are all delivered by the same border control intervention. Therefore, it is reasonable to group these to conduct the assessment.

Where pests differ in their proposed objective, scale, and/or level of assessment, they are assessed separately.

Table 3 – Pest groupings for analyses

Proposed programme	Level of assessment for CBA	Pest group	Section ref.
Exclusion	Low	American foulbrood (AFB) Ant (Argentine ant; Darwin's ant) Asian paddle crab Australian droplet tunicate Boneseed Chilean needlegrass Clubbed tunicate Hedgehog Mediterranean fan worm Mustelid (ferret; stoat; weasel) Plague skink Possum Pyura Rabbit Rat (kiore; Norway rat; ship rat) Varroa bee mite Wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby) Wasp (common wasp; German wasp)	3.1
Eradication	Low	Banana passionfruit Old man's beard Reed sweet grass Wild ginger (Kahili ginger; yellow ginger) Willow (crack willow; grey willow)	3.2.1
	Medium	Broom (common broom; white broom; Montpellier broom) Canada geese Feral goat Chilean rhubarb Chilean guava*	3.2.2
Progressive containment	Low	Buddleia Ragwort Sycamore African club moss Ice plant	3.3
Sustained control	Low	Chilean guava*	3.4.1
	Medium	Gorse	3.4.2

* Note that Chilean Guava is included in two management programmes, Eradication and Sustained Control, for two separate locations

The assessments will refer to cost and impacts against the 'pest curve'. This is show in Figure 1 below. This shows the pest infestation curve alongside the corresponding RPMP Programmes and

demonstrates basic pest population dynamics. It can be used to help guide Plan objectives and management programmes for individual pests.

Exclusion:	Eradication:	Progressive containment:	Sustained control:
American foulbrood (AFB) Ant (Argentine ant; Darwin's ant) Asian paddle crab Australian droplet tunicate Boneseed Chilean needlegrass Clubbed tunicate Mediterranean fan worm Mustelid (ferret; stoat; weasel) Plague skink Pyura Rabbit Varroa bee mite Wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby) Wasp (common wasp; German wasp) ***Exclusion from Pitt Island/Rangihaute/Rangiauria only:*** Hedgehog Possum Rat (kiore; Norway rat; ship rat)	Banana passionfruit Broom (common broom; white broom; Montpellier broom) Canada geese Chilean guava* Chilean rhubarb Feral goats Old man's beard Reed sweet grass Wild ginger (kahili ginger; yellow ginger) Willow (crack willow; grey willow)	African club moss Buddleia Ice plant Ragwort Sycamore	Chilean guava* Gorse **Note that Chilean guava is included in two management programmes, relating to two different locations on Chatham Island/Rēkohu/Wharekauri*

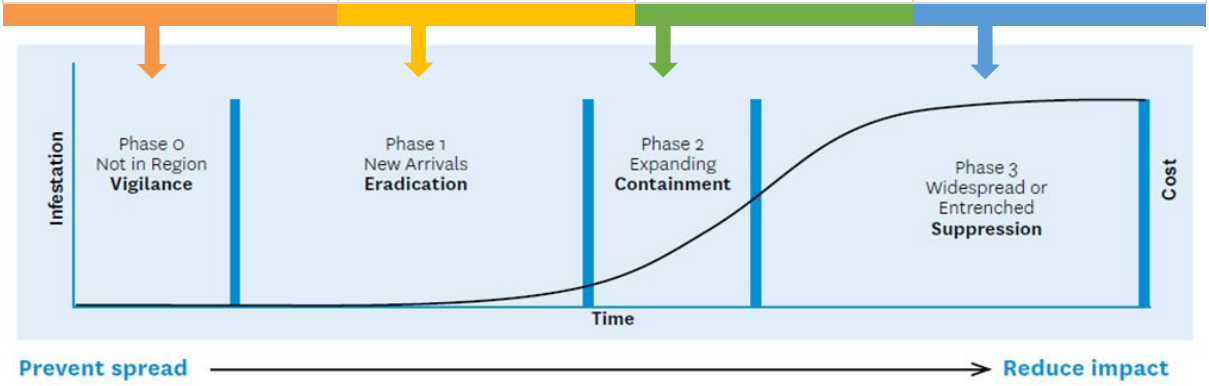


Figure 1 - Pest infestation curve (derived from Williams, 1997. Ecology and Management of Invasive Weeds. Department of Conservation) and proposed pest programmes

2.3.2 The Agresearch cost benefit analysis tool

The AgResearch CBA tool is a web app, developed by Agresearch, that enables a cost-benefit analysis to be conducted for a proposed pest management programme. This tool was used for pests requiring a *medium level* assessment. The model assumes that the pest would spread logistically in the absence of the programme and that the management would prevent this spread. The 'benefits' in the CBA are

the lost earnings that would be prevented by the management, and the 'costs' are the sum of the programme's implementation costs and lost earnings in the infested area.

The model also calculates costs associated with a 'do nothing' approach, which assumes that in the absence of a management objective and programme, nobody would undertake any control and the pest in question would spread. These costs are included in the 'do nothing' approach analyses for relevant pests.

The tools results in a Net Present Value, or NPV. For a programme to be considered economically worthwhile it should have a NPV greater than zero. Conversely, if the NPV is less than zero (minus), it is considered that the economic costs outweigh the benefits.

It is important to note that the results calculated by the tool provide an economic indication of costs and benefits – it does not include the costs of impacts from pest on other values, such as biodiversity, recreational use and cultural gathering. Therefore, the results are to be used to assist decision-making alongside the evaluation of other monetised or non-monetised costs and benefits.

The model and user manual can be found at: https://www.agresearch.co.nz/cba/cba.php

2.3.3 Model parameters and assumptions

All assumptions used in the analyses are detailed in section 3. Where a *medium level* analysis has been undertaken using the Agresearch CBA tool, model input parameters were sourced from Environment Canterbury biosecurity staff. These are presented in Appendix 1.

A discount rate of 4% has been used for the CBAs in this report. A lower discount rate gives greater weight to future costs and benefits than a higher discount rate, which is suitable when considering what are often long-term impacts of pest infestations.

A key input parameter to model 'costs' is the earnings that land occupiers would earn per hectare of farm (or lose in the event of pest infestation or spread). The predominant farm type on the Chatham Islands is non-intensive sheep and beef and the geographic location of the islands means the earnings per hectare are not as high as mainland New Zealand[1]. Land type for farming is assumed as hill country due to the lower stocking rates in the Chatham Islands. For this CBA, $300/ha earnings[2] has been used as a conservative estimate.

[1] Marin Jenkins (2017). *Chatham Islands Economic Profile: Final report*.
[2] Based on Beef & Lamb NZ Benchmarking Tool, $355.85/ha 2019-2020 forecast for All New Zealand Region, All [Farm] Classes at https://beeflambnz.com/data-tools/benchmarking-tool

3 Cost benefit analysis

3.1 Exclusion programme

Pests in this group: American foulbrood, ant (Argentine ant; Darwin's ant), Asian paddle crab, Australian droplet tunicate, boneseed, Chilean needlegrass, clubbed tunicate, hedgehog, Mediterranean fan worm, mustelids (ferret; stoat; weasel), plague skink, possum, pyura, rat (kiore, Norway rat, ship rat), varroa bee mite; rabbit, wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby) and wasp (common wasp; German wasp)	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	Pests to be managed in the exclusion programme are not present on the Chatham Islands. The biology, impact and spread potential of these pests is documented and well understood. These pests are already established in New Zealand, where they have impacted multiple geographic locations. The programme is delivered by the Chatham Islands Council's border biosecurity programme at a cost of $145,000 per year. The border programme has been in operation for a number of years and has been generally successful in excluding these and other pests. There have been recent incursions of German wasp and several other unwanted organisms, which were detected early and eradicated quickly. Chatham Islands residents are generally supportive of the border biosecurity programme. Excluding these pests is beneficial to the general public and private land occupiers to mitigate impacts to cultural, social, economic, biodiversity, landscape, and recreational values. This is considered a low cost for the benefits provided and avoidance of potential impacts. **A low-level assessment is considered appropriate.**
(2) Analysis of benefits and costs	
(a) Impacts of pest	Most of the pests in this programme affect terrestrial or marine biodiversity values and it is considered that there would be high impact on the Chatham Island's natural environment, including species diversity, ecosystem condition and visual impact to landscape. These pests will kill and/or outcompete and displace native species, which will affect the condition, composition and extent of native ecosystems.

	The marine pests Asian paddle crab, Australian droplet tunicate, clubbed tunicate, Mediterranean fanworm and pyura have the potential for moderate to high impact on commercial fisheries, cultural food gathering, cultural sites, recreational fishing and tourism. Wasps, ants and rats have the potential for moderate impact on social values, including to human health from bites, stings, carrying disease and nuisance. The impact potentially increases as population increases. Rats, rabbit, wallaby and Chilean needlegrass affect production values, which could heavily impact commercial farmers and growers if they become established. Chilean needlegrass, in particular, could have a high impact on farming as it affects pasture availability and animal welfare.	
(b) Potential management options:	**Do nothing**	**Exclusion**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	In the absence of management, these pests may find their way onto the Chatham Islands and become established. There are no benefits to this option. There are no council costs associated with a do-nothing approach. In the absence of a Council programme, there would be no concerted effort to exclude pests from the Chatham Islands. The cost of this option is a potential loss of terrestrial and marine biodiversity values, cultural, landscape and recreational values and limited loss of production values. Control costs will increase if these pests spread to the Chatham Islands and become established, requiring control in the future.	Exclusion is considered the most cost-effective option to manage these pests, operating at the base of the pest curve. The benefits of this option include: • Pests will be excluded, mitigating risks to cultural, social, economic, biodiversity, landscape, and recreational values • Council are responsible for providing the service, which will be undertaken by skilled biosecurity staff The Chatham Islands Border Biosecurity Programme costs $145,000 per year. There is a low risk that this programme does not meet its objective if the methods used do not identify all pests are low quality or insufficient. If this eventuated, it could affect the benefits above and increase costs. This is mitigated by ensuring skilled personnel carry out operations and further mitigated by monitoring, to make sure the management option is working. Incursion response will be carried out if any pest enters the Chatham Islands.

