



ATTACHMENTS TO REPORTS

GENERAL COUNCIL MEETING

ITEMS UNDER SEPARATE COVER

25 SEPTEMBER 2019

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**PEST MANAGEMENT ADVISORY
COMMITTEE MEETING MINUTES - 3
SEPTEMBER 2019**

**AEC Group Report - Invasive Pests
Control Scheme Evaluation**

Meeting Date: 25 September 2019

Attachment No: 3

INVASIVE PEST CONTROL SCHEME EVALUATION

SOUTHERN DOWNS REGIONAL COUNCIL
SEPTEMBER 2019



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INVASIVE PESTS CONTROL SCHEME EVALUATION



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EXECUTIVE SUMMARY

BACKGROUND

Southern Downs Regional Council (Council) introduced the Invasive Pests Control Scheme (IPCS) in 2017/18 as a proactive approach to reducing the impact of invasive pests on the region's agricultural productivity, biodiversity, and resident amenity. Landholders are required to abide by the scheme and identify and take necessary measures to control invasive pests on their land.

The scheme includes a pest management levy and an upfront concession fee. Those who comply with the IPCS retain their concession and those who do not have their levies collected and invested in strategic pest management initiatives. Council promotes best practice control methods and helps landowners to achieve this through advice and facilitation, with a focus on reducing the impacts of invasive pests in the Southern Downs region.

In order to develop a deeper understanding of the IPCS and its associated benefits and costs to the community, Council has engaged AEC Group Pty Ltd (AEC) to undertake an evaluation to measure the scheme's impacts to the regional community.

PURPOSE & APPROACH

This report provides a Triple Bottom Line (TBL) impact assessment of the IPCS to the Southern Downs region. The evaluation considers the impacts the IPCS has had on invasive pests and their prevalence, as well as the associated economic, environmental, and social benefits and costs this has delivered to the region.

The analysis is both historic (2017/18 and 2018/19) and forward looking (2019/20 to 2029/30). The findings of this evaluation will be used by Council to refine the IPCS and support community engagement regarding the regional benefits of the scheme. The report includes a Cost Benefit Assessment (CBA) of the IPCS, estimating the net socio-economic benefits to the Southern Downs community over a 30 year period.

KEY FINDINGS

Review of the IPCS

A range of data relating to the initial two years of IPCS operations were reviewed, including headline outcomes from control works form submissions and the results of an online survey completed by Council. Key outcomes of the IPCS over its initial two years of operations include:

- Since the implementation of the IPCS, the number of inspections has increased by approximately 340, with the percentage assessed increasing from 73.9% in 2017 to 92.7% in 2018.
- From 2017 to 2018, the hectares with pests declared in the Southern Downs has decrease by 23,815ha indicating that the IPCS is successfully decreasing the impact of invasive pests within the region.
- Since the implementation of the IPCS, landholders' level of awareness of both invasive pests and the control scheme has increased by 16 percentage points to reach 71%.
- Majority (53.5%) of landholders support the continuation of the IPCS and think the scheme is of value to the Southern Downs region and particularly the agricultural industry.
- The number of control works form reminders decreased by approximately 650, with landholders adjusting to the administrative process of the IPCS.
- An average of 26ha per property have been treated for pests that were previously infested.
- Since implementation, respondents have spent an additional \$3,258 on average for invasive pest control.

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Social, Environmental and Economic Impacts

Based on the review of data provided by Council, major invasive pest species impacting the Southern Downs were identified as:

- Blackberry.
- Wild dogs.
- African boxthorn.
- Velvety tree pear.
- Rabbits.

Impacts of these invasive pests were reviewed within a TBL framework, with results summarised in the table below.

