Improving DAFF's effectiveness in engaging the community in general surveillance

CEBRA Project 22C

Final Report (Report on Phase 2)

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June 4, 2025

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Centre of Excellence for
Biosecurity Risk Analysis

How to cite:
Arndt, E. and Hester, S.M. (2025). Improving DAFF's effectiveness in engaging the community in general surveillance. Final Report (Phase 2) for CEBRA Project 22C.

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Acknowledgements

This report is a product of the Centre of Excellence for Biosecurity Risk Analysis (CEBRA). In preparing this report, the authors acknowledge the financial and other forms of support provided by the Department of Agriculture, Fisheries and Forestry (the department), and the University of Melbourne.

In particular, we thank Bertie Hennecke, Andrew Pearce, and Justin Billing from the Environmental Biosecurity Office in the department for their ongoing interest in and support of this project.

We are also grateful to Heleen Kruger, Jen Ticehurst, and Scott Burrows from ABARES Social Science for their involvement in the workshop and for providing advice on some general surveillance questions. This builds on the significant contribution made by ABARES Social Sciences in Phase One of the project, which formed the foundation for the Phase Two work reported in this document.

The authors would like to thank the participants in the stakeholder workshop and expert reviewers Rosalie McCauley, Laura Fagan, Catherine McInerney, and Angela Constantine for their feedback on a previous version of the economic analysis tool.

We would like to thank our CEBRA colleagues Les Kneebone and James Camac for their help and advice with specific aspects of this project.

List of Definitions

Biosecurity-focused community engagement: Activities undertaken to encourage awareness and uptake of desired behaviours in the community or sectors of the community, in order to contribute to positive biosecurity outcomes. Community engagement involves a spectrum of activities ranging between passive methods such as pest, weed and disease displays, newspaper or magazine articles, webpages, posters, through to activities involving close collaboration between DAFF (or its partners) and certain community groups, such as farmers, Natural Resource Management groups, private vets, agronomists or tourist operators.

Community: A group of people with diverse characteristics who are linked by social ties, share common perspectives and/or interests, and engage in joint action in geographical and virtual locations or settings.

Community engagement: The process of working with groups of people affiliated by geographic proximity, special concern, community concern or similar situations to address the issues affecting them (Alter *et al.*, 2017).

Discounting: Allows the costs and benefits that arise in different time periods to be transformed into a comparable unit– a 'present-value' monetary value, using a discount rate. For more information see Bland *et al.* (2024).

Discount rate: Used in the process of discounting to reduce the value of a future income stream to its present value. Higher discount rates erode future amounts more rapidly than lower discount rates. In invasive species management, where costs of control are typically borne upfront while benefits of control accrue further into the future, high discount rates undervalue the benefits of invasive species control programmes in conventional cost–benefit analysis. Very low discount rates may be appropriate in the invasive species management context (Costanza *et al.*, 2021).

Economic analysis: Economic analysis involves understanding the relative benefits and costs of different courses of action, and using this information to make a decision about the 'best course' of action. Return on Investment (ROI), Benefit-cost analysis (BCA), Cost-effectiveness analysis are all examples of economic evaluation techniques used to understand the merits of invasive species management programmes. See Emerton & Howard (2008) for more information.

General surveillance: Surveillance undertaken by the community rather than officially appointed trained staff (active surveillance). It is often termed 'general surveillance', defined as biosecurity surveillance activities that have one or more element(s) of opportunism, usually to broaden the coverage of surveillance and/or achieve more cost-effective biosecurity outcomes, on a spectrum ranging from

fortuitous ad hoc detections (called passive surveillance) to relatively highly structured activities, but excluding active surveillance (Camac, 2024; Kruger *et al.*, 2020).

Multi Criteria Analysis (MCA): While economic analysis techniques are most often used for evaluating invasive species programmes, economic measures are not the only criteria that could be used to making decisions about invasive species programmes. MCA offers a method for integrating different types of monetary and non-monetary decision criteria into decisions when multiple objectives must be taken into account. See Emerton & Howard (2008) for more information.

Shared responsibility: Means everyone takes responsibility for biosecurity matters under their control. It is a core concept underpinning Australia's national biosecurity system whereby all stakeholders—including Australian governments, industry and the broader community—have important roles and responsibilities in the management of biosecurity risks in Australia.

Acronyms

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ALA	Atlas of Living Australia
CEBRA	Centre of Excellence for Biosecurity Risk Analysis
DAFF	Department of Agriculture, Fisheries and Forestry
NAQS	Northern Australia Quarantine Strategy

1 Executive summary

The Australian Government Department for Agriculture, Fisheries and Forestry (DAFF) plays a key role in preventing and responding to exotic, new and emerging pests, weeds and diseases. As part of this process, DAFF considers the whole Australian community — the general public, industry and all levels of government — to be partners in protecting Australia from the impact of pests, weeds and diseases. This notion of 'shared responsibility', first suggested several decades ago (Nairn *et al.*, 1996), is now entrenched in the Biosecurity Act 2015 (Cth) and most high-level state and federal biosecurity strategies.

Implementing 'shared responsibility' requires the effective engagement of industry, community groups and others in the monitoring, detection, and reporting of biosecurity threats — known as 'general surveillance' in this report. This type of surveillance differs from the targeted (active) surveillance activities conducted by biosecurity agencies for a specific purpose.

Between 2018 and 2022 DAFF supported almost 60 general surveillance programmes. DAFF investment in general surveillance programmes occurs based on the premise that shared responsibility is beneficial, despite a lack of analysis of the economics of general surveillance programmes.

CEBRA Project 22C investigated DAFF's role in supporting general surveillance activities to understand: the range of programmes supported; the value of support; whether chosen programmes provide a good return on investment; and key challenges faced by DAFF staff and close collaborators in implementing the community engagement activities that enable general surveillance. Staff identified key challenges around designing, implementation and evaluation of programmes, in particular they lamented that data were seldom gathered that could formally link activities with achievement of programme outcomes, or allow the monetisation of benefits from the programmes. Similarly, at higher level, the monetary value of DAFF's total investment in general surveillance programmes is unknown. An important output of 22C is a proof-of-concept tool that surveillance managers can use in the design, implementation and evaluation of general surveillance programmes. Broad use of the tool (i.e., external to DAFF) would have the added benefit of better planned and coordinated general surveillance funding proposals that result in programmes that are more likely to achieve their intended outcomes.

1.1 Key findings

1. **DAFF's leadership of and engagement with 'shared responsibility' principles is substantial.**

   DAFF contributed directly or indirectly to more almost 60 general surveillance programmes between 2018 and 2022. Programmes varied in size, duration, objective and structure. DAFF's total financial contribution to the identified general

surveillance programmes, however, is unclear. It is also unclear whether the community engagement programmes that enable general surveillance provide a good return on investment including for DAFF because there is no routine way to collect data, nor any impetus for data collection, that would enable an economic analysis of general surveillance programmes. Monitoring and evaluation of these activities also tend to be under-developed.

2. **The benefits of general surveillance programmes are not well-understood and important questions about funding future programmes cannot be answered.**

   General surveillance programmes appear to be beneficial — programmes successfully generated reports on pest, weed, and disease occurrences; programmes have established biosecurity networks that may be used during pest, disease and weed outbreaks; and knowledge and capacity building that result from general surveillance programmes might result in improved and faster response to outbreaks. It is unclear, however, whether these outcomes are best achieved by general surveillance programmes, nor indeed whether funding for general surveillance programmes is at the right level. Unfortunately, the impacts of general surveillance programmes are seldom subject to economic analysis. Because of this, we do not have any insights into the appropriate level of DAFF funding of general surveillance programmes, how best to use general surveillance programmes to complement active surveillance, or how to cost-effectively enable general surveillance through community engagement.

3. **Monitoring, evaluation and reporting of general surveillance programmes is variable and therefore opportunities for programme improvement are missed.**

   Across sectors, there is usually some level of monitoring and evaluation of general surveillance initiatives. The quality and extent of evaluations vary depending on the initiative, and results are not necessarily made public. Monitoring, evaluation and reporting of general surveillance programmes does not appear to be a requirement of funding agencies, including DAFF. If undertaken in a robust and consistent manner, monitoring, evaluation and reporting would allow improvements in programme development, implementation and funding into the future, and would help fulfil public accountability requirements. Where monitoring, evaluation and reporting have been undertaken, they generally lack information about the value of benefits provided by initiatives – relevant data are either not collected or not analysed.

4. **DAFF staff and close collaborators are positive about the decision-support tool developed as part of CEBRA 22C.**

   A proof-of-concept decision-support tool was demonstrated to DAFF staff and their close collaborators via a workshop. All attendees had some involvement in general surveillance programme design and implementation. Attendees were overwhelmingly positive about the tool and provided useful feedback that has been used to improve the tool.

1.2 Recommendations

1. **That priority be given to understanding the impact of DAFF-funded and supported general surveillance programmes via economic analysis of a sample of different types of programmes.**

   Resource allocation to general surveillance programmes will be significantly improved if it is based on an understanding of the costs and benefits of different types of programmes (e.g. size, duration, objective and structure). To enable this analysis, collection of data on costs and benefits over time should become a routine part of programme development and implementation. We note that the past monetary value of DAFF's investment is unknown and there are no existing processes in place for its collection. Use of non-market valuation techniques may also be necessary to capture the value of benefits.

2. **That the decision-support tool developed in this project be further tested, with use-cases captured and available for wider use.**

   The proof-of-concept tool developed in this project requires additional testing and improvement if widespread adoption is to occur. This should be easily undertaken given the large number of general surveillance programmes that are developed and/or supported by DAFF each year. The worksheets generated from applying the tool to particular programmes should be systematically captured within DAFF. This will allow future analysis of programme cost-effectiveness.

3. **That a decision-support tool developed in this project be used to support DAFF decision making with respect to the development of general surveillance programmes**

   The decision support tool developed in this project should be used by DAFF staff to better understand the cost-effectiveness of various types of biosecurity community engagement programs in different contexts. This would include advice on data collection to inform the analysis of programme benefits.

2 Introduction

2.1 Objectives

The overarching objective of this project was to better enable DAFF staff to commission, undertake and support cost-effective biosecurity community engagement. The research was set in the context of DAFF's unique operating environment: there are limited staff at the on-ground level, staff rely a great deal on print and electronic awareness-raising, and DAFF staff are usually required to partner with other stakeholders to undertake engagement activities.

This project consists of two distinct phases. An initial exploratory phase of research (Phase One) aimed at understanding DAFF's involvement in community engagement for general surveillance. This first phase used qualitative analysis of interviews with DAFF staff and general surveillance collaborators to understand:

- perspectives and needs of general surveillance practitioners and supporters (DAFF staff and collaborators)
- the range of current and past community engagement activities to enable general surveillance undertaken in, or supported by, DAFF — a 'stocktake'.

The results of Phase One of the project are documented in Arndt *et al.* (2024b) and summarised in Chapter 3. Phase Two built on the exploratory work of Phase One, and had the following objectives:

1. gather available data on DAFF's financial contribution to the general surveillance programmes it supports, to understand historical budgets, typical cost items and desired benefits (for use in the economic analysis tool);
2. gather the relevant literature on community engagement for biosecurity and ensure it is readily available to interested parties. This work will take advantage of CEBRA Project 21E in which a Biosecurity Risk Research Portal is under development (Kneebone *et al.*, 2024);
3. collate existing data to support the development of the economic analysis methodology and framework within which it sits. This could include identification of one or more different types of existing general surveillance programmes for which an in-depth economic analysis could be undertaken;
4. explore different decision-support and economic analysis tool options, to understand whether any might be suitable for use in the current context, with or without modification. If none are found suitable, then a new economic analysis tool will be developed;
5. develop a draft economic analysis methodology;

6. demonstrate use of the tools and receive feedback via a workshop where one or more general surveillance programmes is used to test the decision-support tool. This process will allow for identification of future research that would enhance the tool's utility;

7. refine the decision-support tool and economic analysis methodology based on workshop feedback and additional case study applications; and

8. finalise a manual describing use of the tool to support future use of the tool by DAFF and its close collaborators, and general surveillance stakeholders more broadly.

2.2 Methodology

Phase One used a sequential research approach in gathering the information that underlies the situational analysis presented in Arndt *et al.* (2024b) and summarised in Chapter 3. Data collection was divided into two steps (Figure 2.1). First, ABARES Social Sciences and CEBRA interviewed a number of DAFF staff and external biosecurity stakeholders to identify the extent of DAFF involvement in community engagement for general surveillance and their experiences in this area over the last five years. A qualitative analysis of the interview transcripts identified common topics and emerging themes. Then, using focus groups led by ABARES Social Sciences, a different collection of experts verified the interview findings and filled any information gaps.