(i) adjust benefits and costs for each option to take account of (g) and (h)	The border biosecurity programme has been operational for a number of years. Where an incursion has been detected, incursion response measures have successfully removed any threat. It is considered that the benefits and costs remain the same when risk and risk mitigation are taken into account.
(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed: • in the absence of a Council-led programme, no other person or agency would undertake management of these species to prevent them from arriving and establishing on the Chatham Islands; and • that these pests are not already present on the Chatham Islands.
(j) Preferred management option	**Exclusion** is considered to be a cost-effective option to manage these pests, operating at Phase 0 on the pest curve. Chatham Islands Council will undertake extensive border control, surveillance, and incursion response work to implement this programme. There is some low-level risk to achieving 100% exclusion of the pests, due to the many and varied pathways, but incursion response minimises the risk of pests becoming established. The costs involved under an exclusion programme are relatively minor compared to the benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	There is a risk of low-quality surveillance and inspection work being carried out, but the likelihood is considered to be low. Work will be undertaken by experienced biosecurity contractors and Council biosecurity staff who have a proven track record of delivering border control operations.
(b) Extent to which preferred option will be implemented and complied with	As a professional biosecurity contractor and the Council will be delivering this programme, the compliance risk is considered to be low.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	The general public generally support the exclusion of pests. There are no concerns of public or political opposition. The risk is considered to be low.
(e) Any other material risk	Not aware of any other material risks.
(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and*	There is always a risk that a pest will evade the border biosecurity system and backup surveillance and incursion response. The impact would be moderate to high across all values, but there is a low likelihood of this occurring. A pest incursion would need to be of a significant scale for all controls to fail.

(ii) specify which of the benefits are most likely to be affected if the risk eventuated.	

3.2 Eradication programme

3.2.1 Low-level assessment pest group

Pests in this group: Banana passionfruit, old man's beard, reed sweet grass, wild ginger (kahili ginger & yellow ginger) and willow (crack willow & grey willow)	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	Plant pests in the eradication programme are low incidence and present at limited locations in the Chatham Islands. Banana passionfruit is present at 5 locations across Chatham Island/Rēkohu/Wharekauri; crack willow/grey willow has been identified at 11 sites on Chatham Island/Rēkohu/Wharekauri, and 1 site on Pitt Island/Rangihaute/Rangiauria; wild ginger (kahili ginger & yellow ginger) has been identified at one location on Chatham Island/Rēkohu/Wharekauri; old man's beard is present at two adjacent sites in the northern part of Chatham Island/Rēkohu/Wharekauri; and reed sweet-grass is known to be present at 1 site, in the southeast of Chatham Island/Rēkohu/Wharekauri. Chatham Islands Council has been controlling these pests in recent years. The biology, impact and spread potential of these pests is documented and well understood. These pests are controlled by application of herbicide, which is known to be effective and, as Council will provide service delivery for the eradication programme, control will be undertaken by skilled biosecurity officers. Eradicating these pests is beneficial to the general public by protecting biodiversity values and it is understood that there is no opposition to their inclusion. The cost of the programme will be $26,000 per year for the first 5 years of the Plan, then reducing to $10,000 per year from year 6 onwards, which is considered to be low compared to the benefits of permanently eradicating these pests. **A low-level assessment is considered appropriate.**
(2) Analysis of benefits and costs	
(a) Impacts of pest	All of the pests in this programme affect terrestrial biodiversity values and it is considered that there would be high impact on the Chatham Islands' natural environment, including species diversity,

	ecosystem condition and visual impact to landscape. These pests will kill and/or outcompete and displace native species, which will affect the condition, composition and extent of native ecosystems.	
(b) Potential management options:	**Do nothing**	**Eradication**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	There are no benefits to this option. There are no council costs associated with a do-nothing approach. In the absence of management, these pests would continue to spread and become established in new areas. The cost of this option is a potential loss of terrestrial biodiversity values. Control costs will increase if these pests spread in density and extent and then require a greater level of control.	The benefits of this option include: • Pests will be eradicated, mitigating risks to biodiversity values • Eradication of these pests in the next five years prevents further spread and increasing costs of control in the future. The Eradication programme for these pests costs $26,000 per year for the first 5 years of the Plan, then reducing to $10,000 per year from year 6 onwards to maintain inspection and monitoring. This is considered a low cost for the benefits provided and avoidance of potential impacts. There is a risk that this programme does not meet its objective if plants are missed before seeding, increasing the seedbank. The risk is considered low due to the small number of locations and plants that require control. If this eventuated, it could affect the benefits above and increase costs. This can be further mitigated by monitoring to make sure control is effective, and pests have not spread to other areas.
(i) adjust benefits and costs for each option to take account of (g) and (h)	Council has been managing these pests for a number of years, reducing them to the extent where eradication can be considered. There is high certainty in terms of pest characteristics, impacts and risks. It is considered that the benefits and costs remain the same when risk and risk mitigation are taken into account.	
(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed that in the absence of a Council-led programme, no other person or agency would undertake management of these species to prevent further spread.	

(j) Preferred management option	**Eradication** is considered the most cost-effective option to manage these pests, operating in phase 1 of the pest curve. Chatham Islands Council will undertake the control work to implement this programme. There is some low-level risk to achieving eradication of the pests, but this can be mitigated with effective inspection and monitoring. The costs involved for this eradication programme are considered to be low compared to the benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	Risks include: • low-quality control work being carried out (plants being missed or herbicide poorly applied), but the likelihood is considered to be low. Work will be undertaken by experienced Council biosecurity staff who have a proven track record of delivering pest control programmes. Controlled sites will be monitored to ensure pests are removed.
(b) Extent to which preferred option will be implemented and complied with	As the Council will be delivering pest control for this programme, the compliance risk is considered to be low.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	There are no concerns of public or political opposition. The risk is low.
(e) Any other material risk	Not aware of any other material risks.
(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and* *(ii) specify which of the benefits are most likely to be affected if the risk eventuated.*	Even with a successful control programme, there is a low-moderate risk of seed spread by human activity (machinery, stock, clothing, etc.) or natural means (bird carry, etc.) over the next five years. This risk cannot be entirely mitigated, but biosecurity officers will continue to work with land occupiers and the general public via advocacy and education to minimise risks from human spread.

3.2.2 Medium-level assessment pest group

Pests in this group: Canada geese, feral goat, Chilean rhubarb, broom (common, Montpellier and white) and Chilean guava	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	The biology, impact and spread potential of these pests is well documented and understood as they are established on Chathams Islands and widespread across New Zealand. Chatham Islands Council has been controlling these pests for a number of years and are experienced in their control. These pests are now present at populations that can be eradicated where control measures are applied effectively. There has been considerable effort to reduce the populations of Canada geese and feral goat in recent years and these are now at sufficient levels to consider eradication. An area of Chilean guava has established near the town of Owenga and it is considered that early eradication of this infestation is necessary to prevent further spread. There are a number of locations of broom (common, Montpellier & white) on Chatham Island, which are now at low enough levels to consider eradication. Chilean rhubarb has been reduced in extent to a number of locations in the southern part of the main island and is now considered suitable for eradication. The remaining Chilean rhubarb is located on rocky outcrops that require specialist abseiling to access and undertake control. This increases the cost of control, which would be applicable whether managing for Eradication, Progressive Containment or Sustained control. Control measures for Canada geese and feral goat include ground-based and helicopter shooting. These pests are highly mobile, but measures are known to be effective when undertaken with sufficient planning. Landowner cooperation will be critical to the success of control measures for these pests. The control measure for Chilean rhubarb, broom and Chilean guava is application of herbicide and is known to be effective. Council will provide service delivery for the eradication programme. This will be undertaken by skilled biosecurity officers and contractors. The cost of the programme will be $95,000 per year for the first 5 years of the Plan, then reducing to $10,000 per year from year 6 onwards to maintain inspection and monitoring.

	Eradicating these pests is beneficial to the general public and commercial landowners and it is understood that there is no opposition to their inclusion. Chilean guava is desirable for wine and jam-making and its inclusion in the Plan may be questioned by some local residents. However, it is understood that there has been no opposition raised to its inclusion in the Plan. **A medium-level assessment is considered appropriate.**	
(2) Analysis of benefits and costs		
(a) Impacts of pest	The pests in this programme all affect both terrestrial biodiversity values and production values and it is considered that there would be high impact on the Chatham Island's natural environment, including species diversity, ecosystem condition and visual impact to landscape. They will kill and/or outcompete and displace native species, which will affect the condition and extent of native ecosystems. The ongoing spread of Canada geese, feral goat and broom present a moderate impact to commercial farmers and growers, if left uncontrolled (quantified below).	
(b) Potential management options:	**Do nothing**	**Eradication**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	In the absence of management, these pests would continue to spread and become established in new areas. There are no benefits to this option. There are no council costs associated with a do-nothing approach. The cost of this option is a potential loss of terrestrial biodiversity values and limited loss of production values. Control costs will increase if these pests spread in density and extent and then require a greater level of control. As farming makes a significant contribution to the Chatham Islands economy, the costs of a do-nothing approach over 20 years are: • $831,069 for Canada geese; • $8.16M for feral goat; • $65,599 for Chilean rhubarb;	Eradication is considered the most cost-effective option to manage these pests, operating low down on the pest curve in phase 1. The benefits of this option include: • Pests will be eradicated, mitigating risks to biodiversity, landscape and production values • Eradication of these pests in the next five years prevents further spread and increasing costs of control in the future. The Eradication programme costs $95,000 per year ($20,000 for Canada Geese, $20,000 for Feral goat, $35,000 for Chilean Rhubarb, $10,000 for Chilean Guava and $10,000 for Broom). This is considered a low cost for the benefits provided and avoidance of potential impacts. Council will bear the full cost of this programme. This results in a Net Present Value over 20 years of:

	• $67,215 for broom; and • $81,662 for Chilean guava. See Appendix 1 for model outputs from quantitative analysis, per species.	• $715,410 for Canada geese; • $7.86M for feral goat; • -$117,725 for Chilean rhubarb; • -$2,910 for broom; and • $6,935 for Chilean guava. See Appendix 1 for model outputs from quantitative analysis, per species. There is an additional cost of lost hunting/recreational opportunities for hunters associated with feral goat. There is a low risk that this programme does not meet its objective. Canada geese and feral goats are highly mobile pests and can move to areas that are not easily accessible. If this eventuated, it could affect the benefits above and increase costs. This can be mitigated by monitoring to make sure the management option is working, and pests have not spread to other areas.
(i) adjust benefits and costs for each option to take account of (g) and (h)	Council has been managing these pests for a number of years, reducing them to the extent where eradication can be considered. There is high certainty in terms of pest characteristics, impacts and risks. It is considered that the benefits and costs remain the same when risk and risk mitigation are taken into account.	
(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed that in the absence of a Council-led programme, no other person or agency would undertake management of these species to prevent further spread. Assumptions for model parameters are detailed in Appendix 1.	
(j) Preferred management option	**Eradication** is considered the most cost-effective option to manage these pests, operating in phase 1 of the pest curve. The NPVs for Chilean rhubarb and broom are negative, representing costs outweighing benefits when only production values are considered. Chilean guava is only marginally positive when considering the same. However, when considering the impact of all three pests on other values, including biodiversity, cultural and landscape values alongside the opportunity to permanently eradicate these pests, it is considered that benefits of control outweigh the costs. Chilean rhubarb could be considered under the Progressive Containment or Sustained Control	

	programmes where control costs would typically be lower due to the lower level of control necessary to meet those objectives. However, because the remaining Chilean rhubarb is located on rocky outcrops that require specialist abseiling to access and undertake control, the cost of control is unlikely to be substantially lower if working towards a different objective. Eradication is therefore the best value objective for Chilean rhubarb. Chatham Islands Council will undertake the control work to implement this programme. There is some low-level risk to achieving eradication of the pests, but this can be mitigated by working with land occupiers and implementing effective inspection and monitoring. The costs involved for this eradication programme are considered to be low compared to the benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	Risks include: • Low-quality control work being carried out (plants and animals being missed or control measures poorly applied), but the likelihood is considered to be low. Work will be undertaken by experienced Council biosecurity staff who have a proven track record of delivering pest control programmes. Controlled sites will be monitored to ensure pests are removed. • Canada geese and feral goat are highly mobile and, if control work is not sufficiently planned and executed, these pests could move to other areas of the island, avoiding control measures evading detection. • Land occupier cooperation will be critical to meeting this objective. Council have good relationships with landowners and the risk of failing to secure cooperation is considered low.
(b) Extent to which preferred option will be implemented and complied with	As the Council will be delivering pest control for this programme, the compliance risk is considered to be low. However, control of feral goat requires cooperation of all affected land occupiers to increase the chances of programme success. Council biosecurity officers will work with land occupiers to plan and execute control to mitigate risks of non-compliance.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	There are no concerns of public or political opposition. The risk is low.
(e) Any other material risk	Not aware of any other material risks.

(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and* *(ii) specify which of the benefits are most likely to be affected if the risk eventuated.*	Even with a successful control programme, there is a low-moderate risk of seed spread by human activity (machinery, stock, clothing, etc.) or natural means (bird carry, etc.) over the next five years. This risk cannot be entirely mitigated, but biosecurity officers will continue to work with land occupiers and the general public via advocacy and education to minimise risks from human spread.

3.3 Progressive containment programme

Pests in this group: Buddleia, ragwort, sycamore, African club moss and ice plant	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	The biology, impact and spread potential of these pests is documented and well understood. There is high confidence that all locations of these pests are known on the Chatham Islands. Buddleia and sycamore are relatively widespread in pockets on Chatham Island/Rēkohu/Wharekauri and are considered to be too prevalent to eradicate within reasonable timeframes. Ragwort is present at 7 locations on Chatham Island/Rēkohu/Wharekauri. Council previously attempted to eradicate ragwort, but it was found to be more widespread than initially thought. Reducing the extent is considered to be achievable. African club moss is known at 3 sites and ice plant at 2 locations on Chatham Island/Rēkohu/Wharekauri but Council suspects that there may be more locations that have not been identified. All five pests are present at populations that can be reduced in extent using herbicide application – spraying for ragwort, African club moss and ice plant and 'drilling and filling' for buddleia and sycamore - which are known to be effective control measures. Council will provide service delivery for the progressive containment programme. Skilled Council biosecurity officers will provide service delivery for these pests, which will reduce the risk of control failing. The cost of the programme will be $7,000 per year for the duration of the Plan, which is considered to be low cost for the benefits of reducing the extent of these pests and reducing impacts to biodiversity and production values. Controlling these pests is beneficial to the general public and commercial landowners and there is no opposition to their inclusion. **A low-level assessment is considered appropriate.**
(2) Analysis of benefits and costs	
(a) Impacts of pest	All of the pests in this programme affect terrestrial biodiversity values and it is considered that, if left unmanaged, the impact of infestation would be significant on the Chatham Islands' natural environment. The impact is considered to be moderate. They will kill and/or outcompete and displace native species, which will affect the condition and extent of native ecosystems.

	Ragwort can affect production values by decreasing the amount of land available for production, which could impact commercial farmers and growers if they are left uncontrolled. The impact is considered low to moderate.	
(b) Potential management options:	**Do nothing**	**Progressive Containment**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	In the absence of management, these pests would continue to spread and become established in new areas. There are no benefits to this option. There are no council costs associated with a do-nothing approach. The cost of this option is a potential loss of terrestrial biodiversity values and limited loss of production values. Control costs will increase if these pests spread in density and extent and then require a greater level of control.	Progressive containment is considered the most appropriate option to manage these pests as eradication is unlikely to be achieved in the timeframe of the Plan. The benefits of this option include: • Pests will be reduced in extent, reducing impacts on biodiversity and production values • Control of these pests prevents further spread and increasing costs of control in the future. The programme costs $7,000 per year to deliver for the duration of the Plan. This is considered a low cost for the benefits provided and avoidance of potential impacts and costs. There is a risk that this programme does not meet its objective, if further sites are identified that were not previously identified, increasing the scale of control that is needed. The risk is considered low to moderate. If this eventuated, it could affect the benefits above and increase costs. This can be mitigated by increased surveillance to identify new sites and monitoring to make sure pests have not spread to other areas.
(i) adjust benefits and costs for each option to take account of (g) and (h)	Council has been managing these pests for a number of years and the pest characteristics and control methods are well understood. However, there is some risk associated with the presence of other unknown pest sites. However, the benefits and costs are still considered to be as described even if costs slightly increase to achieve the programme objective.	

(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed that in the absence of a Council-led programme, no other person or agency would undertake management of these species to prevent further spread.
(j) Preferred management option	**Progressive Containment** is considered the most cost-effective option to manage these pests, as eradication is unlikely to be achievable within the timeframes of the Plan. Chatham Islands Council will undertake the control work to implement this programme. There is some low-level risk to achieving progressive containment of the pests, especially where pest presence has not been fully identified, but this can be mitigated with effective surveillance, inspection and monitoring. The costs involved for this programme are considered to be low compared to the benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	Risks include: • low-quality control work being carried out (plants being missed or herbicide poorly applied), but the likelihood is considered to be low. Work will be undertaken by experienced Council biosecurity staff who have a proven track record of delivering pest control programmes. Controlled sites will be monitored to ensure pests are removed.
(b) Extent to which preferred option will be implemented and complied with	As the Council will be delivering pest control for this programme, the compliance risk is considered to be low.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	There are no concerns of public or political opposition. The risk is low.
(e) Any other material risk	Not aware of any other material risks.
(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and* *(ii) specify which of the benefits are most likely to be affected if the risk eventuated.*	Even with a successful control programme, there is a low-moderate risk of seed spread by human activity (machinery, stock, clothing, etc.) or natural means (bird carry, etc.). This risk cannot be entirely mitigated, but biosecurity officers will continue to work with land occupiers and the general public via advocacy and education to minimise risks from human spread.

3.4 Sustained control programme

3.4.1 Low-level assessment pest group

Pest: Chilean guava	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	Chilean guava is present at a scale where significant investment would be needed to reduce its extent. The biology, impact and spread potential of Chilean guava is documented and well understood. Chilean guava is located predominantly in the north half of Chatham Island/Rēkohu/Wharekauri and is reasonably widespread. There is also one isolated location near the town of Owenga, which is being considered separately as part of the eradication programme (see section 3.2.2). Chilean guava is controlled by the application of herbicide, which is known to be an effective control measure. Council will provide service delivery for the programme, which will be undertaken by skilled biosecurity officers. The cost of the programme will be $2,000 per year for the duration of the Plan. Controlling this pest is beneficial to the general public and commercial landowners. Chilean guava is desirable for wine and jam-making and its inclusion in the Plan may be questioned by some local residents. However, it is understood that there has been no opposition raised to its inclusion in the Plan. **A low-level assessment is considered appropriate.**
(2) Analysis of benefits and costs	
(a) Impacts of pest	Chilean Guava affects terrestrial biodiversity values and it is considered that, if left unmanaged, the impact of infestation would be significant on the Chatham Islands' natural environment. The impact is considered to be moderate. It will outcompete and displace native species, which will affect the condition and extent of native ecosystems. Chilean guava can also affect landscape values as the population increases, which is considered to present a low to moderate impact. Chilean Guava can also affect production values by decreasing the amount of land available for production, which could impact commercial farmers and growers if left uncontrolled. The impact is considered to be low to moderate, depending on level of infestation.

(b) Potential management options:	**Do nothing**	**Progressive Containment**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	In the absence of management, Chilean guava would continue to spread and become established in new areas. There are no benefits to this option. There are no council costs associated with a do-nothing approach. The cost of this option is a potential loss of terrestrial biodiversity values and limited loss of production values. Control costs will increase if this pest spreads in density and extent and then requires a greater level of control.	Sustained control is considered the most cost-effective option to manage Chilean guava due to its widespread extent. The benefits of this option include: • It will not increase in extent, which will mean no increase in impacts on biodiversity and production values • Control of this pest prevents further spread and increasing costs of control in the future. The sustained control programme for Chilean guava costs $2,000 per year for the duration of the plan. This is considered a low cost for the benefits provided and avoidance of potential impacts and costs. There is a low risk that this programme does not meet its objective if the methods are insufficient to manage the population. If this eventuated, it could affect the benefits above and increase costs. This can be mitigated by monitoring to make sure the management option is working and the pest has not spread to other areas.
(i) adjust benefits and costs for each option to take account of (g) and (h)	The known extent of Chilean guava is well understood, and management methods are known to work well. It is considered that the benefits and costs remain the same when risk and risk mitigation are taken into account.	
(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed that in the absence of a Council-led programme, no other person or agency would undertake management of Chilean guava to prevent further spread.	
(j) Preferred management option	**Sustained Control** is considered the most cost-effective option to manage Chilean guava, as reducing the extent would have a much greater cost and is unlikely to be achievable within the timeframes of the Plan. Chatham Islands Council will undertake the control work to implement this programme. There is some low-level risk to achieve sustained control, but this can be mitigated with effective	

	inspection and monitoring. The costs involved for this programme are considered to be low compared to the overall benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	Risks include: • low-quality control work being carried out (plants being missed or herbicide poorly applied), but the likelihood is considered to be low. Work will be undertaken by experienced Council biosecurity staff who have a proven track record of delivering pest control programmes. Controlled sites will be monitored to ensure plants are removed.
(b) Extent to which preferred option will be implemented and complied with	The Council will be delivering pest control for this programme. However, local residents may transport or communicate Chilean guava for the purposes of consumption. The risk is considered as moderate. To mitigate this, Council will provide advocacy and education for Chilean guava to ensure the general public understands its status as a pest and the impact of aiding its spread.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	Chilean guava is desirable for wine and jam-making and its inclusion in the Plan may be questioned by some local residents. However, it is understood that there has been no opposition raised to its inclusion in the Plan. The risk is considered to be low.
(e) Any other material risk	Not aware of any other material risks.
(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and* *(ii) specify which of the benefits are most likely to be affected if the risk eventuated.*	Even with a successful control programme, there is a low-moderate risk of seed spread by human activities (machinery, stock, clothing, etc.) or natural means (bird carry, etc.). This risk cannot be entirely mitigated, but biosecurity officers will continue to work with land occupiers and the general public via advocacy and education to minimise risks from human spread.