ES.1. Social, Environmental and Economic Impacts of Invasive Pests

Pest Species	Economic Impacts	Environmental Impacts	Social Impacts
Wild Dogs	<ul style="list-style-type: none"> Reduced income due to loss of stock. Costs to dispose of deceased animals. Wild dogs transmit diseases which can infect agricultural production of sheep and cattle (including sheep measles, hydatidosis, mange, distemper, hepatitis, parvovirus, Neospora caninum and toxoplasmosis (DPI, n.a.)). Changes to the stock composition with premium stock that has been built up over a number of years being destroyed. Impacted properties typically have a negative impact on land values. 	<ul style="list-style-type: none"> Attacks on native animals and subsequent loss of biodiversity. Potential for transmission of diseases to native animals. 	<ul style="list-style-type: none"> Psychological impacts on farmers if attacks on livestock are repetitive. The predation of livestock has significant social and psychological effects on primary producers and their families. In addition, pest animals such as wild dogs are a nuisance, damaging infrastructure and culturally important sites and displaying adverse behaviours such as disruptive noise (Invasive Plants and Animals Committee, 2017). Financial stress implications due to loss of income. Injury risks of attacks to humans (particularly children).
Rabbits	<ul style="list-style-type: none"> Grazing of field crops reducing yields and damaging soils, resulting in a reduction in farmer income. Impacted properties due to warrens etc. creates a negative impact on land values. 	<ul style="list-style-type: none"> Overgrazing native pastures, leading to loss of plant biodiversity. Preventing vegetation from regenerating and degrading the quality of soil. Cause significant land degradation by building warrens. Acting as a food source for larger predators such as wild dogs. Reduced the amount of food stock available for native animals. Increasing and spreading invasive weeds (Cooke, 2011). Potential spread of diseases to native animals. 	<ul style="list-style-type: none"> Financial stress implications due to loss of income. Psychological stress due to the potential for infestation. Reduced natural amenity due to destruction/degradation of rural areas.

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Pest Species	Economic Impacts	Environmental Impacts	Social Impacts
African Boxthorn	<ul style="list-style-type: none"> • Impacting stock due to the spiny thickets hindering mustering and stock movement. • Reducing productive potential and yields. • Presence typically has a negative impact on land values. 	<ul style="list-style-type: none"> • Dense covering can create shade and crowd out vegetation and prevent regeneration. • Commonly harbour other invasive pests such as rabbits. 	<ul style="list-style-type: none"> • Dense infestations likely to impact recreation and potential injuries to people. • Financial stress implications due to loss of income associated with reduced production land.
Blackberry	<ul style="list-style-type: none"> • Dense and impenetrable thickets and are often situated along waterways, impacting access to watering points for stock. • Due to its rapid growth, the weed spreads across land relatively fast impacting vegetation and pasture. • Presence typically has a negative impact on land values. 	<ul style="list-style-type: none"> • Provides shelter and acts as a food source for other invasive pests. • The pest can become a significant fire hazard due to the large amount of dead canes. • Due to its rapid growth, the weed spreads across land relatively fast impacting native vegetation. 	<ul style="list-style-type: none"> • Degradation of natural habitats and reduced natural amenity. • Loss of income associated with agricultural production may cause financial stress to landholders.
Velvety Tree Pear	<ul style="list-style-type: none"> • Hindering stock movement and limit access for recreational activities. • Sharp spines may get lodged into the wool of sheep and contaminate the product. • The sharp spines have the potential to cause injury to animals. • Presence has a negative impact on land values. 	<ul style="list-style-type: none"> • Rather dense infestations can compete with natural habitats, limiting the growth and regrowth of vegetation. • The tree pear provides a harbour for other invasive pests. 	<ul style="list-style-type: none"> • Dense infestations can reduce recreational activity and cause injuries to people as a result of the sharp spines. • Can negatively impact income due to loss of stock or crops.

Source: AEC.

Stakeholder Engagement

Telephone consultations were undertaken with a small selection of Southern Downs landholders to help inform the IPCS evaluation.

Stakeholders were generally supportive of the IPCS in its objective to reduce the impacts of invasive pests in the Southern Downs region. Council staff were generally identified as knowledgeable regarding pest control processes and seen as partners in supporting the control of invasive species. Landholders typically focussed on the economic/financial costs and benefits of the scheme but when questioned were aware of the broader environmental and social/community implications of the scheme.

A number of landholders found it challenging to quantify their costs associated with implementing the scheme, given that activities were undertaken internally or using a mix of hired and internal labour and equipment

A number of recommendations were made for future improvements to the scheme, including:

- **Ensuring consistency within IPCS requirements across properties:** Poor controls on neighbouring properties would lead to a reoccurrence of the pests in future years.