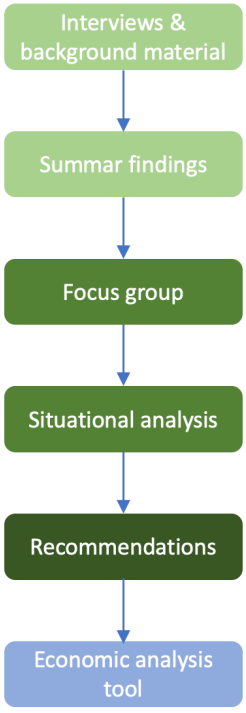

Figure 2.1: Research approach; Phase One (green) and Phase Two (blue).

Phase Two, which this the subject of this report, was shaped by the three interconnected recommendations of Phase One, in particular Recommendation 2, the development of an economic analysis tool to assist with decisions around general surveillance programmes. The development of such a tool is the focus of this report. Development of an economic analysis tool will enable the achievement of Recommendations 1 and 3.

An existing decision-support tool was identified (Blaney *et al.*, 2016) and adapted. Blaney *et al.* (2016) had developed a tool for the evaluation of UK citizen science programmes related to environmental modelling. The adaptation of the existing tool to the context of general surveillance programmes in biosecurity required stakeholder consultation. Selected general surveillance specialists provided written feedback on the suitability of the tool for development and evaluation of general surveillance programmes. A broader stakeholder group, including representatives from different organisations and states/territories, tested and discussed all elements of the tool in a half-day face-to-face workshop. Based on the consolidated feedback from the stakeholder consultation,

the tool was further modified to improve its usability for the evaluation of general surveillance programmes in Australia.

Use of the decision-support tool will contribute to achieving Recommendations 1 and 3 of Phase One (to undertake economic analysis of general surveillance programmes; to ensure monitoring and evaluation of general surveillance programmes becomes routine).

See Chapter 3 for more details on the other recommendations. Recommendation 3 is currently being addressed by an ABARES project[1].

[1]Developing Monitoring and Evaluation Guidance for General Surveillance Programs, at https://www.agriculture.gov.au/abares/research-topics/social-sciences/biosecurity/gen-surveil-program-monitor-eval

3 Summary of Phase One

ABARES Social Sciences and CEBRA staff interviewed 28 biosecurity stakeholders employed by DAFF and various partner organisations, which revealed DAFF's goals, outputs and outcomes in relation to general surveillance and the benefits that general surveillance activities provide. The main goal is early detection and reporting, but network and capacity building are also important objectives. Outputs are the immediate results of general surveillance activities and include the number of traps deployed, premises visited, and the number of pests reported. Outcomes, the most important aspects of general surveillance activities are related to changing people's pest, weed, and disease reporting behaviour to increased reporting and better quality reporting via various awareness raising, engagement, and networking activities. All of these will lead to longer-term outcomes, such as detections that reduce uncertainty around pest/disease spread, data for area freedom claims, and stakeholder networks that can be mobilised during emergency responses. These outcomes will serve to make the biosecurity system more resilient (Arndt *et al.*, 2024a) and will thus benefit society more generally.

Further, Phase One analysis, led by ABARES Social Sciences identified DAFF's role in general surveillance, how resources are allocated, and what factors influence resourcing decisions. DAFF supports general surveillance initiatives in a wide range of capacities, including supporting design, coordination, or management activities, provision of funding or co-funding, and provision of technical advice and operational staff. Allocation of resources towards general surveillance initiatives can be based on approved internal proposals (often pilot programs), one-off initiatives, or new policy directions in response to detections. Short-term funding is a major problem for general surveillance programmes which work best if they are adequately funded and resourced for the long-term. Programme managers need to consider a range of factors that influence the success of a programme. They need to, for example, define a clear purpose of the programme, ensure the programme delivers a value proposition for notifiers, choose the right target group, continuously engage stakeholders, and demonstrate a favourable return on investment (which is difficult to estimate due to lack of data).

Phase One of the project captured what works well in general surveillance (e.g. effective relationships, coordination of on-ground efforts such as the Indigenous ranger programme, and industry collaboration) vs what does not work well (e.g. uncertainty around funding, no monitoring and evaluation data, and no DAFF presence on the ground). Stakeholder maps for each sector showed involvement of different areas in DAFF (operational, policy, and corporate support services), who have built a network of effective relationships with external stakeholders, including the jurisdictions, industry bodies, not-for-profit organisations, producers, retailers, interest groups, and the general public.

In conclusion, the report of Phase One showed that, first, **DAFF's engagement with shared responsibility principles is substantial**. However, while DAFF contributes

directly and indirectly to a range of general surveillance programmes, its total financial contribution is unclear. This lack of information is due to the absence of a routine data collection method and leads to uncertainty on whether investment in general surveillance provides a good return on investment for DAFF and benefits to the Australian general public. Second, **the benefits of general surveillance programmes are not well understood and important questions about funding future programmes cannot be answered**. This lack of information on whether general surveillance programmes achieve their intended outcomes and are funded at the right level leads to doubt how to best integrate general and active surveillance and how to engage the community cost-effectively. Third, **monitoring, evaluation and reporting of general surveillance programmes is variable and therefore opportunities for programme improvement are missed**. Not having a routine method for monitoring and evaluating the performance of general surveillance programmes deprives decision makers of the ability to fulfill public accountability and transparency requirements and to improve existing programmes.

Based on these research findings, the Phase One report made the following recommendations:

1. **That priority be given to understanding the outcomes of DAFF-funded and supported general surveillance programmes via economic analysis of a sample of different types of programmes.**

   Resource allocation to general surveillance programmes could be significantly improved if it were based on an understanding of the costs and benefits of different types of general surveillance programmes. To enable this analysis, collection of data on costs and benefits over time should become a routine part of programme development and implementation. Use of non-market valuation techniques will likely be necessary.

2. **That an economic analysis tool be developed to support DAFF decision making with respect to the evaluation and development of general surveillance programmes.**

   The development of, or modification to, an economic analysis tool would enable recommendation 1 and would allow DAFF staff to better understand the cost-effectiveness of various types of biosecurity community engagement programs in different contexts. Such a tool could also enable data collection to inform the analysis of programme benefits. Information from the qualitative analysis of interviews and focus group discussions would also inform the tool.

3. **That a routine and robust methodology for monitoring, evaluation and reporting of general surveillance programmes be developed and adopted.**

   Monitoring, evaluation and reporting should become a routine part of general surveillance initiatives, with a focus on understanding whether programme goals are being met, thus fulfilling public accountability requirements, and informing future decision making about programme improvement and resource allocation.

4 Updated stocktake of general surveillance initiatives

In Phase One of this project ABARES Social Sciences and CEBRA identified that DAFF supports general surveillance activities in a variety of ways (Arndt *et al.*, 2024b). It directly funds or co-funds programmes, or might initiate a pilot programme which may subsequently continue using different funding. In other cases, DAFF might support general surveillance programmes via developing or upgrading materials, providing strategic direction, managing projects, undertaking research; or DAFF's targeted surveillance activities might enable community action.

The aim of the stocktake was to capture the number and type of general surveillance activities that DAFF has supported between 2018 and 2022 and to collate data relevant to decision making and programme evaluation. Therefore, in the second phase of the project we sought to confirm the identified general surveillance initiatives and collate financial information to show the magnitude of DAFF's investment in general surveillance, as a first step in capturing the costs of general surveillance activities and to support efficient resource allocation to these activities (Objective 1). Programme contacts were approached via email and requested to provide financial information on their programme, in particular any annual financial contributions made by DAFF.

Financial information, such as DAFF's annual financial contribution to specific general surveillance programmes and programme evaluation information were not available for all of the initiatives. This was due to high-level financial reporting, lack of data access, and a paucity of performance evaluation data. We were therefore not able to fully achieve Objective 1, although the implications of this are addressed by the proposed tool. Consequently, the updated stocktake of general surveillance initiatives focuses on the volume and diversity of implemented general surveillance initiatives. These include on-ground initiatives delivered with the support of many partners and involving co-design processes, through to awareness-raising campaigns via print and electronic media delivered by DAFF staff. General surveillance initiatives involving the general public are often supported by custom built apps that allow reporters to upload photos, the location of sightings, and relevant metadata.

Phase One in this project provided a draft list of DAFF-supported initiatives between 2018 and 2022. Some of the initiatives identified by interviewees are no longer active, while others are ongoing. In Table 4.1, we present a curated list of almost 60 general surveillance initiatives that were supported by DAFF between 2018 and 2022[2]. Again, general surveillance initiatives are grouped by biosecurity sector with initiatives related to marine and aquatic (freshwater) environments being combined into one sector called Marine/Aquatic. General surveillance initiatives under 'General Biosecurity' apply to all biosecurity sectors and include programs such as the post-border detection team which follows up on community reports.

[2]The initiatives listed were named by experts during the interviews and do not represent a complete list of all general surveillance initiatives that were active for the period 2018-2022.

Table 4.1: DAFF-supported general surveillance initiatives, grouped by sector

Name of initiative	Target audience
ANIMAL BIOSECURITY:	
Animal Health Australia communications	Livestock producers
Australian Chief Veterinary Office communication	Jurisdictions, industry, general public
DAFF 1800 number (See.Secure.Report)	General public, especially communities around ports of entry
Emergency Animal Disease Watch hotline	Livestock producers
Emergency animal disease online training for vets, delivered by the University of Melbourne	Veterinarians
FMD Ready Project (Sub project 2, farmer-led surveillance)	Livestock producers (cattle, sheep, goat, pig)
Great Southern Cattle Surveillance Network	Cattle producers in WA
Indigenous Rangers & Business Management Section (IRBMS)—Animal biosecurity	Rangers and Indigenous communities
Northern Australia Biosecurity Surveillance Network (NABSnet)	Private livestock vets in northern Australia
NAQS animal biosecurity engagement activities	Communities within the NAQS zone, in particular Aboriginal and Torres Strait Islander communities
NAQS Report a pest, weed or disease in Northern Australia (e.g. old-world screw-worm fly, rabies)	Communities within the NAQS zone, in particular Aboriginal and Torres Strait Islander communities
NAQS Top Watch	Communities within the NAQS zone, in particular Aboriginal and Torres Strait Islander communities, and Indigenous rangers
National Animal Health Information Program	Livestock industries and wildlife carers
National Arbovirus Monitoring Program (NAMP)	Livestock industries
National Avian Influenza Wild Bird Surveillance Program	Members of the public, private practitioners, and staff operating in the field from other departments, universities, zoos and sanctuaries
National Significant Disease Investigation Program	Veterinary practitioners
NSW Small-holder research project (Livestock Surveillance Champions in Peri-urban areas—a NSW case study)	Producer champions and small landholders
Southern Australia Biosecurity Surveillance Network (SABSnet, at exploration stage)	Private livestock vets in Southern Australia
Biosecurity Champion (DAFF videos)	Agricultural producers, tourists and other travellers, communities and community organisations in northern Australia

Table 4.1: DAFF-supported general surveillance initiatives (continued)

Name of initiative	Target audience
Tasmanian Livestock Health Monitoring Network	Service providers (e.g. private vets, stock agents, rural merchandisers, and shearing contractors
PLANT BIOSECURITY:	
Botanical gardens program	Botanic gardens and arboreta
CitrusWatch	Citrus industry and general public
Exotic Plant Pest hotline	Everyone
External Territories Surveillance Program	General public, growers, urban communities
International Plant Health Surveillance Program	Offshore communities (e.g. in Timor-Leste, Papua New Guinea and the Solomon Islands)
Northern Australia Biosecurity Strategy (NABS; objective 3)	Farmers, producers, local councils, pastoralists, Indigenous communities, Indigenous rangers, tour operators, irrigation and service utility providers, defence, recreational and commercial fishers, and peri-urban land users
Northern Australia Quarantine Strategy (NAQS)—Plant Health Surveillance (insect pests, weeds and diseases) in remote areas across Northern Australia	Various stakeholders (e.g. community garden members, schools, local universities)
Indigenous Rangers & Business Management Section (IRBMS)—Plant biosecurity	Rangers and Indigenous communities
National Border Surveillance Program	Approved arrangement staff
Plant pests and diseases webpage (DAFF webpage)	General public
Urban plant health network	Urban and peri-urban community gardeners
AUS VEG Urban biosecurity engagement program	Urban population (e.g. community gardens, councils, and schools
ENVIRONMENTAL BIOSECURITY:	
Australia's National Wildlife disease surveillance program (e.g. zoo-based wildlife disease surveillance, sentinel clinic wildlife disease surveillance, wild bird surveillance)	University veterinary clinics and pathology departments, veterinary hospitals with a high wildlife caseload, zoo wildlife hospitals, private veterinary practitioners, general public, wildlife sanctuaries
Bug hunt (by the Invasive Species Council, ISC)	Community groups
Electronic Wildlife Health Information System (eWHIS)	Same as for the national wildlife disease surveillance program
Environmental biosecurity projects (e.g. trail how environmental biosecurity reporting and awareness for newly established and emerging pests in Australia can be improved, increased and streamlined through the use of citizen science)	Community groups and general public