3.4.2 Medium-level assessment pest group

Pest: Gorse	
NPD Section 6. Directions on analysing benefits and costs (summarised)	
NPD provision:	**Evaluation**
(1) Determining appropriate level of analysis:	
Consideration of: *(a) Uncertainty of the impacts of pest, and effectiveness of measures.* *(b) Likely significance of pest or proposed measures in terms of stakeholder interest and contention, and total costs of the plan.* *(c) Likely costs of the programme relative to the likely benefits.* *(d) The level of certainty and quality of available data.*	Gorse is the most widespread pest on the Chatham Islands, covering an estimated 4,500 hectares, and is abundant in suitable habitat throughout all the islands. It cannot be reduced in extent without significant investment over a few decades. It can rapidly invade pasture and outcompete grass and clover, reducing food for stock. Spines pull fleece and lower the value of wool. The biology, impact and spread potential of gorse is documented and well understood and Council has been controlling it for a number of years. Gorse can be difficult to control on infertile and steep land and it regenerates profusely from seed, especially after fire, disturbance, or non-selective spraying. Control measures, including herbicide use and rotational grazing, are known to be effective. Land occupiers are expected to provide boundary control for Gorse on their land, so it does not spread from one property to the next. Council provides non-regulatory support as part of its wider biosecurity programme (helicopter spraying and herbicide contestable fund) to assist land occupiers. Council will undertake inspections to ensure work is being undertaken. The cost of the programme for Council will be $40,000 per year for the duration of the plan. Land occupier control of Gorse is conservatively estimated at $150,000 each year. Controlling Gorse is of benefit to commercial land occupiers to maintain the availability and productivity of productive land and prevent the spread to neighbours. The boundary control requirements reduce the cost burden on land occupiers by avoiding full control across all land area. It is understood that there is no opposition to its inclusion. **A medium-level assessment is considered appropriate.**
(2) Analysis of benefits and costs	
(a) Impacts of pest	Gorse predominantly affect productive land by overtaking pasture and spreading at a fast rate. It has dispersal mechanisms that would allow it to spread to adjacent land within the life of the RPMP. Seed is spread ballistically, being shot away up to 6m from the source plant. Slope angle, rain wash or transport by birds, farm machinery and stock can spread seeds further. Where gorse grows on

	waterway margins, seeds can also be transported downstream by streams and rivers to affect nearby neighbours. As it spreads, it can form dense stands that decrease the amount of land available for production, which could impact commercial farmers and growers if they are left uncontrolled. The impact is considered to be moderate to high, depending on infestation levels. Gorse does not provide a significant threat to native ecosystems as it can be over topped by natives over time. It is a nitrogen-fixer and can facilitate the regeneration of native forest on cleared land. It can, however, affect landscape values by dramatically changing the landscape, particularly in flowering season when the vibrant yellow flowers develop. The impact is considered to be moderate to high.	
(b) Potential management options:	**Do nothing**	**Sustained Control**
Consideration of: *(c) Benefits of management option* *(d) Costs of management option* *(g) Risks that management option will not meet objective, and (h) potential mitigation methods*	In the absence of management, these pests will continue to spread and become established in new areas. Control will be left to the discretion of land occupiers. There are no benefits to this option. There are no council costs associated with a do-nothing approach. As farming makes a significant contribution to the Chatham Islands' economy, the costs of a do-nothing approach, based on lost revenue, are high at $11.1M over 20 years. See Appendix 1 for model outputs from quantitative analysis, per species.	Sustained control is considered the most cost-effective option to manage these pests. The proposed Good Neighbour boundary control width for gorse is 15 metres. While such boundary control is not considered likely to alter the region-wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the Council to assist land occupiers in limiting weed spread between adjacent properties. The requirement to keep areas of publicly funded control clear will protect Council investment in larger-scale gorse control. The benefits of this option include: • Gorse will not increase in extent, which will mean no increase in impacts on production and landscape values • Boundaries will generally be kept clear meaning the effect on neighbouring properties will be minimised • Control of this pest prevents further spread and increasing costs of control in the future. The programme costs $40,000 per year for Council for the duration of the plan. Based on Council costs alone, this results in a Net Present Value of $2,873,756 over 20 years, which shows a

	Future control costs will increase, if this pest spreads in density and extent and then requires a greater level of control.	net benefit under the sustained control programme. Costs to landowners of undertaking control to meet the rule will vary depending on a range of factors, such as the density and extent of the infestation and accessibility of the site. Costs to landowners to comply with the rule are estimated at $100 - $1,000 per hectare, depending on the severity of infestations. This has been conservatively estimated at $150,000 per year. Combined with Council costs, this results in a Net Present Value of $835,207 over 20 years, which shows a net benefit under the sustained control programme. The burden on landowners may be reduced by Council's non-regulatory support as part of the wider biosecurity programme, which currently provides like-for-like funding for helicopter gorse control every year. See Appendix 1 for model outputs from quantitative analysis, per species. There is a low to moderate risk is that this programme does not meet its objective. If this eventuated, it could affect the benefits above and increase costs. This can be mitigated by Council inspection and monitoring to make sure land occupiers are undertaking control and monitoring the wider extent of gorse, to check whether the management option is working and the pest has not spread to other areas.
(i) adjust benefits and costs for each option to take account of (g) and (h)	Council and land occupiers have a long history of managing gorse. There is high certainty in terms of pest characteristics, impacts, risks and mitigation. It is considered that the benefits and costs remain the same when risk and risk mitigation are taken into account.	
(e) Assumptions on which impacts, benefits and costs are based.	For this analysis, we have assumed that: • in the absence of a Council-led programme, no other person or agency would undertake management of these species to prevent further spread; and • the level of Council investment in the programme will be consistent for a 20-year duration. Assumptions for model parameters are detailed in Appendix 1.	

(j) Preferred management option	**Sustained Control** is considered the most cost-effective option to manage gorse, as reducing the extent would have a much greater cost and is unlikely to be achievable within the timeframes of the Plan. Land occupiers are expected to undertake control work and Chatham Islands Council will undertake inspection and monitoring to implement this programme. There is some low-level risk to achieving sustained control, but this can be mitigated with effective inspection and monitoring and work with/supporting land occupiers to undertake control effectively. The costs involved for this programme are considered to be moderate compared to the overall benefits to the Chatham Islands.
(3) Consideration of risks	
(a) Technical and operational risks of preferred option	There is a long history of attempts to control gorse. The technical risks of preventing spread for a well-established and widespread plant are considerable. Risks include: • Low-quality control work being carried out (plants being missed or herbicide poorly applied). The risk is considered to be low-moderate. Work will be undertaken by land occupiers or their contractors. Controlled sites will be inspected and monitored by Council biosecurity officers to ensure pests are removed. Council also provide non-regulatory facilitation and funding support (at its discretion). • Reinvasion from the seed bank may occur for several years, even in the absence of new inputs of seed from off site.
(b) Extent to which preferred option will be implemented and complied with	There is a requirement for land occupiers to undertake control of gorse on private land for this programme. Council will undertake control on road reserves. The compliance risk is considered to be low-moderate. Some land occupiers live off-island and it can be difficult to ensure control work has been undertaken in these cases. Council biosecurity staff will undertake inspections, to monitor the level of work carried out by landowners, advocacy and provide education on control measures. Council also offer non-regulatory support for landowners to undertake control. Where voluntary compliance is not forthcoming, Council will ensure compliance with the rule.
(c) The risk that compliance with other legislation will adversely affect implementation of the preferred option	The Council's Resource Management Document (Report No. R17/3) has rules regarding discharges to land and water. However, the discharge of herbicide is a permitted activity if it is not discharged into water. The risk of these rules adversely affecting the implementation of the preferred option is low.
(d) Risk that public or political concerns will adversely affect implementation of preferred option	The risk is considered to be medium. There is a high cost involved in gorse control (dependent on levels of infestation) and it is widespread. Land occupiers are required to bear the cost of control, which differs from the Council-delivered control for all other pests in the Plan.
(e) Any other material risk	Not aware of any other material risks.

(4) Consideration of residual risks	
(b) for analyses where the benefits are not fully quantified: *(i) state residual risks to the programme and, where practicable, likelihood and impact; and* *(ii) specify which of the benefits are most likely to be affected if the risk eventuated.*	Even with a successful control programme, there is a low-moderate risk of seed spread by human activity (machinery, stock, clothing, etc.) or natural means (bird carry, etc.). This risk cannot be entirely mitigated, but biosecurity officers will continue to work with land occupiers and the general public via advocacy and education to minimise risks from human spread.

4 Good Neighbour Rules

Under section 69(5) of the Biosecurity Act, all land occupiers, including the Crown, must meet 'Good Neighbour Rules' within RPMPs. A Good Neighbour Rule (GNR) responds to the issues caused when a land occupier imposes unreasonable costs on an adjacent land occupier who is actively managing a certain pest, by not undertaking management, or sufficient management, of that pest.

GNRs have specific requirements for cost benefit analysis under Section 8 of the NPD. It requires that:

- The pest would spread onto adjacent land and cause unreasonable costs for the adjacent receptor land occupier
- The receptor land occupier is taking reasonable steps to manage the pest
- The characteristics and proximity of the adjacent land is well understood along with the biological characteristics and behaviour of the pest
- The rule does not set a requirement on an occupier that is greater than that required to manage the spread of the pest to adjacent or nearby land
- The costs of compliance for the source land occupier are reasonable relative to the cost that the receptor land occupier would incur from the pest spreading.

An analysis of costs and benefits has already been undertaken for gorse above. This GNR analysis therefore focuses on whether the costs for the source land holder are reasonable relative to the costs caused by the spread of the pest in the absence of the rule.

The GNR analysis is undertaken using the model developed for the Regional Councils Biosecurity Working Group[3]. The model provides a tabular output describing the boundary distance required before the benefits outweigh the costs, and the relationship between the costs for the source and receptor land holders. These are given to assist and inform any decisions as to whether the rule is reasonable, as per the requirements of clause 8(1)(e)(ii) of the NPD. The model requires a region to be selected, which affects input parameters for benefits (earnings per hectare) and costs (inspection costs per inspection). For this model, Canterbury was selected due to the similarity in operational procedures with the Chatham Islands biosecurity programme.