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- **Smaller industrial/commercial properties being included in the scheme:** Some smaller landholders felt their smaller industrial/commercial properties should fall outside the IPCS.
- **Consideration of greater use of biological controls:** Some landholders identified a greater utilisation/incorporation of biological control such as the Cactoblastis Moth would be effective in controlling invasive pests such as prickly pear.
- **Stress associated with the scheme implementation:** Some landholders felt significant stress associated with potentially receiving a supplementary rates notice through the scheme despite their efforts to comply.
- **Notices being directed via mail and to the landholder:** Some landholders which were based outside of the Sothern Downs (either leasing their properties or run via a manager) expressed a desire to create an option for scheme communications to be sent to a nominated manager/operator via electronic methods (SMS or email).
- **Desire for ongoing landholder input into IPCS control activities:** A number of landholders identified a wish to have greater/ongoing input into future control activities funded by the scheme.

Future IPCS Projections

Limited data was available to project future impacts of the IPCS. Potential scenarios of future projections were developed based on the outcomes of the initial two years of scheme operations and workshops with Council. The scenarios examined were:

- **Low Scheme Impact (approximately 150,000 additional hectares declared pest free by 2030):** Declining landholder input over time and diminishing returns to control works over time result in lower hectare reductions in invasive pests as the scheme matures. Remaining impacted growers continue to limit their involvement within the scheme.
- **Medium Scheme Impact (approximately 300,000 additional hectares declared pest free by 2030):** Continued control works, with landholders implementing the current control methods over the next 10 years and returning a similar yield in pest reduction.
- **High Scheme Impact (approximately 415,000 additional hectares declared pest free by 2030):** Significant landholder engagement within the scheme and ongoing increases in pest eradication success as management controls are adopted and the ongoing economic, environmental and social benefits begin to flow through to landholders.

Cost Benefit Assessment

The CBA assessed the project over a 30-year timeframe. Specifically, the following costs and benefits were considered:

- **Costs:**
 - IPCS implementation costs.
 - On-property pest control costs.
- **Benefits:**
 - Reduced impacts of invasive pests.

The CBA modelling at the discount rate of 7% (under the medium impact scenario) is economically desirable, returning an Net Present Value (NPV) of \$74.3 million over the 30-year assessment period, with a Benefit Cost Ratio (BCR) of 2.01 highlighting that the project returns \$2.01 per every dollar of cost, and an Internal Rate of Return (IRR) of 20.6%. The CBA returned a positive NPV under all scenarios and discount rates assessed.

In addition to the costs and benefits quantified within the analysis, the project is expected to generate a range of impacts, including:

- **Costs:**

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- **Impact of IPCS implementation on landholders:** As was noted in Chapter 4, the potential for a supplementary rates notice is a noted point of stress for landholders (particularly during times of drought and financial hardship). The impacts of the psychological burden of the IPCS on landholders has not been incorporated into the analysis as it is understood that Council will continue to work empathetically with landholders to support the outcomes of the scheme while minimising any adverse impacts.
- **Benefits:**
 - **Benefits from IPCS revenues:** IPCS levy collection results in additional pest control activities (beyond those undertaken on-property by landholders) including on Council lands. The impacts of IPCS levies have been conservatively assumed to be a transfer of benefits between landholders and Council and have been excluded from the assessment. However, it should be noted that benefits from control works undertaken by council (including on Council-owned lands) are significant.
 - **Increased economic activity from contract control works:** The IPCS promotes qualified local contractors to undertake control works for landholders to comply with the scheme. This in turn supports industry growth and employment outcomes within the Southern Downs LGA. Two additional contract businesses have established operations in the Southern Downs region post-implementation of the IPCS.
 - **Potential spread of invasive pests under the base case:** The benefits of invasive pest control are based upon the reported (and projected) reduction in areas impacted under the scheme. However, it is likely that under the base case (i.e. without the implementation of the scheme) that invasive pest species would have continued to spread and impacted additional lands within the Southern Downs.
 - **Increased collaboration and potential application of the scheme in other areas:** The IPCS is an innovative approach for local government pest control. Broader State and other agency stakeholders consulted for this study were broadly supportive of the scheme's approach and its objectives as well as the applicability of the scheme to other LGA's across Queensland and Australia.

CONCLUSIONS AND RECOMMENDATIONS

The analysis undertaken in this review has identified that the IPCS is an important mechanism for the control of invasive pest species and support for the ongoing viability of the critical agricultural industry. Over the longer term the scheme is estimated to have significant ongoing benefits, which outweigh the costs vs. inaction.