Table 4.1: DAFF-supported general surveillance initiatives (continued)

Name of initiative	Target audience
FeralScan (by the Centre for Invasive Species Solutions)	General public, farmers
General surveillance focus groups (Invasive Species Council)	General public
MyPestGuide trees (Reporting app, extension to MyPest Guide, coming soon)	Foresters, local councils, general public
Existing tools Atlas of Living Australia (ALA; provides the basis for environmental surveillance by setting up the system to facilitate surveillance)	Everyone
AUSPestCheck (Tool for collecting, analysing and displaying plant pest surveillance data)	General surveillance practitioners, general public
Emergency Animal Disease hotline and Emergency Plant Pest hotline	Everyone
See.Secure.Report hotline (Focus on cargo, containers and parcels)	Everyone
MARINE/AQUATIC BIOSECURITY:	
Marine Library of marine pest photos to support identification (for the top marine pest species, but also for vessel hygiene activities)	National stakeholders
MarinePestPlan 2018-2023 (National strategic plan for marine pest biosecurity; Activity 2.2, passive surveillance)—*not strictly an initiative, but a national strategic plan*	Recreational divers, marina and slipway operators, Indigenous rangers, citizen scientists
Marine pests website (by Australian Government)	General public and industry
National marine pest care plan	Multiple
National awareness campaign for marine pests	Recreational and commercial divers
National Introduced Marine Pest Information System (NIMPIS; contains marine pest profiles, also database for surveillance data)	Everyone, but particularly useful for environmental consultancies and biosecurity managers
Passive Surveillance Engagement and Awareness (PSEA) task group	Marine stakeholder groups, including divers and people involved with ports, agriculture, and marinas
Aquatic Aquatic animal diseases identification field guide	Aquaculture and fisheries
Aquaculture survey of people's willingness to pay and other past surveys (under *Aquaplan*)	General public

Table 4.1: DAFF-supported general surveillance initiatives (continued)

Name of initiative	Target audience
Aquaplan 2022-2027 (National strategic plan for aquatic health; Activity 3.3, passive surveillance)—*not strictly an initiative, but a national strategic plan*	Farmers, fishers, veterinarians
GENERAL BIOSECURITY:	
Biosecurity awareness raising via social media (Biosecurity and compliance external communication)	General public, targeted groups
Development of communications during emergency response (Biosecurity strategic communications team)	General public (e.g. through the National Biosecurity Communication and Engagement Strategy, outbreak.gov website)
Post-biosecurity detection (Biosecurity reports team, after biosecurity incursions or outbreaks have been detected; BPDN sent directly to states when a clear risk of escape is determined)	Anyone who made a report of a pest, weed or disease
Targeted communications campaigns (Biosecurity education and engagement section)	Travellers, senders of international mail, importers

5 Biosecurity Risk Research Portal

ABARES Social Sciences and CEBRA collated relevant literature (academic and grey literature) on the topics of general surveillance, engagement, and communication and manually labelled the identified references in EndNote using key words (Objective 2). The labels included descriptors such as publication type, publisher, behaviour, concepts, sectors, specific pests/diseases, etc. (Table 5.1). An EndNote library was not considered a suitable long-term solution for storing references and making them available to interested parties, which was an objective of this project. We therefore contacted the CEBRA Project 21E team who were working on the development of the Biosecurity Risk Research Portal (Kneebone *et al.*, 2024). Our collection of references was uploaded to the new portal, retaining all the labels, and adding new key words identified by the portal through AI tagging. The 22C resources can be viewed and searched in the portal, which is currently only accessible through the University of Melbourne network. This is a temporary solution while CEBRA explores options for continued development of the portal, which may involve a more permanent hosting environment and public launch in the future.

Table 5.1: Key words used to label references in the 22C collection

LABELS	
Published by:	**Behavioural aspects:**
ABARES	Human behaviour
CEBRA	Incentives
DAFF	Detection reporting
IACRC (Invasive Animals CRC)	
	Risk/resource management practices:
Publication type (≠ report or journal article):	Adaptive management
Literature review	Monitoring and evaluation
Thesis	Resource allocation
Gap analysis	Biosecurity governance
	Knowledge management
Surveillance:	
General surveillance	**Concepts:**
General surveillance program	Systems thinking
Surveillance system	Shared responsibility
Passive surveillance	

Table 5.1: Keywords used to label references in the 22C collection (continued)

LABELS	
Engagement and communication:	**Methods/tools/technology:**
Community engagement	Rubrics
Stakeholder engagement	Qualitative research
Engagement program	Modelling
Communication program	Tool
Guidelines	Technology
Awareness	
Consultation	**Sector:**
Communication	Marine biosecurity
Citizen science	Plant biosecurity
Participatory design	Animal biosecurity
Stakeholder mapping	Human biosecurity
Social networks	Aquaculture
	Forestry
Specific pests and diseases:	Wildlife
TR4	Beef/dairy
Mediterranean fruit fly	Sheep
Carp	Grains
Acute oak decline	Weeds
Rabies	
RIFA	**Biosecurity data:**
Lionfish	Data
Bigheaded ant	Information system
Classical swine fever	
Avian influenza	**Governance:**
Gypsy moth	Institutions
Burmese python	Enabling environment
American mink	
Lady beetle	**Target groups:**
	Livestock owners
	Peri-urban
	CALD (Culturally and linguistically diverse)

6 Economic analysis tool

Investment in general surveillance programmes by DAFF occurs on the premise that shared responsibility is beneficial, despite a lack of economic evidence from formal evaluation of programmes, e.g. via benefit-cost analysis (BCA) or return on investment (ROI) analysis, confirming that this is the case. This was highlighted during interviews with stakeholders involved in general surveillance, undertaken as part of CEBRA 22C (Arndt *et al.*, 2024b), in which stakeholders lamented the lack of economic analysis of programmes. It also became clear from interviews that the data needed to enable such analysis was not being routinely collected. This deficit, in both data collection and data analysis, hinders the design of cost-effective and efficient general surveillance programmes. This, in turn, impedes confidence in the efficient allocation of resources to surveillance more generally, including in terms of how active and general surveillance should be used in combination to manage particular biosecurity threats. More broadly, trust and confidence are critical factors that influence the successful integration of support systems into decision making processes (Jones *et al.*, 2021).

In addition to ROI and BCA, programme data could be analysed to allow a deeper understanding of how attributes of different activities make them more or less effective in terms of the likelihood that stakeholders will report, as suggested by Hester & Cacho (2017). Effectiveness of a given activity could be represented by the total number of detections, the number of detections per time period; or the number of reports (positive and negative) per time period, or the quality of reports from general surveillance programme participants versus members of the public. In addition, collecting data on reporter context (e.g. Roe *et al.*, 2024) would enable analysts to determine relationships between effectiveness and explanatory factors such as pest characteristics, event duration, location and reporter characteristics (Hester & Cacho, 2017). This would further inform efficient resource allocation for general surveillance programmes.

6.1 Pre-existing tools

A literature and web search of publicly available approaches to conducting economic evaluations of general surveillance programmes (or citizen science programmes) did not yield any suitable results in Australia. However, the CEBRA research team discovered an existing economic analysis tool developed in the UK that had good potential for adaptation to the Australian biosecurity context (Objectives 4 and 5) — 'The UK citizen science evaluation tool' (the tool; Blaney *et al.*, 2016). This discovery of a pre-existing tool removed the need to collect data to support the development of an economic analysis methodology and framework (Objective 3).

The tool was an output from a 2015-16 UK Environmental Observation Framework (UKEOF) project that aimed to better understand the potential of citizen science in

supporting environmental monitoring programmes, and how to evaluate the costs and benefits of such programmes. Outputs of that project included a review of methods for valuing the contribution of citizen science and a spread sheet based economic evaluation tool. The tool was tested using four case studies (Blaney *et al.*, 2016), but subsequently does not appear to have been taken up by programme managers for routine evaluation of their citizen science programmes. The lack of adoption may be due to the lead author of the report leaving this area of research and the need for a developer to further refine the tool. With permission from the original creators we adapted the tool for the evaluation of general surveillance programmes in Australia.

6.2 The Tool

The existing UKEOF tool was modified for use in the context of general surveillance programmes in biosecurity. A summary of the modified spreadsheet tool (hereafter: the tool) is provided below, followed by a summary of the testing that occurred, and a discussion of the various practical applications of the tool ('use-cases') for programme managers. The tool's manual is given in Appendix A.

The tool consists of a series of worksheets that users can work through when planning, implementing, monitoring, and evaluating a general surveillance programme. The worksheets in the tool are as follows:

1. **Introduction:** A brief introduction to the tool by the original developers.
2. **Screening:** High-level questions that aim to help general surveillance practitioners and decision-makers with the planning and design of general surveillance programmes; modified for the biosecurity context.
3. **Set-up:** For recording background information on the general surveillance programme. Also links to the *Default values* worksheet for calculating the alternative options and provides guidance on selecting an appropriate evaluation approach.
4. **Default values:** Where users define default values (e.g. discount rate, annual salary costs) that will be used in other worksheets. Includes a table for calculating the present value costs of the alternative option.
5. **Costs:** Captures the total programme expenditure, the annual operational costs of the general surveillance programme.
6. **Benefits:** Captures the quantifiable benefits generated by the general surveillance programme.
7. **Spread and damage:** A simple spread model that simulates the spread of invasive species over time and estimates the damage caused by the species occupying an area. The benefit is the avoided damage if the species is detected early through general surveillance. This worksheet is an addition to the UKEOF tool.
8. **MCA Inputs:** An extension to the *Costs* and *Benefits* worksheets that collates non-monetised costs and benefits using qualitative judgements of the levels of benefit and the likelihood of costs.

9. **Outputs summary:** Displays the results of the selected evaluation approach based on the information entered in the previous worksheets.

10. **Notes:** Contains notes written by the original developer. Content is superseded by the manual in this report (Appendix A).

6.3 Testing

Testing of the tool occurred via a stakeholder workshop and pre-workshop testing. Pre-workshop testing involved four surveillance practitioners from two general surveillance programmes (one weeds related and the other related to hitchhiker insects) entering their own data into the tool to test its usability. Each person provided extensive feedback on the first version of the modified tool. Feedback on the tool was generally positive. Testers noted that it has strong potential to support managers in establishing surveillance programmes, evaluating economic benefits, securing funding, and raising the profile of general surveillance programmes. In response to specific feedback regarding user friendliness, clarity of individual worksheets, and data input requirements, targeted improvements were made to enhance the overall user experience.

The aim of the subsequent stakeholder workshop, which brought together participants from different organisations and jurisdictions, was to create a hands-on experience where participants could test the tool first with a hypothetical dataset and then with their own data. As the workshop progressed, the approach shifted and the group decided to enter the hypothetical data together and discuss each worksheet in detail. This change in approach resulted in comprehensive feedback from the workshop participants (Objective 6). The feedback from the general surveillance specialists and the workshop was consolidated and considered in the further development and refinement of the tool (Objective 7).

To support future testing and use of the tool, the draft manual presented at the workshop was updated and finalised in this project (Objective 8; Appendix A). The proof-of-concept tool delivered by this project will need additional testing and modification to ensure it is fit for purpose.

6.4 Using the tool

The use of the tool is not limited to the general surveillance context, it can also be applied to other biosecurity programmes or projects (e.g. projects under the Environmental Biosecurity Project Fund), and non-biosecurity programmes (e.g. a citizen science programme about forest biodiversity monitoring).

Regardless of the context in which the tool is applied, some data inputs are consistently of higher importance and should be prioritised, particularly when time or data availability is limited. Staff costs, including salaries and overheads, represent a significant expenditure in any programme and should, at a minimum, be entered into the tool both as a cost and as a benefit (in terms of avoided salary costs for experts). Including this information is essential to generate meaningful outputs concerning the programme's economic value.

Although the tool is effective as a stand-alone decision support aid, integrating it into a broader monitoring and evaluation framework (Recommendation 3; ABARES project) could further enhance its impact and long-term value. As a standalone tool in the context of general surveillance, we recommend that it be used as detailed in the following sections.