4.1 GNR analysis for gorse

The biological characteristics and behaviour of gorse is described in Section 3.4.2 above. Gorse will spread naturally in the absence of intervention and potentially trigger control costs for adjacent land occupiers.

Gorse is widespread throughout the Chatham Islands and has continuing and significant impacts on the farming (predominantly non-intensive sheep and beef) sector. It is a significant agricultural production weed that reduces the value of arable land and pastures and threatens economic values. Gorse is a primary coloniser of almost every land class. It can infest grazed pastures and has a long-lived seed bank (~ 30 years) that adds to the length of time (and hence cost) it takes to control the infestation. Once widely established, it can be difficult to manage and management can come at significantly more cost than normal pastoral management. It is considered that land that is affected

[3] Simon Harris, Melissa Hutchison, Jon Sullivan, and Graeme Bourdôt (February 2017). Economic Assessment of Good Neighbour Rules under the National Policy Direction for Pest Management 2015: Model definition and trial results. Developed for the Regional Councils Biosecurity Working Group.

by gorse will be similar to the characteristics of the adjacent or nearby land and therefore equally prone to the same pest.

Gorse has dispersal mechanisms that would allow it to spread to adjacent land within the life of the RPMP. Seed is spread ballistically, being shot away up to 6m from the source plant. Slope angle, rain wash or transport by birds, farm machinery and stock can spread seeds further. Where gorse grows on waterway margins, seeds can also be transported downstream by streams and rivers to affect nearby neighbours.

The Proposal includes a 15-metre boundary clearance rule for gorse[4]. This takes into account the ballistic spread up to 6m from the source plant and other dispersal mechanisms including stock, machinery and birds, and an additional 'safety' buffer has been included to make the required control distance 15 metres from the boundary. This would require land occupiers, including the Crown, on the Chatham Islands to ensure their boundary is kept clear of gorse, where their neighbour is controlling gorse on their respective boundary. The purpose is to prevent the spread from property to property and be a 'good neighbour', to protect values on both sides of the boundary. The selected boundary distance is considered to be practical to ensure seed would not spread onto neighbouring property. The buffer approach is an economically realistic option compared to a requirement to destroy these pests across an occupier's entire property.

Reasonableness of good neighbour rule

For light infestations of gorse in the source property, the costs of control for the source and receptor land occupiers are likely to be similar, which is considered to be reasonable.

For dense infestations, the costs of control for source land occupiers exceeds the costs for the receptor land occupier by up to 40%. In this situation, a case-by-case judgement needs to be made by Chatham Islands Council (or a biosecurity officer with delegated authority) as to whether the costs of compliance are reasonable, relative to the costs that the adjacent land occupier would incur from the pest spreading in the absence of the rule.

Modelling results are shown in Appendix 3.

[4] Proposal for the Chatham Islands Pest Management Plan 2021-2041, Rule 2 (Section 6.4)

5 Funding analysis

Section 7 of the NPD sets out how an assessment of the allocation of costs for the plan is to be undertaken. This section of the report documents the analysis and underlying assumptions.

Chatham Islands Council are the smallest council in New Zealand and the most isolated. The local community contributes rates and county dues in the order of $700,000 per year. Yearly operational costs for the Council are approximately $4M, which funds core activities, including the biosecurity programme. The Council has a funding agreement with the Department of Internal Affairs and receives Crown Appropriation to ensure that the Council is able to meet its statutory obligations and maintain essential services.

Chatham Islands Council consider the provision of biodiversity and biosecurity activities as a public good. However, there can be a private element of benefit where Council-funded work reduces risks for private landowners. In previous years, biosecurity activities have been funded equally from a mix of the Crown contribution, general rates, and landowner contributions. This funding arrangement is expected to continue for the duration of the next Plan.

5.1 The anticipated cost of implementing the Plan, cost allocation and funding rationale

The Chatham Islands Council has been managing many of the pests included in the Proposal for a number of years. The Council has delivered the majority of the work required by the Plan alongside some control work directly funded and undertaken by landowners. As a result of this, implementation costs are generally well understood.

5.1.1 Anticipated implementation costs

The Proposal differs from the previous Regional Pest Management Strategy 2008-18 (RPMS) in that, rather than representing the entire Chatham Islands Council biosecurity programme, it is limited to the pests for which powers under the Biosecurity Act may be required. The Council's wider programme encompasses a suite of regulatory and non-regulatory tools that the Council can deploy to achieve their biosecurity outcomes. Therefore, RPMP implementation costs comprise only a portion of the full biosecurity programme cost.

Table 4 provides the estimated annual expenditure and revenue source for the implementation of the Plan. The expenditure and revenue estimates are expressed in present value terms. Some cost escalation may be unavoidable, but the annual planning process undertaken by Chatham Islands Council should serve to constrain any significant increase in the scale of activity authorised under this Plan. A breakdown of the annual costs of each pest programme is provided in Appendix 2.

Table 4 – Estimated total cost of implementing the Plan

	Expenditure	**Revenue by source**
Application of principal measures across all programmes	$315,000	Combination of general rates and Crown contribution
Landowner control of gorse	$150,000	User pays
Total	**$465,000**	

The Council expects that the relative cost of pest management will be similar for the duration of the Plan.

5.1.2 Beneficiaries and exacerbators, cost allocation and funding rationale

The extent to which any person benefits or is likely to benefit from a pest management plan depends on the organism to be controlled and the area for which expenditure is being incurred. Beneficiaries include land occupiers, commercial organisations (e.g. commercial fisheries) and the community as a whole. Occupiers and commercial organisations may benefit from increased productivity as a result of the effects of the Plan on their own property or area of operation and from reduced risk of spill-over effects from other properties. The community as a whole may obtain non-producer benefits from the implementation of the Plan. Non-producer benefits include a reduction in the actual and potential effects of pests and other organisms to be controlled on one or more of the following:

a. the viability of rare or threatened species or organisms
b. the survival and distribution of indigenous plants or animals
c. the sustainability of natural and developed ecosystems, ecological processes and biological diversity
d. soil resources or water quality
e. human health or enjoyment of the recreational value of the natural environment
f. the relationship of Moriori and Māori with their cultures, traditions and their ancestral lands, waters, sites, waahi tchap'/wāhi tapu and miheke/taonga
g. New Zealand's international obligations, assurances, and reputation
h. other aspects of the environment including amenity and landscape values

Spill-over (externality) effects result in costs or benefits to people other than the land occupier on whose property the pests are located. They include the effects of the spread of plant or animal pests onto neighbouring properties and environmental effects that have costs or benefits to the community as a whole. For example, the spread of seeds of plants onto neighbouring properties or damage to indigenous biodiversity are spill-over effects. The reduced risk of spill-over occurs because the Plan brings about the control of pests, thereby reducing the risk to neighbouring properties and the risk of non-producer values being affected. The non-spill-over benefit (producer benefit) that producers receive by way of extra production and lower control costs, when they control pests on their property, occurs regardless of whether a plan is in place.

The extent to which persons contribute to the problems to be resolved by the Plan for each pest depends on whether their inaction has the potential to result in spill-over effects that cause significant harm to other persons or to the environment generally. Table 5 provides a summary of identified beneficiaries and exacerbators, and recommended cost allocation.

Private land occupiers will be primarily responsible for costs associated with gorse control, although Chatham Islands Council may support them through non-regulatory tools and support at their discretion. Private land occupiers will contribute to the programmes identified in this Plan through a proportion of the general rate that is levied on every separately rateable property in the region under Section 33 of the Rating Powers Act 1988.

5.1.3 Funding limitations

There are no unusual administrative problems or costs expected in relation to recovering costs from any of the persons who are required to pay. It is recognised that there may be a need to recover enforcement costs for some exacerbators through the courts. In some cases, for example where not

all exacerbators can be identified, full cost recovery will not be realised, and a rating contribution will be required.

Table 5 - Beneficiaries and exacerbators

Pest	Beneficiaries	Exacerbators	Recommended cost allocation
American foulbrood (AFB) Ant (Argentine ant; Darwin's ant) Asian paddle crab Australian droplet tunicate Boneseed Chilean needlegrass Clubbed tunicate Hedgehog Mediterranean fan worm Mustelid (ferret; stoat; weasel) Plague skink Possum Pyura Rabbit Rat (kiore; Norway rat; ship rat) Varroa bee mite Wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby) Wasp (common wasp; German wasp)	The islands-wide community for the protection of biodiversity, landscape and recreational values. Private land occupiers for the long-term protection of economic values.	These pests are not present on the Chatham Islands so there are no known exacerbators. Poor delivery of Council exclusion programme	**100% Council funded** – the proposed pests predominantly affect values of interest to the wider community, including biodiversity, landscape, social and cultural values. The wider island community benefits from their control. Council will take responsibility for delivery of programmes to manage these pests.
African club moss Banana passionfruit Buddleia Ice plant Old man's beard Reed sweet grass Sycamore	The islands-wide community for the protection of biodiversity, landscape and recreational values	Occupiers who fail to control these organisms where they occur on their properties Persons who knowingly sell, propagate, or distribute these organisms Poor delivery of Council programmes	

Pest	Beneficiaries	Exacerbators	Recommended cost allocation
Wild ginger (kahili ginger; yellow ginger) Willow (crack willow; grey willow)			
Broom (common broom; white broom; Montpellier broom) Canada geese Chilean guava Chilean rhubarb Feral goat Ragwort	Rural occupiers for the long-term protection of economic values Neighbouring properties for the prevention of spill-over The islands-wide community for the protection of biodiversity, landscape and recreational values	Occupiers not controlling these organisms on their properties Persons who knowingly sell, propagate, or distribute these organisms Poor delivery of Council programmes	**100% Council funded** – the proposed pests affect both biodiversity and production values. The wider island community benefits and private land occupiers from their eradication. The infestations are small and would require targeted control by some landowners and not others. Council will take responsibility for delivery of programmes to manage these pests as a better result is expected and it would be administratively ineffective to target a small number of landowners. Land occupiers will contribute through the General Rate.
Gorse	Rural occupiers for the long-term protection of economic values.	Occupiers not controlling these organisms on their properties. Persons who knowingly sell, propagate, or distribute these organisms.	For inspection and monitoring costs to prevent spread onto neighbouring properties – **100% Council funded** Control costs to prevent spread – **100% land holder-funded as exacerbators** The control of gorse primarily provides production benefits, and the prevention of any spread is of benefit to the rural land. Therefore, land occupiers should bear the majority of any costs to control it. Because land holders are able to determine whether control is worthwhile on their own property, in the absence of any wider benefit the major gains will come from preventing spread. Council will fund and provide inspection and monitoring of control actions by land occupiers.

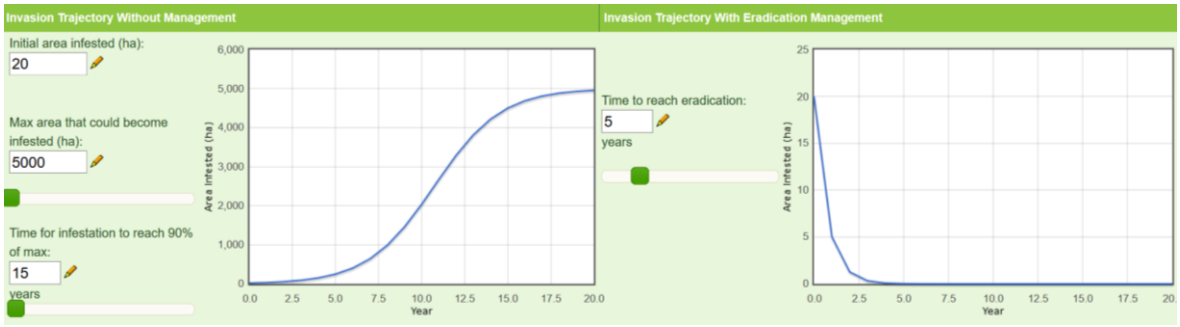
Appendices

Appendix 1 - Model parameters, assumptions and model outputs

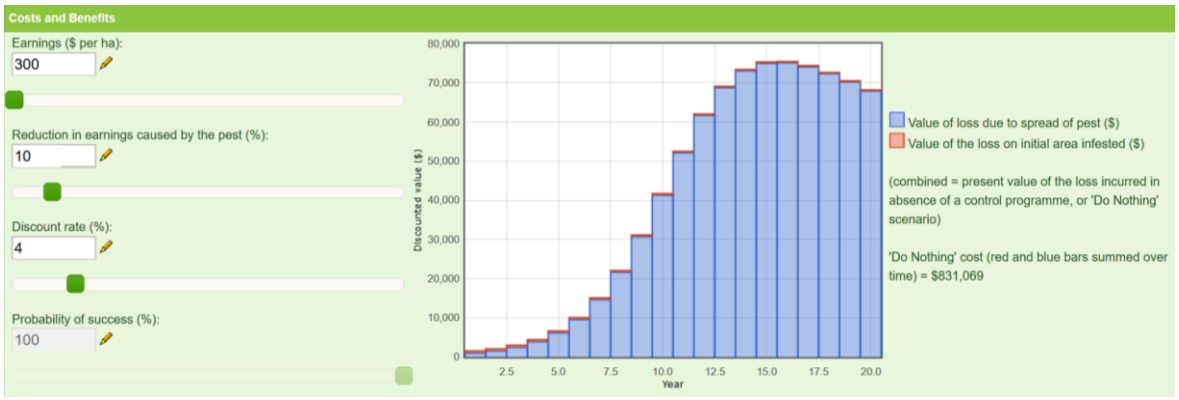
Pest	Proposed programme	Initial area infested (ha)	DO NOTHING OPTION		ERADICATION OPTION	COSTS & BENEFITS					ASSUMPTIONS
			Max area that could become infested without control (ha)	Time for infestation to reach 90% of max (years)	Time to eradication (years)	Earnings ($ per ha)	Reduction in earnings caused by the pest (%)	Probability of programme success (%)	Programme cost ($/yr)	Programme cost breakdown over 20 years	List assumptions for any of the data, i.e. estimates or second-hand info
Canada geese	Eradication	20	5,000	15	5	300	10	100	20,000	Initial 5 years at $20,000 Yrs 6-20 reduce to $2,000 for monitoring	• Assumed 50 birds still resident in 2020 • Conservative estimate of $300/ha for sheep & beef farming
Feral goats	Eradication	150	15,000	15	5	300	30	100	20,000		• Conservative estimate of $300/ha for sheep & beef farming
Chilean rhubarb (Gunnera)	Eradication	15	20,000	50	5	300	10	95	35,000	Initial 5 years at $35,000 Yrs 6-20 reduce to $2,000 for monitoring	• Conservative estimate of $300/ha for sheep & beef farming • Conservative estimate for reduction in earnings based on likely impact – impact determined by density & extent per property
Broom; (common, white and Montpellier)	Eradication	5	30,000	50	5	300	20	95	10,000	Initial 5 years at $10,000 Yrs 6-20 reduce to $2,000 for monitoring	• Conservative estimate of $300/ha for sheep & beef farming • Conservative estimate for reduction in earnings based on likely impact – impact determined by density & extent per property
Chilean guava	Eradication	5	200	15	5	300	20	90	10,000		• Initial area is estimated by known sites • Conservative estimate of $300/ha for sheep & beef farming • Conservative estimate for reduction in earnings based on likely impact – impact determined by density & extent per property
Gorse	Sustained control	4,500	20,000	30	NA	300	20	95	190,000	$190,000 every year for full 20 years ($40,000 Council; $150,000 land occupiers)	• Conservative estimate of $300/ha for sheep & beef farming • Conservative estimate for reduction in earnings based on likely impact – impact determined by density & extent per property • Conservative estimate of $150,000/year expenditure on land occupier control

Canada Geese

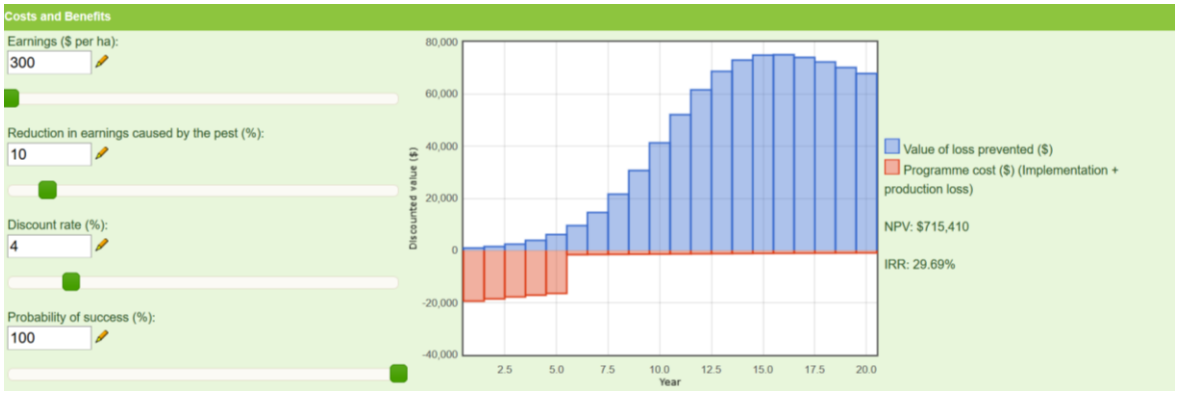
Area infested (ha)	20
Maximum area that could become infested (ha)	5,000
Rate of spread (r)	0.514
Time for infestation to reach 90% of maximum (years)	15
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	10
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	831,069
Total yearly costs ($) [over 20 years]	130,000
Net Present Value (NPV) ($)	715,410
Internal Rate of Return (IRR) (%)	29.7



Do nothing approach



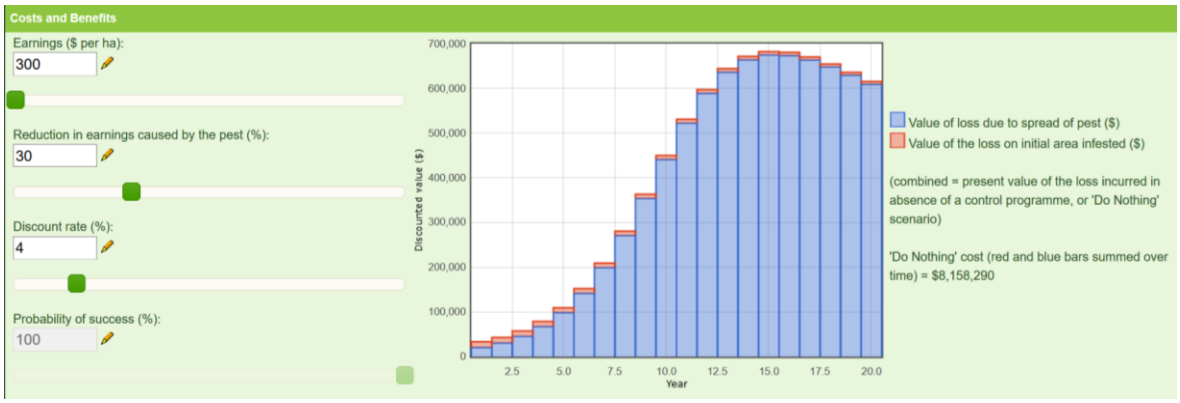
Eradication



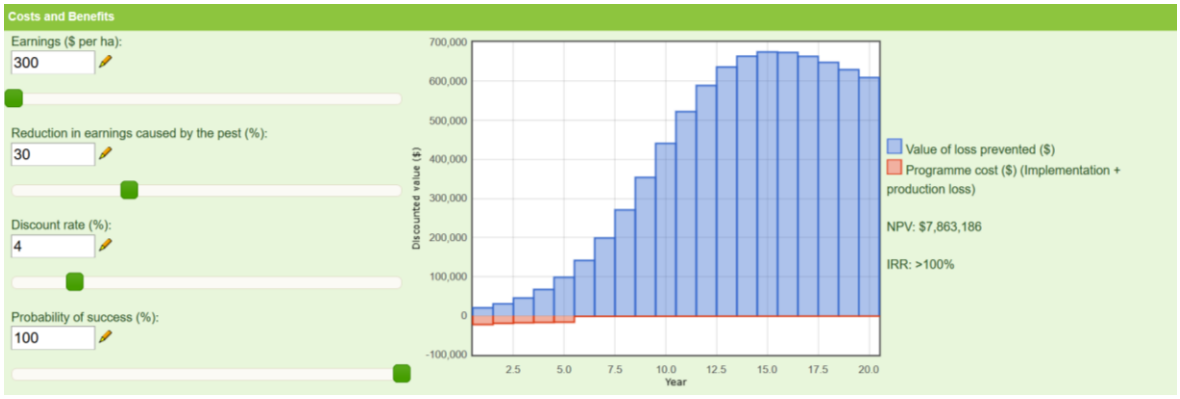
Feral goat

Area infested (ha)	150
Maximum area that could become infested (ha)	15,000
Rate of spread (r)	0.452
Time for infestation to reach 90% of maximum (years)	15
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	30
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	8,158,290
Total yearly costs ($) [over 20 years]	130,000
Net Present Value (NPV) ($)	7,863,186
Internal Rate of Return (IRR) (%)	>100