6.4.1 Programme planning, pre-implementation

In the programme planning stage, managers develop budgets for their funding applications. They need to estimate what the likely costs and benefits of the programme will be. The tool encourages critical thinking and supports programme planning by highlighting important factors to consider in the *Screening* worksheet (Figure 6.1). In that way, the tool is indicative, which means that users can apply it to their specific context and choose which worksheets they wish to populate (e.g. managers may choose to only use the *Costs* worksheet to identify expected cost items and estimate the required investment). Users can also adapt the tool so it matches their individual needs better. More substantial changes to the tool that would be of benefit to other users should trigger the development of an updated version of the tool.

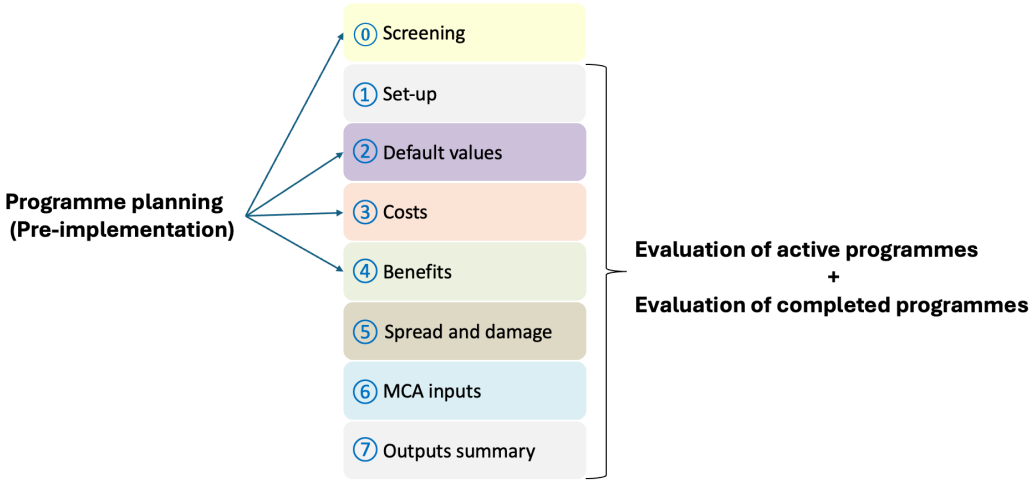

Figure 6.1: Using the tool for different purposes. Coloured boxes represent the worksheets in the tool in sequential order.

The use of the *Screening* worksheet is important in the pre-implementation stage because the screening questions guide users through specific aspects of planning and design of new programmes that should be considered, such as collaboration, pilot studies, objectives/goals, target audience, resources, and records. Managers can step through the screening questions and identify and rectify any shortcomings in their planning. The *Costs*, *Benefits* and *Default* worksheets contain examples of cost and benefit items that may be relevant for the intended general surveillance programme. In the pre-implementation stage, managers can then estimate the likely magnitude of these items (e.g. staff costs, IT maintenance, insurance, etc.). Further examples of costs and benefits are included in the manual (Sections A.4 and A.5).

The budget estimates should be saved so they can be revisited and, if the programme is funded and implemented, compared with actual programme costs and benefits at specific time intervals to obtain feedback on the accuracy of the planning process.

With the routine use of the tool and sharing of economic data over time, different use cases can be collated and support other general surveillance managers in their budget estimates during programme planning.

An additional important consideration is the potential benefit of the economic analysis tool being adopted by surveillance managers external to DAFF. Broader use of the tool could improve the quality of future funding proposals submitted to DAFF, in that these proposals are guided by the programme planning questions in the tool, promoting more rigorous and strategic planning of general surveillance activities. In turn, better planning may lead to stronger partnerships, better coordination, and more effectively resourced programmes that are well-positioned to achieve their intended outcomes.

6.4.2 Evaluation of active programmes

If programme managers want to capture costs and benefits of an actively running general surveillance programme, they do not need to consult the *Screening* worksheet. They can step through the seven worksheets as described in Figure 6.1 and in the manual (Appendix A), starting with the *Set-up* worksheet. Data on costs and benefits most likely will be collected in other spread sheets and can then be entered into the tool at chosen intervals (e.g. annually, every two years). As the tool is a proof-of-concept that has not been widely tested in the UK or Australia, testing with real world data will reveal how economic data are best collected and entered, and evaluation outcomes then stored in the tool.

6.4.3 Evaluation of completed programmes

Programme managers can evaluate the benefits and costs of general surveillance programmes after they have been completed by following the same steps as outlined in Section 6.4.2.

When BCA is done retrospectively after the programme has been completed, it is referred to as *ex-post* BCA. In contrast, *ex-ante* BCA is done before implementation, typically to support programme funding approval by appraising its feasibility (Bland *et al.*, 2024; Bernardos *et al.*, 2021). Both approaches offer distinct advantages. *Ex-post* BCA can be of great value to programme managers, as it provides insight into the actual costs and benefits, and therefore on the quality of the investment (the return on investment). Additionally, findings from *ex-post* BCA can enhance the accuracy of future *ex-ante* BCAs and contribute to improved planning and design of similar initiatives (NSW Treasury, 2023), by identifying issues (e.g. consistent over- or underestimation of costs and benefits) that should be addressed at the planning stage (Bernardos *et al.*, 2021). *Ex-ante* BCAs allow managers to choose between different programme options and adjust the programme design if necessary, but estimating costs and benefits is more difficult because they have not yet occurred (Bernardos *et al.*, 2021).

In general, capturing the general surveillance programmes that are designed, monitored and evaluated using the tool will also be important for future learning about the efficiency of programmes. We recommend creating an easily accessible storage solution for the outputs of the tool to facilitate communication between programme evaluation and future learning and planning, thereby closing the loop of the planning cycle (Arndt, 2024). A storage solution for created knowledge is part

of organisational knowledge management and facilitates dissemination of research outputs and application of knowledge, creating value for biosecurity management (Hester *et al.*, 2024).

6.4.4 Facilitation of stakeholder engagement

In addition to capturing economic information related to general surveillance programmes, the tool can support the development of transparent, collaborative, and productive partnerships with key stakeholders. It functions as a facilitation mechanism for engaging both programme managers and volunteers, while underscoring the importance of monitoring and evaluating programme performance. Engaging with stakeholders about the use of the tool to guide planning and undertake economic assessments can enhance their understanding of the key components required to establish effective general surveillance systems, as well as the types of data needed for economic analysis. This can foster trust, which is essential to overcoming resistance to externally developed tools and insights, referred to as the 'not-invented-here' bias (Hester *et al.*, 2024). Actively involving stakeholders at early stages of the evaluation process also strengthens their commitment to the programme and increases the likelihood that evaluation results will be used to guide future management decisions (Pankaj & Emery, 2016).

7 Conclusion and recommendations

Phase One of CEBRA project 22C, undertaken with ABARES Social Sciences, provided recommendations around the need for a decision-support tool to assist with general surveillance planning, implementation and evaluation. This would allow general surveillance practitioners and decision-makers to better understand and describe/quantify the benefits of general surveillance programmes, and how to achieve those particular benefits at lowest cost. In this report we have presented work that addresses the need for a more structured economic analysis of general surveillance programmes.

7.1 Updated general surveillance stocktake

One objective of this project was to gain a better understanding of the magnitude of DAFF's financial contributions to general surveillance initiatives to support appropriate resource allocation to general surveillance into the future. However, DAFF's total financial contribution to general surveillance programmes remains unclear, because financial information that accurately reflects DAFF's monetary investment in general surveillance programmes is often unknown (e.g. if general surveillance is an aspect of a broader initiative) or difficult to obtain for various reasons (e.g., staff turnover). If financial data for existing programmes was collected in a way that provides a clear picture of actual investment, this knowledge could form the basis of informed and strategic decision making that leads to realistic budgeting and resourcing decisions.

From a broader perspective, when the tool is used to evaluate investments in community surveillance programmes outside of DAFF, it provides value to external investors by enabling a clearer understanding of the economic return of their non-DAFF funded programmes. In parallel, DAFF would gain greater visibility into investment decisions made by other stakeholders, allowing for the identification of potential gaps, overlaps and opportunities to enhance the overall efficiency and effectiveness of its own investment strategies. The tool is also capable of capturing co-investment scenarios, which, while often difficult to quantify, are critical to understanding the full return on investment.

Past expenditure patterns can help estimate future expenditure, and known financial information for different types of general surveillance programmes can also be useful in estimating budgets for scaled-up programmes. For example, financial data for a short-term general surveillance programme (e.g. a food pantry Blitz) will be helpful in budgeting for future implementations of that programme that may involve more community households. Greater financial transparency will lead to greater confidence in budget estimates by programme managers and more cost-effective implementation of planned programme activities, and together with programme performance data it can support government agencies in their responsibility to allocate resources wisely and be accountable to Australian taxpayers.

7.2 Economic analysis tool

The paucity of publicly available economic analysis tools for general surveillance or citizen science programmes was somewhat surprising to the project team given that the use of community members, or citizen scientists, is a widely applied approach in the environmental management of invasive species across the biological invasion process (i.e. pre-arrival, establishment, spread, and persistence; Pocock *et al.*, 2024). The existing economic analysis tool developed by the UKEOF Citizen Science Working Group was successfully adapted to the Australian general surveillance context, as a proof-of-concept tool. The tool requires additional testing for a range of different general surveillance programmes, but offers a promising way to improve the design, implementation and evaluation of general surveillance programmes.

7.2.1 Further testing of tool and systematic collection of case studies

To further improve the tool, its applicability to a range of different types of general surveillance programmes should be tested, where chosen 'use-cases' would best cover different:

- programme objectives (e.g. public reports of new detections, establishment of networks)
- biosecurity sectors (e.g. plant biosecurity - weeds, marine biosecurity - marine pests)
- jurisdictions (regional, state, national)
- audiences.

Ideally, managers responsible for selected general surveillance programmes would use the tool to assess the economics of *potential* programmes, *refine* programmes as necessary following implementation, and finally undertake some kind of economic *evaluation* of the programme based on actual data collected during programme operation. To support effective data collection, the manual includes instructions on data requirements for economic analysis.

The further testing of the tool should be carried out in a structured way that ensures that feedback from stakeholders is captured and taken into account in the continuous refinement of the tool. The systematic capturing of use-cases will build a catalogue of knowledge about the costs and benefits of different types of general surveillance programmes. Ideally, systematic collection of use-cases would involve using a database (e.g. Access) that can automatically upload data from the worksheets in the tool and that can be shared with general surveillance practitioners and decision makers. As some data may be confidential, access rights to these datasets need to be carefully considered.

7.2.2 Embedding the tool in business-as-usual processes

A functioning tool is unlikely to be enough to encourage general surveillance practitioners to adopt the tool and undertake routine economic evaluation of their

programmes. In the UK, the original tool was tested using four case studies (Blaney *et al.*, 2016), but subsequently does not appear to have been taken up by programme managers for routine evaluation of their citizen science programmes. While the reasons for this lack of uptake are unknown, we speculate that the problem may be linked to issues related to 'knowledge management' – the set of processes an organisation uses to create, store, disseminate and apply information assets (Alavi & Leidner, 2001). Knowledge creation needs to be linked with knowledge storage (a place where the tool is easily accessible), dissemination (socialising the tool among stakeholders in meetings and workshops), and application (creating a standard that requires program managers to use the tool) to achieve integration of the tool into organisational processes and to create the benefits discussed above (Hester *et al.*, 2024).

The tool described in this project should enable improved economic analysis of programmes, particularly their design, implementation, and evaluation, with the ultimate aim of improving resourcing decisions around general surveillance programmes. We also expect the tool to enhance trust and relationship building within the surveillance community.

7.2.3 Future research: answering the bigger questions around public engagement

The ongoing use and improvement of the tool, along with systematic collection of use-cases presents an opportunity to analyse and compare general surveillance programmes and outcomes across contexts. For example, data could be used to:

- build up a picture of the cost-effectiveness and/or efficiency of different types of programmes and pests;
- collect quantitative information that will enhance our understanding of general surveillance in a meaningful way, as a component in a surveillance continuum, alongside other response activities and types of surveillance (Hester & Cacho, 2017);
- identify all eradications/responses of pests, weeds and diseases that were first detected by people from all walks of life, including members of the general public. This would provide the basis for estimating the past contribution of general surveillance to eradication benefits; and
- improve our understanding of the reliability of different types of general surveillance programmes in detecting threats (Camac, 2024). This would require recording the sensitivity of general surveillance and the survey effort undertaken by those making the reports. Analysis of this information would assist biosecurity agencies understand the likelihood that a threat is absent given reports from particular general surveillance contexts.

Future research could explore effective methods for incorporating the valuation of environmental, social, and cultural benefits into the tool. This remains a challenge due to the lack of established markets for environmental goods and services, as well as for social and cultural values, as outlined in the Phase One report (Arndt *et al.*, 2024b).