Do nothing approach

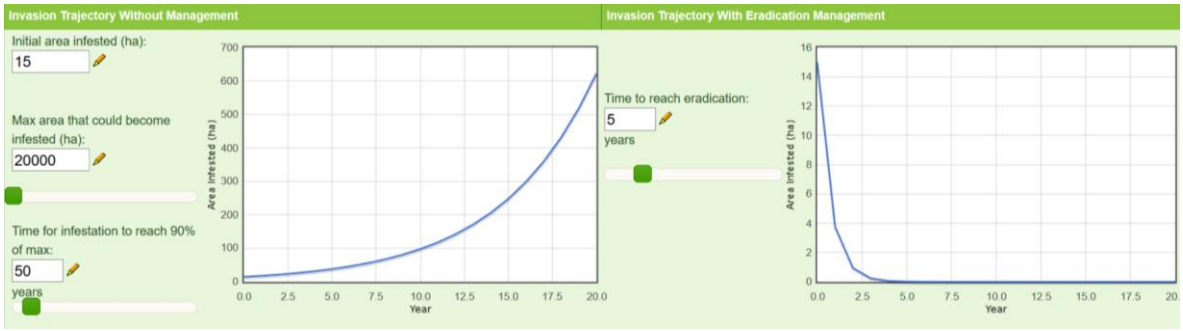


Eradication

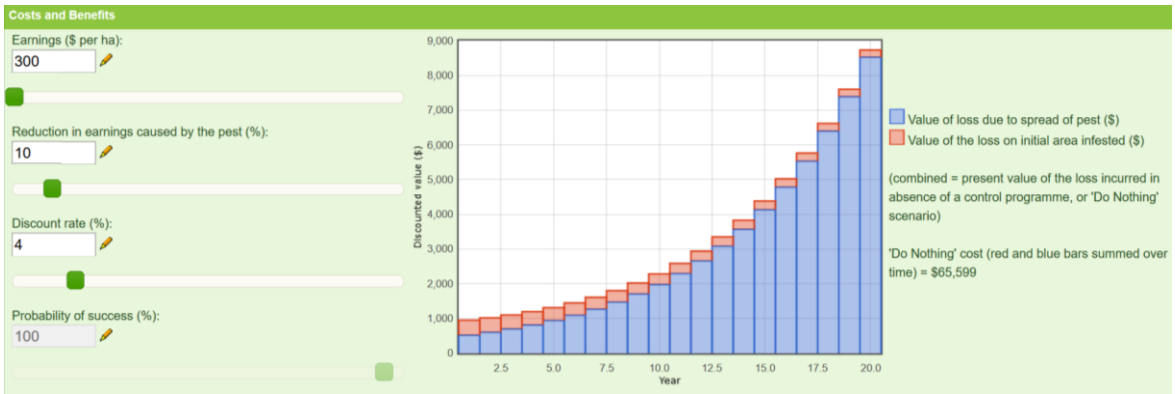


Chilean Rhubarb

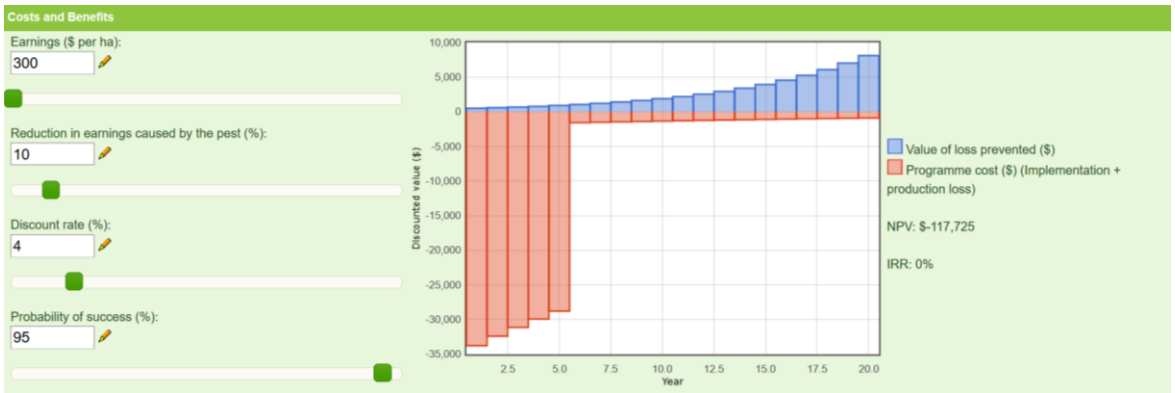
Area infested (ha)	15
Maximum area that could become infested (ha)	20,000
Rate of spread (r)	0.188
Time for infestation to reach 90% of maximum (years)	50
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	10
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	65,599
Total yearly costs ($) [over 20 years]	205,000
Net Present Value (NPV) ($)	-117,725
Internal Rate of Return (IRR) (%)	0



Do nothing approach

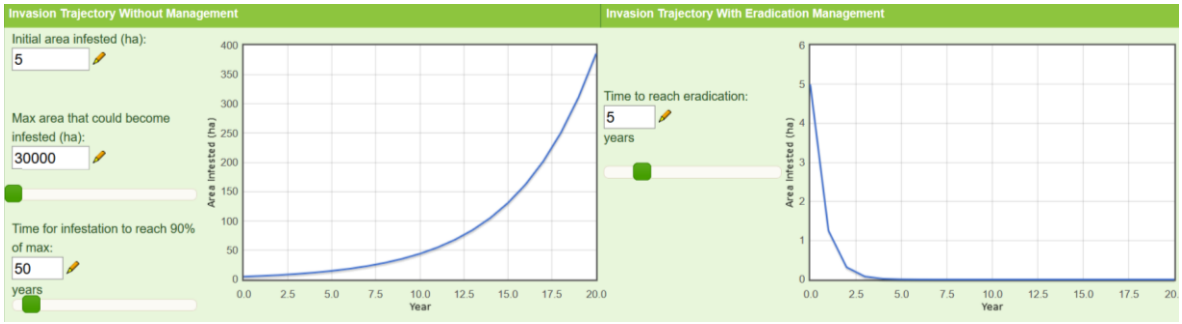


Eradication

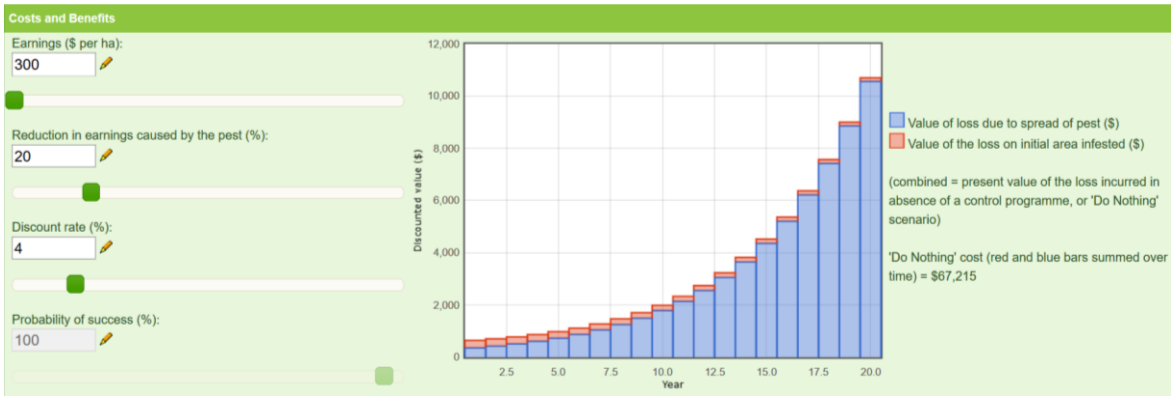


Broom (Common, White and Montpellier)

Area infested (ha)	5
Maximum area that could become infested (ha)	30,000
Rate of spread (r)	0.218
Time for infestation to reach 90% of maximum (years)	50
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	20
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	67,215
Total yearly costs ($) [over 20 years]	80,000
Net Present Value (NPV) ($)	-2,910
Internal Rate of Return (IRR) (%)	3.5