7.3 Recommendations

1. **That priority be given to understanding the impact of DAFF-funded and supported general surveillance programmes via economic analysis of a sample of different types of programmes.**

   Resource allocation to general surveillance will be significantly improved if it is based on an understanding of the costs and benefits of different types of general surveillance programmes (e.g. size, duration, objective and structure). To enable this analysis, collection of data on costs and benefits over time should become a routine part of programme development and implementation. We note that the past monetary value of DAFF's investment is unknown and there are no existing processes in place for its collection. Use of non-market valuation techniques may also be necessary to capture the value of benefits.

2. **That the decision-support tool developed in this project be further tested, with use-cases captured and available for wider use.**

   The proof-of-concept tool developed in this project requires additional testing and improvement if widespread adoption is to occur. This should be easily undertaken given the large number of general surveillance programmes that are developed and/or supported by DAFF each year. While the tool itself will be freely available to other agencies for use and further modification, a version of the tool suitable for use by DAFF staff, should be appropriately stored within DAFF systems, and could be modified further if deemed necessary. It is also important to store worksheets generated from applying the tool to particular programmes before, during and after completion. Systematically capturing information in this way will allow future analysis of programme cost-effectiveness.

3. **That a decision-support tool developed in this project be used to support DAFF decision making with respect to the development of general surveillance programmes**

   The decision support tool developed in this project should be used by DAFF staff to better understand the cost-effectiveness of various types of biosecurity community engagement programs in different contexts. This would include advice on data collection to inform the analysis of programme benefits.

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Appendix A: Manual

NOTE TO USERS
Future updates to the tool will not be reflected in this publication; instead, they will appear in standalone updates of the manual. At the time of publication, the tool and its manual are hosted on the CEBRA website, although a more permanent location may be established in future. The authors of the tool may be contacted for assistance via cebra-info@unimelb.edu.au.

The economic analysis tool consists of several worksheets. In this manual, we will outline the purpose and function of each worksheet. Users will step through the worksheets in the following order when evaluating an existing general surveillance programme or a completed programme in retrospective (Figure A.1). If the purpose is to plan and design a new general surveillance programme, users would first consult the *Screening* worksheet to identify any factors that may influence the future success of the programme. If the focus is on evaluation, the first worksheet sets up the evaluation, by asking for background information on the general surveillance programme and guiding the user in selecting an appropriate evaluation approach. The *Costs* and *Benefits* worksheets record the monetary costs and benefits of the general surveillance programme. If sufficient parameter information is available, users can also calculate the benefits (avoided damages) of early detection by running a simple spread and damage model. Multi-criteria analysis[3] (MCA) is optional, but helps to capture benefits that are difficult to quantify in monetary terms. MCA significantly enriches the evaluation of a general surveillance programme by collecting judgements on the level of benefits at the individual, team, organisational, and societal levels. The outputs summary succinctly displays the results of the different evaluation approaches.

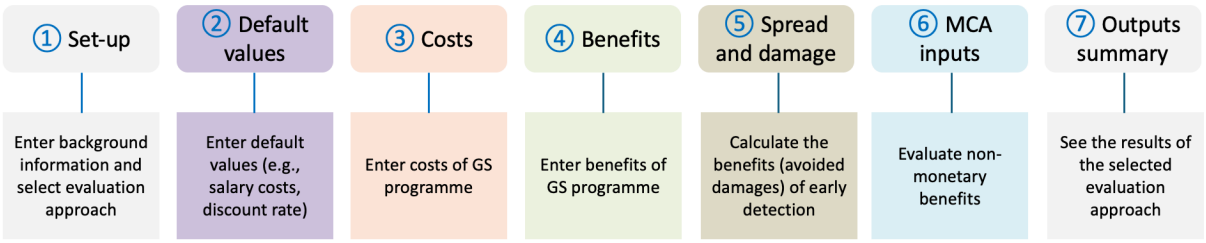


Figure A.1: Steps involved in using the economic analysis tool for programme evaluation.

In general, users of the tool can apply one or more of different economic evaluation

[3]MCA refers to any structured approach that entails identifying criteria, assigning weights to them, and then scoring options on how well they perform against each weighted criterion; see for example UK Treasury (2011) Green Book: Appraisal and Evaluation in Central Government, p 35.

methods in the evaluation of programme data:

- **Return on investment (ROI)**: the monetised aspects of programmes are used to assess the value an organisation receives from their investment in the programme.
- **Benefit-cost analysis (BCA)**: considers the costs and benefits of a programme to society as a whole (rather than to an organisation) and includes non-monetary costs and benefits where these can be estimated.
- **Cost-effectiveness analysis (CEA)**: compares the relative costs of two or more investment options for achieving a given outcome (e.g. a general surveillance programme vs. the use of paid experts), and is particularly useful where benefits are unquantifiable or where a specific goal—such as eradication—has already been set, or that BCA is unable to be used.
- **Multi-criteria analysis (MCA)**: a structured approach is used to determine the relative preference for different options based on evaluation indicators. The measurement of indicators doesn't need to be in monetary terms. MCA relies on expert judgement to evaluate non-monetary costs and benefits.

A.1 SCREENING

This worksheet contains high-level screening questions that aim to help programme coordinators and decision-makers with the planning and design of general surveillance programmes. The screening questions address feasibility of the programme, by asking about general aspects, requirements, stakeholder engagement, and resources, and are linked to pre-determined responses that depend on a boolean (Y/N) user input selection.

The screening questions are not intended to be prescriptive, but aim to provide guidance to general surveillance practitioners when setting up new general surveillance programmes. Practitioners are encouraged to address any factors identified by the tool that may influence the success of the programme if they are not adequately considered. For example, a lack of process for assessment of data accuracy. Where appropriate, the tool refers users to two ABARES publications for more information on how to address inadequacies in programme design: the *Guidelines for General Surveillance Programs (2022)* and the *Guide for General Surveillance Program Design, Monitoring and Evaluation (2024)*[4].

Note: Not all screening questions will be relevant to your individual context.

A.2 SET-UP

The set-up worksheet requires entry of background information on the general surveillance programme, such as name, location, type, a summary of its activities, the source of funds, and the period of economic analysis. This worksheet also helps users

[4]This document is undergoing piloting and is not yet publicly available.

to determine the costs of the alternative option and which evaluation approach may be suitable to use in their economic analysis.

A.2.1 Background information: Type of general surveillance

The background information on the Set-up tab first asks for the **name** of the general surveillance programme and the **location** where its activities take place. Including these details is optional, but improves the quality of record keeping. The question about the **type of general surveillance programme** defines its purpose. This field is a free text field where practitioners can record what the main purpose of the general surveillance (GS) programme is. Below are examples of potential purposes as presented in section 1.1.1 of the *Guidelines for General Surveillance Programs* (Kruger *et al.*, 2022):

- producing evidence of freedom to support trade
- enabling the early detection of pests, weeds, and diseases
- monitoring prevalence and trends (e.g. in animal diseases)
- increasing understanding of current and future spread
- improving epidemiological understanding of diseases, infections and infestations
- early warning of approaching threats
- informing programme evaluation
- other benefits (e.g. delivering biodiversity data).

Summarise the alternative option asks the user to specify who undertakes the activities under the alternative option: government staff or paid contractors. If nothing is being done at this time, users can select 'no baseline'. In the next input box users can **summarise the proposed GS option** by selecting which scenario best describes the general surveillance programme's use of, and engagement with, participants: (1) General crowd-sourcing of information[5], (2) Use of untrained volunteers to collect data in the field, (3) Training volunteers to undertake work as experts, or, (4) a Combination of training volunteers to undertake work & paid workers. The **source of the GS funds** field offers a free text box where users can identify the source of the GS programme funding.

A.2.2 Financial parameters: Alternative Option

The alternative option to the general surveillance initiative involves experts undertaking the surveillance activities who are paid for these services. These experts are assumed to have adequate training in design and implementation of field

[5]A portmanteau of "crowd" and "outsourcing", crowd-sourcing is a typically passive, on-line platform-based reporting with limited engagement between contributor and researcher. Australian examples include e.g. FeralScan or MyPestGuide (Table 4.1). See Caley & Barry (2022) for a relevant discussion.

surveys for invasive species and expertise in species identification. Experts include government staff and skilled contractors (e.g. consultants). If surveillance activities undertaken by experts span multiple years (>1), users are directed to the *Default values* worksheet where the total costs of the alternative option can be calculated and discounted to a present value (Figure A.2). The total present value costs should also be displayed on the *Set-up* worksheet under financial parameters (Figure A.3). Copy the present value cost figure across to the *Set-up* worksheet if it doesn't appear there automatically.

If surveillance activities carried out by experts are not currently undertaken, enter zero into the present value calculator on the *Default values* worksheet.

Alternative option: Present Value Cost tool	Year	1	2	3	4	5	6	7	8	9	10	Present value:
Note that these are the costs of the alternative (using experts) that are relevant to the activity being considered.	Cost	$50,000	$40,000	$40,000	$0	$0	$0	$0	$0	$0	$0	$121,727

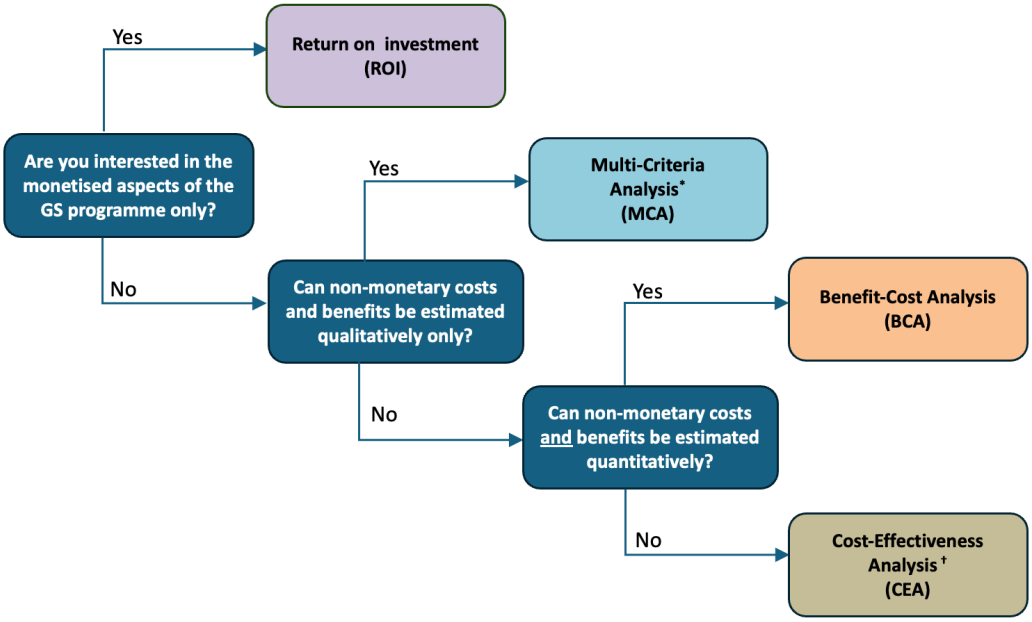
Figure A.2: Table in the *Default values* worksheet that calculates total costs for the alternative option, discounted to present value.

Financial parameters	**Input Box**	**Notes**
Alternative option - Present Value Cost for general surveillance undertaken by experts (over entire period being considered)	**$121,727**	Is the alternative activity currently being undertaken and taking place over multiple years (>1)? If yes, then use the Present Value Cost tool in the **Default values tab** and refer to the manual. Go to the Default values tab for calculation: how much is the surveillance cost as undertaken by your organisation/contractors? (if not currently undertaken then please enter a value of 0).
Determining evaluation approach		

Figure A.3: The alternative option input box on the *Set-up* worksheet, displaying the discounted present value for the alternative option (i.e. the use of experts) as calculated in the *Default values* worksheet.

A.2.3 Determining an evaluation approach

Which evaluation approach is best depends on the data that are available for the evaluation (Figure A.4). The most simple approach is a return on investment (ROI) analysis, which compares the total monetised costs and benefits for the general surveillance programme, disregarding any wider benefits (e.g. volunteer well-being). If the economic analysis will include non-monetary costs and benefits, different approaches are possible. If benefits can be monetised a benefit-cost analysis (BCA) is the preferred approach. If they cannot be monetised, a cost-effectiveness analysis (CEA) can be used, which compares the costs of a general surveillance programme with the costs of an alternative (i.e. experts undertaking the surveillance) where outcomes are measurable in the same units (e.g. cases detected, hectares treated) . If benefits can only be estimated qualitatively, a multi-criteria analysis (MCA) is suitable. MCA can also be used in conjunction with a BCA, to enrich the economic evaluation. For more information on these evaluation approaches see Emerton & Howard (2008).



*MCA can also be applied when non-monetary benefits can be estimated quantitatively, it enriches any evaluation
† CEA assumes that costs are available for both the general surveillance programme and the alternative option

Figure A.4: Decision tree for selection of an evaluation approach (modified from Blaney *et al.*, 2016).

A.3 DEFAULT VALUES

This worksheet allows users to define default values that will be used in the calculation of the costs of general surveillance programmes and the alternatives, and to determine the net present value of future costs. To determine programme costs, users can enter the salary values for senior, mid-level, and junior staff in the *Default values* worksheet. The *Costs* worksheet will draw on these annual salary values to calculate actual salary costs incurred by the programme, based on the FTE information entered into the costs table by users.

In the *Default values* worksheet, users can describe different types of cost items in more detail (e.g. induction and training, supplies and equipment, or insurance) and specify different levels of costs (high, medium, low) for them. The purple cells are standalone and are not linked to other worksheets. They are intended for manual data entry to support documentation and information collection purposes.

Once all cost items for the general surveillance programme are included and summarised for each year, the present value of the costs of the alternative option, if one exists, should be calculated. The alternative option typically includes the annual costs of using trained surveillance experts and associated expenses. The costs of the alternative option can be determined as outlined in section A.2.2, using the Table shown in Figure A.2. This calculation should include all costs (salaries, administration, training, and insurance etc.

An important default value in the economic analysis tool is the **discount rate**, the percentage rate (usually the market rate interest) used to reduce the value of a future income stream to its present value. Discounting acknowledges that a dollar received today is not worth the same as a dollar received tomorrow, which is important when

benefits from a general surveillance project are realised later than when costs are incurred. For more information on discounting see Bland *et al.* (2024) and Costanza *et al.* (2021).

A.4 COSTS

This worksheet captures the annual operational costs of the general surveillance programme. Costs are divided into staff costs (salary + overheads) and other annual costs for the programme.

Costs for staff can be entered as annual costs, if known, or calculated by entering a relevant FTE. If a FTE is entered, the worksheet calculates the annual value by using a default salary, defined in the *Default values* worksheet (G6 or G7). It is important to check which default salary is being used in the equation. Directly entered annual costs override calculations using FTE.

Other annual cost items may include diagnostics, postage and delivery fees, data analysis, software packages and licenses, legal advice, IT development, reviews by independent organisations, and the costs of false positives (Kruger *et al.*, 2022).

The total present value is the total cost at the end of the programme, discounted to present value by using the discount rate defined in the set-up worksheet. The output for the ROI method displays the undiscounted costs. The *Costs* worksheet presents the total present value of the total costs, and its components (staff and other annual costs) in the top left corner.

Users can edit and add cost items to adapt the worksheet to the specific circumstances of their general surveillance programme. If new rows are added to the *Costs* worksheet for additional cost items, formulas in dark and light grey cells need to be copied into the new cells and linked to the correct default value. For example, if a new staff cost row is added to the worksheet, the formulas need to be copied and the last element of the formula in the dark grey cell adjusted (Figure A.5):

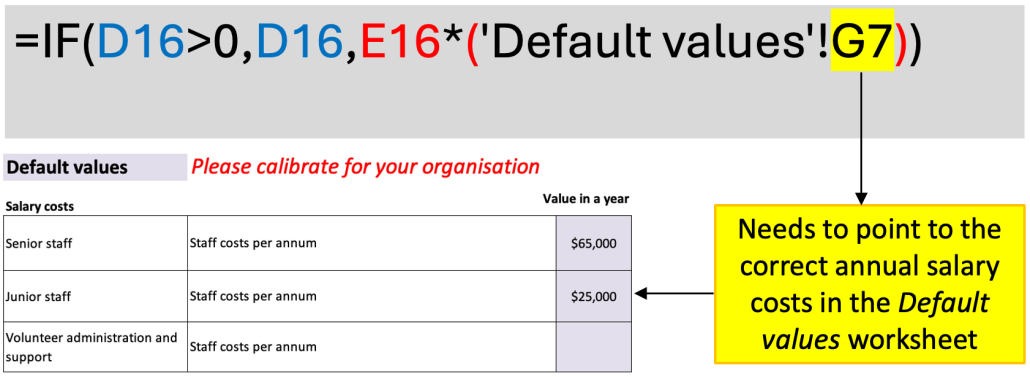


Figure A.5: Formula in the dark grey cells within the *Costs* worksheet. The letter-number combination at the end of the formula (highlighted in yellow) needs to point to the cell with the correct annual salary costs in the *Default values* worksheet.

Note: Dark grey cells and some light grey cells contain mathematical equations and should not be overwritten or deleted.

A.5 BENEFITS

The *Benefits* worksheet captures the benefits generated by the general surveillance programme activities. The main table requires input on the effort (i.e., hours per week, weeks per year) spent by general surveillance practitioners (e.g. agronomists, private vets, nursery workers, private landholders) and other members of the community who volunteer their time. This effort is valued in monetary terms by using the hourly cost of an equivalent paid role[6], which could be that of a government biosecurity officer, a paid field worker (a contractor), or a triage officer.

The outputs of the effort calculations are summarised in the 'Value of the volunteer activities' table underneath. This table contains dark grey cells with formulas, which should not be overwritten or deleted.

The Work Rate Equivalent indicates whether the work of 'volunteers' is considered to be more, equal, or less efficient than that of a government biosecurity officer in terms of data points produced (outputs) per effort invested (input). If users of the tool wish to consider the quality of the obtained surveillance data as well, they could distinguish the quality of surveillance data by weighting the value of activities according to observer type. Lower detection sensitivity by a group of observers will reduce the quality of the data and therefore the value of the benefit by some amount.

The *Benefits* worksheet also considers other types of benefits. The health and well-being of volunteers and their education and skills are examples of benefits inbuilt into the tool by the original developers. Other benefits that can be monetised can be entered in the table at the bottom of the worksheet, where their net present value is calculated using the discount rate defined in the *Set-up* worksheet. These include in-kind contributions (i.e. costs that a programme does not have to pay), networks (i.e. fewer expert staff are required to engage with the community as knowledge is disseminated within the network), and avoided response costs and travel time. Users can either enter the monetary value of other benefits as annual totals or calculate the value in the table using hourly rates.

This project has extended the types of benefits that can be captured by adding a simple spread model that calculates the benefits of early detection (Appendix chapter A.6). The present value of all benefits from the use of general surveillance is displayed on the top left of the worksheet.

[6]Note that by valuing all volunteer contributions we are assuming each volunteer could have earned an income in an alternative use of their time ie. that their volunteering has an *opportunity cost*. For a longer discussion see Sinden *et al.* (2004).

What does Work Rate Equivalent mean?

Work Rate Equivalent is a difficult value to estimate, but it is important when assessing the monetary value of all those participants in GS programmes who are essentially 'volunteers' for the purpose of calculating the benefits from the GS programme. Work Rate Equivalent is the efficiency of volunteers compared to paid workers in this role. It is used to work out the monetary equivalent value of the volunteer effort. Work Rate Equivalent should be considered across the whole dataset (not per individual).

Examples:

1. Volunteers are **directly equivalent** to paid workers in terms of their total inputs (e.g. time) and outputs (e.g. data points), so Work Rate Equivalent is equal to 1.

2. Volunteers are **less efficient** than paid workers (they are slower and less experienced, or altogether they collect more data than is necessary to address the question), so the Work Rate Equivalent is less than 1.

3. Volunteers are **more efficient** than paid workers (because they live near sample sites and so travel time is less, or because they have relevant specialist skills), so the Work Rate Equivalent is greater than 1.

4. I have $20,000 which I could use either to hire a paid worker or to set up a general surveillance project using volunteers, both of which can address my question. So, I either enter the value of $20,000 in *Set-up* cell E22, or I can adjust the Work Rate Efficiency so the value of volunteers equals $20,000, and reflect whether the value of Work Rate Efficiency is reasonable (use Data -> What-if Analysis -> Goal Seek)

Source: (Blaney *et al.*, 2016), with minor modifications.

A.6 SPREAD AND DAMAGE

This worksheet is an addition made by the CEBRA team. It contains a simple spread model developed by Tom Kompas (CEBRA; unpublished) that simulates the spread of species over time and calculates the damage associated with the area occupied by the species. Users can manipulate the input parameters and determine the cumulative damage of a pest or weed with unmitigated vs mitigated spread. Unmitigated spread is the undetected and uncontrolled movement of a pest or weed across the landscape. Mitigated spread is the spread pattern that is influenced by biosecurity control measures after detection by general surveillance or 'natural detection'[7]. The difference between the cumulative damage over 30 years at the natural detection point and the damage with general surveillance can be entered in the benefits worksheet as avoided damage through early detection.

The spread and damage model requires ten user-specified input parameters to run, which are listed and explained in Table A.1. The table includes sensitivity parameters,

[7]The point at which the pest, disease or weed is identified in the environment by farmers or the public without any surveillance expenditures, for more information see Kompas *et al.* (2016).

which are values that are often unknown and have to be assumed or taken from the literature, and can then be varied to assess their influence on model outcomes. Sources of values should be documented to ensure transparency in tool use. A column has been included in the table for this purpose.

The simple spread and damage model works best for weeds and plant pests, using 'ha' as the common unit for the model parameters, except for the discount rate. If users wish to use the spread model to estimate damage from animal diseases, all area-based parameters would need to adopt a unit of 'number of properties' and damage would be calculated using damage in dollars per property ($/property).

Estimating the benefits (=avoided damages) of general surveillance using the simple spread and damage model is a good approximation. Analysis of the economic consequences of the introduction, establishment and spread of a pest, disease or weed can also be done in **Biosecurity Commons**, a cloud-based decision-support platform. Biosecurity Commons can create risk maps (*Risk Mapping* workflow) to identify the areas in Australia at risk from species establishment and then simulate the potential spread of a threat species across the landscape in its *Dispersal Modelling* workflow. The platform also provides an *Impact Analysis* workflow that can overlay land use, biodiversity and demographic data to determine the extent of the impact on an area affected by invasive species.

The inclusion of default values for the spread rate of different threat species or time to early detection is out of scope for this project. However, this information could be collated by users over time, stored in an accessible place and updated when new information becomes available.

Table A.1: The parameters used in the spread and damage model.

Parameters	Explanation
MCC=Maximum carrying capacity or maximum area of occupancy	The maximum possible range size for a species (i.e. the suitable habitat). Usually area, but can be individuals if pest animals are the focus. If zero, there is no limit to spread, it is exponential
Initial incursion (ha)	The initial area of an incursion. An arbitrary number, because this information is often unknown. It is a sensitivity parameter and different values should be explored and tested
Unmitigated (intrinsic) growth rate	The *r* from the logistic growth function
Natural detection point (ha)	The extent of the incursion when it is detected by members of the public, where no engagement has occurred. Use values from the literature (e.g. Kompas & Che, 2009) or if not available document logic behind chosen value
Detection point with active surveillance (ha)	The extent of the incursion when it is detected by active surveillance. A sensitivity parameter, use values from the literature (e.g. Camac, 2024) or if not available document logic behind chosen value
Immediate impact of intervention	Proportion of area still occupied after an intervention. For example, if the parameter is 0.4, the area occupied was reduced by 60%
Decay rate after intervention	The new logistic growth rate *r* after intervention. Should be negative to reduce spread, is zero when spread is contained
Uncertainty impact (0=deterministic)	Uncertainty around the impact, set this to zero
Damage per unit of pest per year ($/ha)	Estimated damage per unit area ($/ha). Get data from ABARES studies or other literature
Discount rate	To determine the net present value of future costs. Use discount rate for portfolio assets (e.g. risk neutral bank rate). For environmental assets set discount rate to zero
Time	Is set to 30 years

A.7 MULTI-CRITERIA ANALYSIS (MCA) INPUTS

This worksheet is an extension to the costs and benefits worksheets, and captures *non-monetised* costs and benefits. Multi-criteria analysis (MCA) is used when it is difficult to quantify benefits in monetary terms. In this worksheet users can evaluate non-monetary benefits and costs using their own expert judgement. The non-monetised

benefits are rated by level of benefit and the importance to the organisation and non-monetised costs are rated by level of likelihood and impact. Non-monetised benefits are divided into benefits to the team and post-border biosecurity, organisation, to the volunteers, and to wider society. A MCA can be performed for a whole general surveillance programme or components of it.

The *MCA Inputs* worksheet categorises benefits into benefits to: the general surveillance team (and post-border biosecurity decision-makers in general); the organisation; the volunteers (or participants in the general surveillance programme); and wider society.