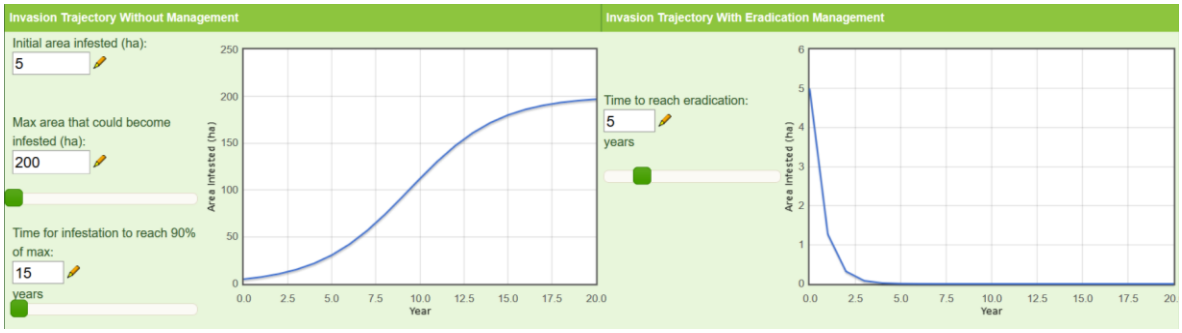
Do nothing approach



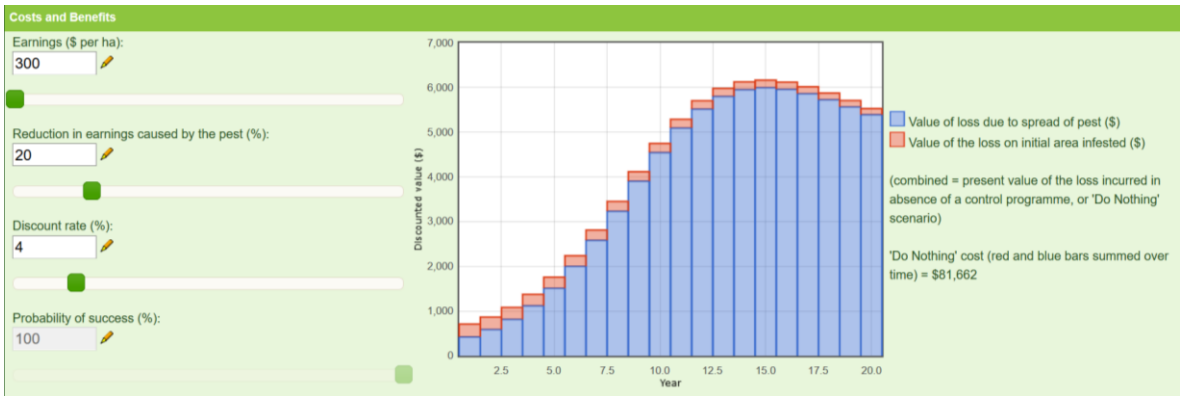
Eradication

Chilean Guava

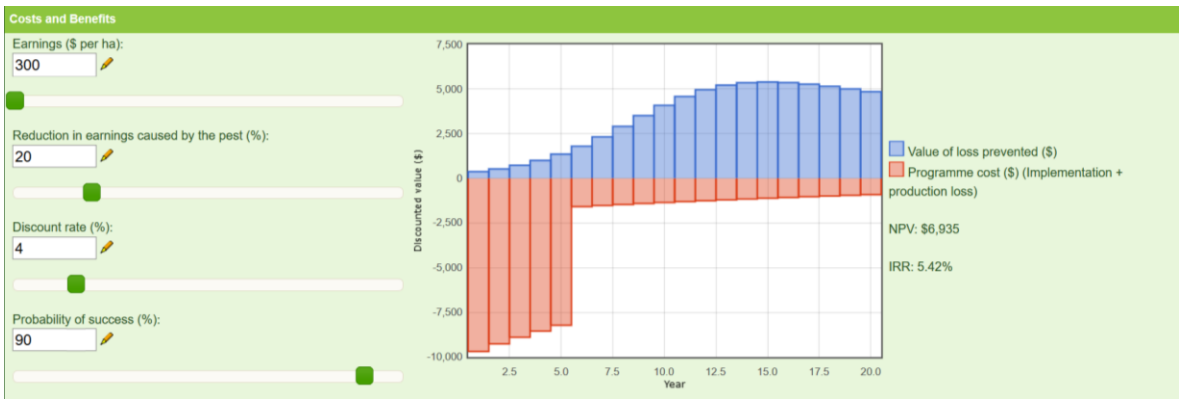
Area infested (ha)	5
Maximum area that could become infested (ha)	200
Rate of spread (r)	0.391
Time for infestation to reach 90% of maximum (years)	15
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	20
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	81,662
Total yearly costs ($) [over 20 years]	80,000
Net Present Value (NPV) ($)	6,935
Internal Rate of Return (IRR) (%)	5.4



Do nothing approach

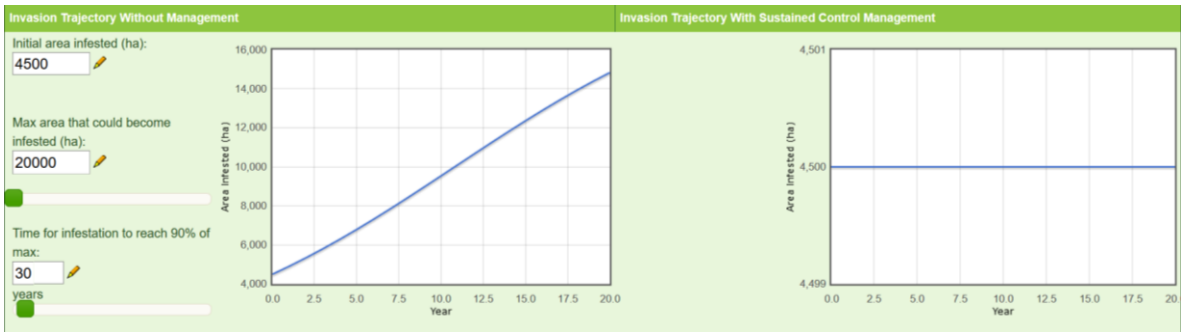


Eradication

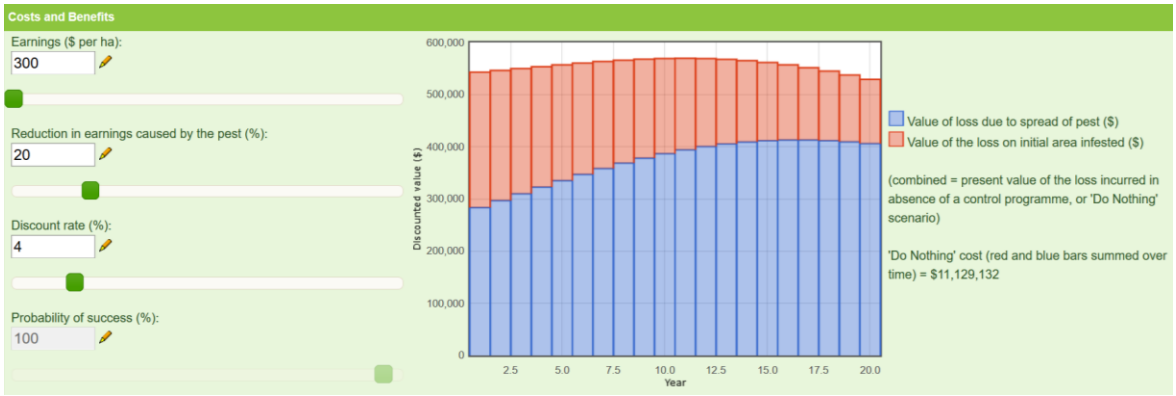


Gorse

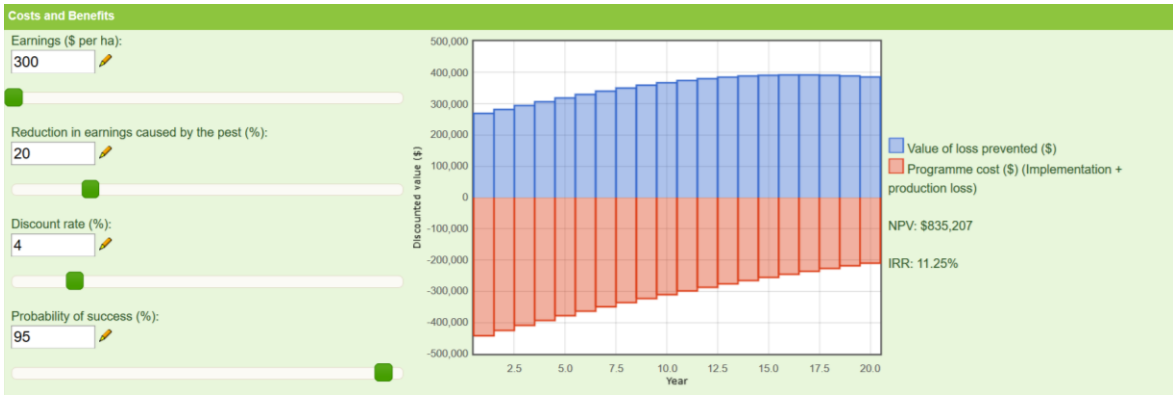
Area infested (ha)	4,500
Maximum area that could become infested (ha)	20,000
Rate of spread (r)	0.114
Time for infestation to reach 90% of maximum (years)	30
Earnings ($/ha)	300
Reduction in earnings caused by pest (%)	20
Discount rate (%)	4
Number of years for this simulation	20
Cost of 'Do Nothing' scenario ($)	11,129,132
Total yearly costs ($) [over 20 years]	3,800,000
Net Present Value (NPV) ($)	835,207
Internal Rate of Return (IRR) (%)	11.3



Do nothing approach



Sustained control



Appendix 2 – Breakdown of Council costs per pest programme

Pest	Values affected*	Programme	Programme budget / year
AFB	B, C	Exclusion	$145,000.00 (delivered through border control programme)
Ant	B, C		
Australian droplet tunicate	B, C, P, R		
Asian paddle crab	B, C, P, R		
Boneseed	B, C, L		
Chilean needlegrass	B, C, P		
Clubbed tunicate	B, C, P, R		
Hedgehog	B, C		
Mediterranean fanworm	B, C, P, R		
Mustelid (ferret; stoat; weasel)	B, C, R		
Plague skink	B, C		
Possum	B, S, C		
Pyura	B, C, P, R		
Rabbit	B, C, P, L		
Rat (kiore, Norway rat, ship rat)	B, S, C, P		
Varroa bee mite	B, C		
Wallaby (Bennett's wallaby; brush-tailed rock wallaby; dama wallaby; parma wallaby; swamp wallaby)	B, C, P, L		
Wasp (common wasp; German wasp)	B, S, C		
Banana passionfruit	B, C, L	Eradication	$4,000.00
Broom (common broom, Montpellier broom, white broom)	B, C, P, L		$10,000.00
Canada geese	B, S, C, P, L		$20,000.00
Chilean guava	B, C, P, L		$10,000.00
Chilean rhubarb	B, C, P, L		$35,000.00
Feral goat	B, C, P, L		$20,000.00
Old man's beard	B, C, L		$10,000.00
Reed sweet grass	B, C		$4,000.00
Wild ginger (kahili ginger, yellow ginger)	B, C, L		$2,000.00
Willow (crack willow, grey willow)	B, C, L		$6,000.00
African club moss	B, C	Progressive containment	$2,000.00
Buddleia	B, C, L		$1,000.00
Ice plant	B, C, L		$2,000.00
Ragwort	B, C, P, L		$1,000.00
Sycamore	B, C, L		$1,000.00
Chilean guava	B, C, P, L	Sustained control	$2,000.00
Gorse	P, L		$40,000.00
		Total	**315,000.00**

* B = Biodiversity, C = Cultural, P = Production, L=Landscape, R = Recreational, S = Social

Infestations where source is scattered plants

Gorse NPD Section 8(e)(ii) - Ratio of costs for Source Landholder to the costs for the Receiving landholder - Source infestation is scattered plants

Source Landuse \ Receptor Landuse	Dairy	Sheep and beef Intensive	Arable	Horticulture	Hill country	High country	Conservation	Forestry	Non Productive
Dairy	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Sheep and beef Intensive	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Arable	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Horticulture	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Hill country	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
High country	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Conservation	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Forestry	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs
Non Productive	No costs	No costs	No costs	No costs	1.00	1.00	No costs	1.00	No costs

Infestations where source is dense

Gorse NPD Section 8(e)(ii) - Ratio of costs for Source Landholder to the costs for the Receiving landholder - Source infestation is dense

Source Landuse \ Receptor Landuse	Dairy	Sheep and beef Intensive	Arable	Horticulture	Hill country	High country	Conservation	Forestry	Non Productive
Dairy	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Sheep and beef Intensive	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Arable	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Horticulture	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Hill country	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
High country	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Conservation	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Forestry	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs
Non Productive	No costs	No costs	No costs	No costs	1.40	1.40	No costs	1.40	No costs