Users rate the levels of benefits and the likelihood of costs by moving sliders. There are seven possible ratings that can be assigned to a particular benefit or cost: None, Low, Med-Low, Medium, Med-High, High, and Very High. The scores associated with each rating increase linearly from None (score of 0) to Very High (score of 1; Figure A.6). To obtain the total rating scores for benefits and costs, the scores for levels of benefit are multiplied by the importance to the organisation and the scores for the likelihood of costs occurring are multiplied by the impact to the organisation. Reasons for the ratings given can be entered in the provided text field for each of the non-monetised benefits and costs.

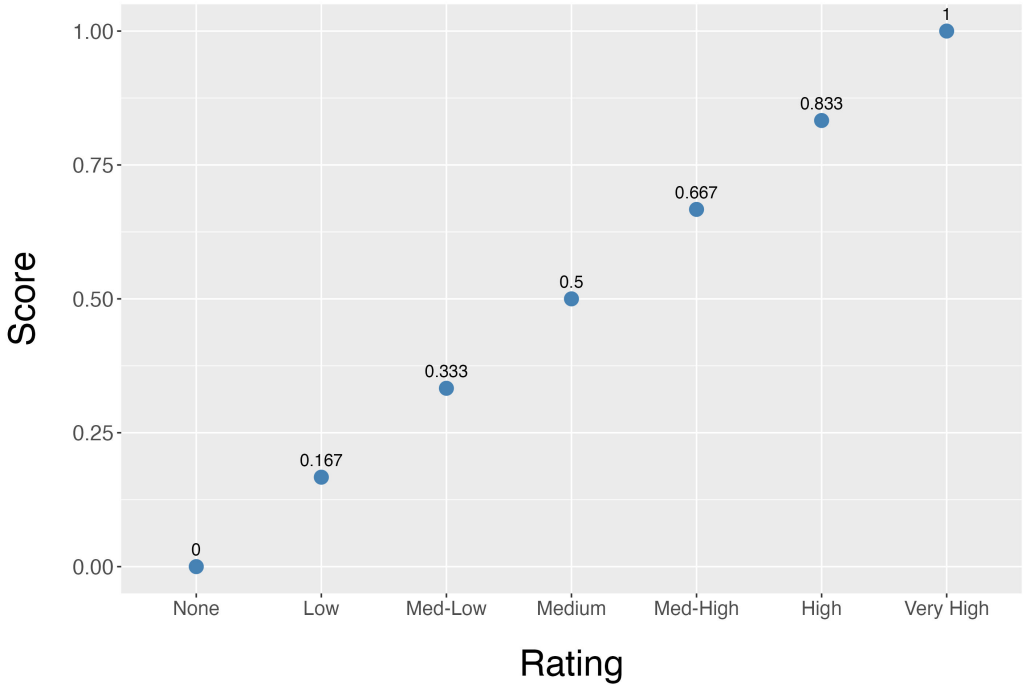


Figure A.6: The ratings that can be used in the MCA and their associated scores.

A.8 OUTPUTS SUMMARY

The outputs worksheet displays the results of each of the economic analysis methods, based on the information entered. The ROI method presents undiscounted values while the CEA and BCA use the discount rate and present discounted values, which means that the total cost of the general surveillance programme will be higher in the ROI analysis output than in the CEA and BCA. The conclusions presented for ROI,

CEA, and BCA are the final results, while users can further manipulate data in the MCA output summary which will affect the conclusion.

The display of the MCA outputs allows the user to determine the relative importance of the non-monetary benefits and costs compared to the monetary benefits and costs from using general surveillance. This selection will influence the weight given to the non-monetised and monetised scores and, in turn, the conclusion on whether general surveillance is the preferred option over the alternative of using expert surveillance staff. The comparison of the two surveillance approaches in the tool is done by comparing the rating scores obtained from the qualitative assessment of benefits and costs in the *MCA Inputs* worksheet with the monetised scores from the CEA (assigning higher scores to the surveillance approach that has lower costs compared to the other).

The tool encourages users to undertake sensitivity analysis by varying input values to their likely upper and lower levels to determine the variables with the greatest effect on the output and to describe the uncertainty around the output.

Below are example statements that can be used in reporting of the outputs of the economic analysis to stakeholders:

Example statements for output reporting:

- "The return on investment of the general surveillance programme was 25%, which means that the investment in the general surveillance programme creates a positive return on investment to the organisation. The return on investment is positive because the total benefits of the programme outweigh the total costs."
- "The cost-effectiveness analysis compared the costs of the general surveillance programme with its alternative (i.e. the use of expert surveillance staff) and showed that general surveillance is more cost-effective than surveillance undertaken by experts. The costs of general surveillance over 5 years were $200,000 less than the costs of the alternative surveillance approach for the same time frame."
- "The benefit-cost analysis showed that the evaluated general surveillance programme provides a net benefit of $384,000 over 7 years, which is the result of subtracting the costs of the programme from the benefits. Further, the general surveillance programme has a benefit:cost ratio of 14:1, which means that the benefits of this programme outweigh its costs."
- "The qualitative analysis of the non-monetary benefits and costs of different surveillance approaches showed that general surveillance is the preferred approach because it is more effective in generating benefits for stakeholders than expert-led surveillance efforts. The ratio of scores was 1.4, which is >1 and means that evaluators judged the general surveillance programme to be better than the alternative in creating a range of benefits for the surveillance team, post-border biosecurity in general, the organisation, volunteers, and wider society."

Once the user has finalised the 'use-case', it should be saved for future reference. Saving of the tool application in its entirety, or screen snapshots of worksheets would

be suitable. Saving of use-cases allows funding bodies, current and future programme managers, and researchers to understand the assumptions and logic behind the outputs. It also allows the use-cases to be revisited and updated if necessary, for example, at key points during a general surveillance programme, or after a programme has finished. It is important to keep a record of any updating that occurs, again via saving a new version of the tool's application or via snapshots of worksheets.

A.9 NOTES

The *Notes* worksheet contains notes for how to use the tool and was included by the original developers in the UK. It has been superseded by this manual, which provides more detail on how to navigate through the economic analysis tool.

A.10 WORKED EXAMPLE

Case study: Hypothetical surveillance blitz programme

This hypothetical case study describes a 'surveillance blitz' managed by an Australian State or Territory Government in a metropolitan area. The purpose of the program is to enable early detection of citrus canker outbreaks in the community and to collect evidence demonstrating the absence of the disease, which supports both domestic and international trade. The jurisdiction developing the blitz programme is not currently undertaking any formal active surveillance (using its agency staff) for citrus canker in the metropolitan area.

A.10.1 Program Overview:

The blitz initiative would be implemented over a single year, with the intention of repeating it annually for an additional four years. The timing of the blitz is aligned with key biological windows, specifically when new shoots emerge or when fruit is in its early development stage, during which the risk of citrus canker emergence is highest.

Each year, a total of 150 volunteers would participate in the program over four weeks. The volunteers include nursery staff, retail staff, and backyard tree owners (Table A.2). Note, there is currently no existing government programme in which surveillance is undertaken by biosecurity agency staff.

Table A.2: Volunteers in the canker blitz programme and their hours worked.

	Hours\week	**Weeks worked**	**Volunteers**	**Total hours**
Nursery staff	3	4	40	480
Retail staff	3	4	30	360
Backyard tree owners	1	4	80	320
Total				1,160

Program Costs:
Personnel costs for the program development and planning include senior staff engaged at an annual salary of $200,000 (including overheads) and mid-level staff at $165,000 per annum. The blitz itself is carried out over a one-month period, following two months of planning and development. A coordinator of volunteers (annual salary including overheads of $120,000) was employed for 1.5 months to facilitate community engagement and logistics. Additional costs involve educating nursery and retail staff, as well as private landowners with backyard citrus trees, on the symptoms of citrus canker and the procedures for reporting suspected detections. Diagnostic laboratories also contribute by providing analytical support to confirm any reported cases. The program is evaluated over the duration of five years.

Expected Benefits:
The program enables early detection of citrus canker in the community, which

significantly reduces the potential costs associated with eradication and long-term disease control. Furthermore, it raises public awareness about the symptoms of citrus canker, enhancing the community's capacity to contribute to ongoing plant biosecurity efforts.

COSTS OF THE CITRUS CANKER BLITZ

The costs of the one-month citrus canker blitz involve project planning and development by government staff over 1.5-2 months and other non-salary costs, such as workshops and diagnostics (Table A.3).

Table A.3: The salary and non-salary costs involved in undertaking the citrus canker blitz.

	Year 1 units	**Year 1 annual costs**	**Years 2-5 units**	**Years 2-5 annual costs**
Project planning & development				
1 Senior staff	0.02 FTE (0.1 for 2 mo)	$4,000	0.01 FTE	$2,000
1 mid-level staff	0.05 FTE (0.3 for 2 mo)	$8,250	0.05 FTE	$8,250
Volunteer coordinator	0.06 FTE (0.5 for 1.5 mo)	$7,200	0.06 FTE	$7,200
Other costs				
Education workshop	One 4-hour workshop for 150 participants ($75 per person incl. room hire and catering)	$11,250	2-hour refresher	$7,500
Education material	200 copies ($8 per copy)	$1,600	100 copies	$800
Biological specimen bags ($4 each)	25 bags	$100	25 bags	$100
Horticulture pathology: microscopic examination and DNA test ($180 per plant sample)	25 samples	$4,500	25 samples	$4,500

BENEFITS OF THE CITRUS CANKER BLITZ

A total of 150 individuals participated in the surveillance blitz. The primary economic benefit derived from this initiative lies in the cost savings associated with utilising general surveillance methods, rather than deploying trained government personnel to conduct the same activities, noting that no government personnel are currently engaged in any surveillance for citrus canker in the metropolitan area.

For the purpose of this analysis, it is assumed that the productivity of each volunteer is equivalent to that of a trained officer. The labour cost of such an officer would be $41

per hour. Additional costs associated with deploying government staff include travel expenses to and from backyards, nurseries, and retailers, estimated at $15 per person per week. Necessary field equipment per individual, comprising a sunhat, work boots, and a field uniform, is estimated at $200 per person.

According to Kompas *et al.* (2015), if citrus canker were to become endemic, it could result in approximately $8.4 million annual yield losses for NSW. With an estimated 13,000 hectares dedicated to citrus production in the state, this equates to potential damages of around $646 per hectare. This figure was used as an input to the model in the *Spread and damage* worksheet, along with other relevant assumptions.

A.10.2 Steps in the tool

This example illustrates a scenario in which the feasibility of the general surveillance programme has been confirmed in the *Screening* worksheet, and the program details have been outlined in the *Set-up* worksheet, including the indication of the use of a benefit-cost analysis (with no multi-criteria analysis). Accordingly, the first step in applying the hypothetical citrus canker blitz is to enter the programme's default values.

A.10.2.1 Enter default values

In this example, default values are provided for the salary costs of government staff at various levels: senior, mid-level, and lower level (for the administration and support of the volunteers). The discount rate is applied in the tool to calculate the present value of programme costs and benefits over a five-year period. The default setting in the tool is 3.5%.

The salary costs cover the programme planning and development work undertaken by government staff listed in Table A.3.

The *Default values* worksheet also captures the non-salary costs of the **alternative option**, which is the use of government biosecurity field officers to undertake the surveillance.

To set up the default salary costs for government staff, the different annual salaries (including overheads) are entered into the purple cells, which are linked with the *Costs* worksheet for the calculation of staff costs (Figure A.7).

(Beta version 2: 10th May 2017)

The default values worksheet contains default values that will be used to calculate costs of general surveillance programmes and the alternative, and to determine the net present values of future cash flows (using the discount rate entered here).

Default values *Please calibrate for your organisation*

Salary costs		**Value in a year**	
Senior staff	Staff costs per annum	$200,000	*Note: should include overhead costs*
Junior staff	Staff costs per annum	$165,000	*Note: should include overhead costs*
Volunteer administration and support	Staff costs per annum	$120,000	*Note: should include overhead costs*

Figure A.7: Annual salaries (including overheads) for different government positions entered into the purple cells.

The second step is to determine the discount rate that will be applied. In this theoretical example we have chosen the default discount rate of 3.5% (Figure A.8).

Discount rate to apply in analysis	3.5%	Enter value. Note: a discount rate is the interest rate used in discounted cash flow analysis to determine the present value of future cash flows. A rate of 3.5% is set as default (check with your organisation the rate that should be used)

Figure A.8: Discount rate entered into the *Default values* worksheet.

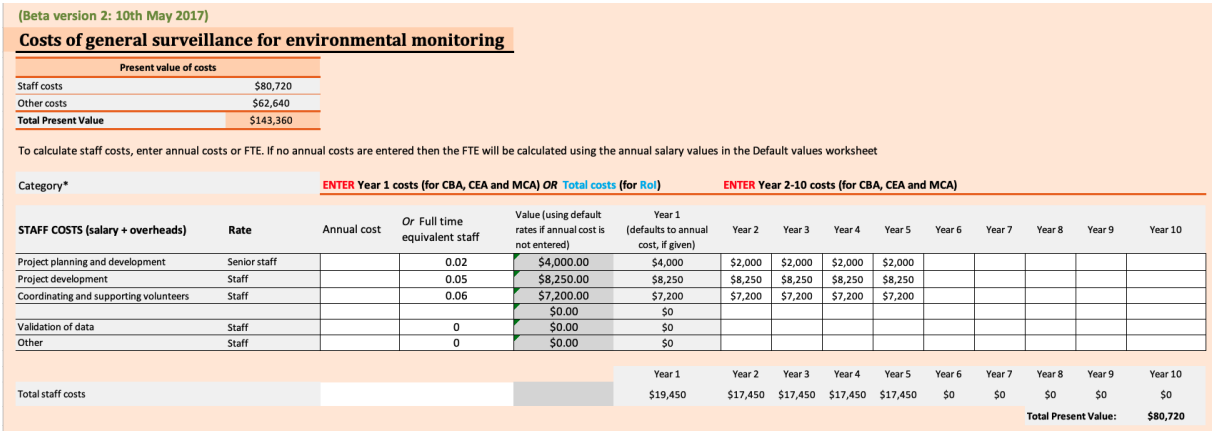
Finally, the costs of the alternative option are entered entered into the wide table further down the worksheet (Figure A.9). Note that since there is no alternative option, values of zero will appear in this table

Alternative option: Present Value Cost tool	Year	1	2	3	4	5	6	7	8	9	10	Present value:
Note that these are the costs of the alternative (using experts) that are relevant to the activity being considered.	Cost	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Figure A.9: Calculation of costs for the alternative option, the use of paid experts.

A.10.2.2 Enter the programme costs

In the first table on the *Costs* worksheet, we enter the salary costs for the three different levels of government staff involved in developing and managing the blitz (Figure A.10). Note that salary costs are slightly higher in the first year due to more involvement of the senior staff member in the first year.



(Beta version 2: 10th May 2017)

Costs of general surveillance for environmental monitoring

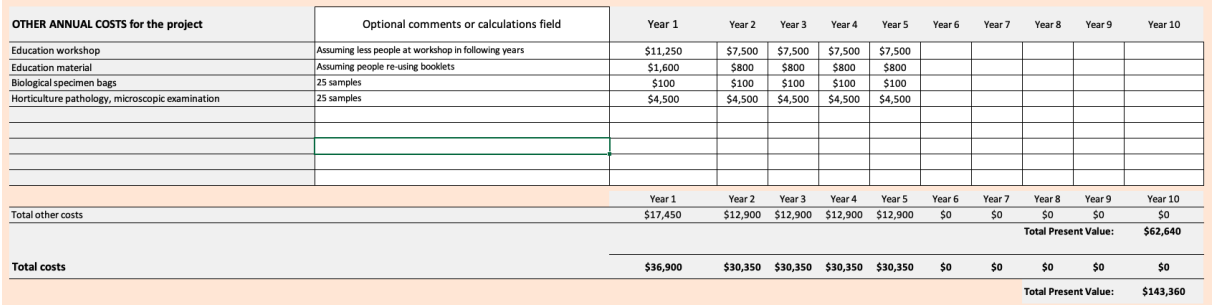
Present value of costs	
Staff costs	$80,720
Other costs	$62,640
Total Present Value	$143,360

To calculate staff costs, enter annual costs or FTE. If no annual costs are entered then the FTE will be calculated using the annual salary values in the Default values worksheet

Category*		ENTER Year 1 costs (for CBA, CEA and MCA) *OR* Total costs (for RoI)			ENTER Year 2-10 costs (for CBA, CEA and MCA)									
STAFF COSTS (salary + overheads)	**Rate**	Annual cost	*Or* Full time equivalent staff	Value (using default rates if annual cost is not entered)	Year 1 (defaults to annual cost, if given)	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Project planning and development	Senior staff		0.02	$4,000.00	$4,000	$2,000	$2,000	$2,000	$2,000					
Project development	Staff		0.05	$8,250.00	$8,250	$8,250	$8,250	$8,250	$8,250					
Coordinating and supporting volunteers	Staff		0.06	$7,200.00	$7,200	$7,200	$7,200	$7,200	$7,200					
				$0.00	$0									
Validation of data	Staff		0	$0.00	$0									
Other	Staff		0	$0.00	$0									
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total staff costs					$19,450	$17,450	$17,450	$17,450	$17,450	$0	$0	$0	$0	$0
												Total Present Value:		**$80,720**

Figure A.10: Salary costs for the citrus canker blitz entered into the *Costs* worksheet.

Then, we enter the non-salary costs specified in Table A.3 for all five years of the programme (Figure A.11).



OTHER ANNUAL COSTS for the project	Optional comments or calculations field	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Education workshop	Assuming less people at workshop in following years	$11,250	$7,500	$7,500	$7,500	$7,500					
Education material	Assuming people re-using booklets	$1,600	$800	$800	$800	$800					
Biological specimen bags	25 samples	$100	$100	$100	$100	$100					
Horticulture pathology, microscopic examination	25 samples	$4,500	$4,500	$4,500	$4,500	$4,500					
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total other costs		$17,450	$12,900	$12,900	$12,900	$12,900	$0	$0	$0	$0	$0
									Total Present Value:		**$62,640**
Total costs		**$36,900**	**$30,350**	**$30,350**	**$30,350**	**$30,350**	**$0**	**$0**	**$0**	**$0**	**$0**
									Total Present Value:		**$143,360**

Figure A.11: Non-salary costs for the citrus canker blitz entered into the *Costs* worksheet.

A.10.2.3 Enter the benefits

The *Benefits* worksheet outlines the estimated benefits of the citrus canker blitz, represented by the avoided costs of engaging trained government biosecurity staff to carry out the surveillance.

The first table presents a calculation based on the hourly rate for an equivalent paid role, $41 in this case, multiplied by the total hours worked per week, the work rate equivalent, the number of weeks worked, and the number of volunteers involved (Figure A.12).

(Beta version 2: 10th May 2017)

Benefits from use of general surveillance for biosecurity

Present Value of Benefits		
Early detection	$221,173	*(from Spread and damage worksheet)*
Volunteer benefits	$214,736	
Other benefits	$0	
Total Present Value	$435,909	

Enter the effort of volunteer activities in this table and see results in the tables underneath.

ENTER Year 1 number (for BAC, CEA and MCA) OR Total (for RoI) — **ENTER Year 2-9 expected/actual number of volunteers number (for BCA, CEA and MCA)**

Volunteer activity [click for info]	Equivalent paid role [click for info]	Cost for an equivalent paid role (per hour)	Work Rate Equivalent [click for info]	Total hours per week (average per volunteer)	Number of weeks worked (per volunteer per year)	Expected number of volunteers	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
example: collecting data	*field worker*	*$22.00*	*1*	*1.0*	*1*	*200*	*500*	*500*							
collecting data in nursery	Government staff	$41.00	1.00	3.00	4	40	40	40	40	40	0	0	0	0	0
collecting data in retail	Government staff	$41.00	1.00	3.00	4	30	30	30	30	30	0	0	0	0	0
collecting backyard data	Government staff	$41.00	1.00	1.00	4	80	80	80	80	80	0	0	0	0	0
					0	0	0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
					0		0	0	0	0	0	0	0	0	0
				Value of the volunteers (per year)		$47,560	$47,560	$47,560	$47,560	$47,560	$0	$0	$0	$0	$0

Figure A.12: The benefits of the citrus canker blitz, entered as the avoided costs of using paid experts (government staff).

The *Benefits* worksheet displays the value of the volunteer activities in a table below the main table, featuring grey cells, and calculates the total net present value of the benefits (Figure A.13).

Value of the volunteer activities*

Activities		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10		
collecting data in nursery	$19,680	$19,680	$19,680	$19,680	$19,680	$19,680	$0	$0	$0	$0	$0		
collecting data in retail	$14,760	$14,760	$14,760	$14,760	$14,760	$14,760	$0	$0	$0	$0	$0		
collecting backyard data	$13,120	$13,120	$13,120	$13,120	$13,120	$13,120	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
	$47,560	$47,560	$47,560	$47,560	$47,560	$47,560	$0	$0	$0	$0	$0	$214,736	Total Present Value

Figure A.13: The net present value of the benefits.

A.10.2.4 Including spread and damage estimates

Estimating the avoided damages from general surveillance, over a 30-year period is a key consideration when assessing the potential benefits of the citrus canker blitz. Early detection of a citrus canker outbreak through such a program can prevent the establishment and spread of the disease in commercial orchards, thereby avoiding significant economic losses. In this example, the model in the Spread and damage worksheet uses damage estimates in dollars per hectare drawn from published literature, while other parameters required for the analysis have been assumed for illustrative purposes (Figure A.14).

The avoided damages from the citrus canker blitz amount to $221,173 over 30 years. This figure will be added to the volunteer benefits in the overview table on the top left of the *Benefits* worksheet (Figure A.12).

Damages from spread	
Parameters	
MCC (ha) (0=exponential growth)	120
Initial incursion (ha)	0.1
Unmitigated (intrinsic) growth rate (*r*)	0.5
Natural detection point (ha)	100
Detection point with general surveillance (ha)	4
Immediate impact of intervention	0.2
Decay rate after (*r*)	-0.1
Uncertainty impact (0= deterministic)	0
Damage per unit of pest per year ($/ha)	646
Discount rate	0.03

Results		
Cumulative damage with unmitigated spread over 30 years	$	646,956
Cumulative damage with natural detection point (no general surveillance) over 30 years	$	228,546
Cumulative damage with general surveillance over 30 years	$	7,373
Avoided damage from general surveillance over 30 years	$	221,173

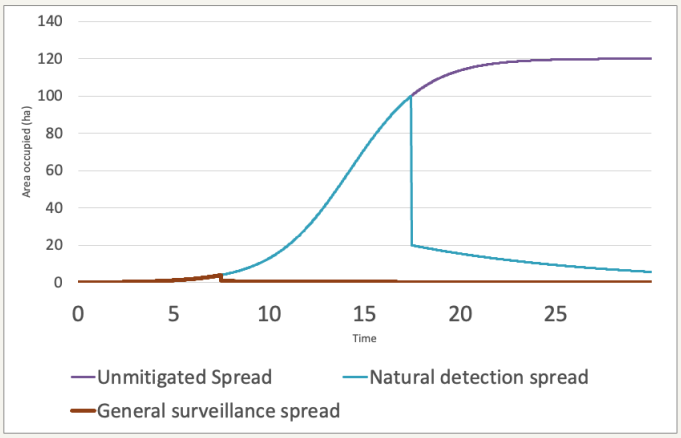


Figure A.14: An estimate of the avoided damages from the citrus canker blitz over a 30-year period.

A.10.2.5 The outputs summary

As this example does not incorporate a multi-criteria analysis, the final steps in the economic evaluation of the citrus canker blitz involves reviewing and saving the results of the benefit–cost analysis presented in the *Outputs summary* worksheet, and undertaking some *sensitivity analysis* of key values (Figure A.15). The initial analysis indicates that the general surveillance approach, represented by the citrus canker blitz, delivers a net (present-value) benefit of $292,548 and a benefit–cost ratio of 3:1. This figure is automatically rounded to the nearest thousand dollars for the purposes of making a statement to potential funding bodies.

Benefit-cost analysis (BCA)		
Costs of use of GS for monitoring	$	143,360
Benefits from use of GS for monitoring	$	435,909
BCA net total		**$292,548**

Conclusion:

General surveillance provides a net benefit of $293000

General surveillance has benefit:cost ratio of 3 : 1

Figure A.15: The output of the benefit-cost analysis for the citrus canker blitz.

This application of the tool should be saved as a 'use case'. It would be most useful to give it a title related to the nature of the calculation – e.g. CCBlitz_CBA_BaseCase May 25 – and it should be saved where others can find it.

Given the preliminary nature of the calculations, undertaking sensitivity analysis is essential to allow increased transparency around decision making. This involves changing the value of one variable or parameter at a time to reflect best/worst case scenarios, recording the BCA output, and then saving the application as a separate but related use case. In the current context it might be useful to change values of work rate equivalent, damage per hectare and/or number of volunteers. More information on sensitivity analysis can be found in Summerson *et al.* (2018).

If the blitz programme does go ahead, additional applications of the tool will likely in the future, either to refine assumptions, to monitor, or to undertake post-programme evaluation. Any further applications of the tool for refining and monitoring of the tool should be saved under related file names for ease of use.