Council has invested significant time and resources to implement the scheme and given its notable early successes and reported gradual acceptance by landholders it is the recommendation of this report that the scheme be continued. The results of the CBA suggest significant longer term benefits are projected to be provided by the scheme. It would be beneficial to the Southern Downs community and agricultural industry to continue the scheme to continue reducing the impacts of invasive pests.

A number of opportunities for the potential improvement of the scheme have been identified throughout the review process for Council's consideration. These include:

- **Consideration of improved mapping and scheme data capture:** This evaluation has identified a number of limitations regarding the availability of pest impact data within properties and across pest types. Improved data capture and mapping will support greater targeting of key areas and improve the capture of TBL benefits. Adoption of this recommendation needs to take into consideration appropriate budget limitations as well as the potential overburdening of landholders with survey/data capture.
- **Continuation of data capture regarding scheme impacts:** This evaluation is based on a small sample of scheme impacts, and the incorporation of future data points will help to improve the CBA and future impact projections significantly.
- **Consideration of additional actions to be taken against repeatedly non-compliant properties:** The evidence of repeat non-compliant properties as well as noted frustration of neighbouring landholders with non-compliant operators suggests that additional actions against non-compliant properties may need to be considered. This could take the form of a three-strike rule or similar, increasing fees required to be paid for

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non-compliance after the third infringement. Such an approach would support consistency within the IPCS requirements across all properties.

- **Consideration of adjusting the properties included within the scheme:** The noted prevalence of small commercial/industrial properties within the scheme suggests a review of properties which are included within the scheme may be considered. The limitations of appropriate ratings categories through which to apply the scheme is acknowledged in making this recommendation.
- **Consideration of alternative notice methods to support non-resident landholders:** Council should consider avenues to implement an option for a nominated manager/operator to be notified directly via electronic methods (SMS or email) to support prompt compliance with the IPCS for properties operated under lease or through employed management.
- **Consideration of avenues for ongoing landholder input and engagement into IPCS control activities:** An opportunity exists for ongoing engagement with IPCS ratepayers to collaborate on future control initiatives utilising IPCS levies. Ongoing engagement will support greater buy-in to the scheme and help promote a collaborative approach to invasive pest control.

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1. INTRODUCTION

1.1 BACKGROUND

Southern Downs Regional Council (Council) introduced the Invasive Pests Control Scheme (IPCS) in 2017/18 as a proactive approach to reducing the impact of invasive pests on the region's agricultural productivity, biodiversity, and resident amenity. Landholders are required to abide by the scheme, which includes identifying and taking necessary measures to control invasive pests on their land.

The scheme includes a pest management levy and an upfront concession fee. Those who comply with the IPCS retain their concession and those who do not have their levies collected and invested in strategic pest management initiatives. Council promotes best practice control methods and helps landowners to achieve this through advice and facilitation, with a focus on reducing the impacts of invasive pests in the Southern Downs region.

In order to develop a deeper understanding of the IPCS and its associated benefits and costs to the community, Council has engaged AEC Group Pty Ltd (AEC) to undertake an evaluation to measure the scheme's impacts to the regional community.

1.2 PURPOSE OF THIS REPORT

This report provides a Triple Bottom Line (TBL) impact assessment of the IPCS to the Southern Downs region. The evaluation considers the impacts the IPCS has had on invasive pests and their prevalence, as well as the associated economic, environmental, and social benefits and costs this has delivered to the region.

The analysis is both historic (2017/18 and 2018/19) and forward looking (2019/20 to 2029/30). The findings of this evaluation will be used by Council to refine the IPCS and support community engagement regarding the regional benefits of the scheme.

1.3 APPROACH

The remainder of the report is as follows:

- **Chapter 2:** Provides an overview of the IPCS, the broader Southern Downs agricultural sector and key invasive pest species to provide context for the evaluation.
- **Chapter 3:** Reviews existing data relating to the impacts of the IPCS over 2017/18 and 2018/19.
- **Chapter 4:** Presents the outcomes of engagement with key landholders involved in the IPCS.
- **Chapter 5:** Provides an evaluation of the historic and projected future impacts of the IPCS.
- **Chapter 6:** Presents a Cost Benefit Assessment (CBA) of the IPCS, estimating the net socio-economic benefits to the Southern Downs community over a 30 year period. While the project scope is based on a ten-year forward-looking analysis period, analysis of costs and benefits is undertaken over a longer timeframe to reflect the socio-economic benefits delivered by pest control are longer term in nature. A description of the CBA modelling approach is presented as Appendix A.

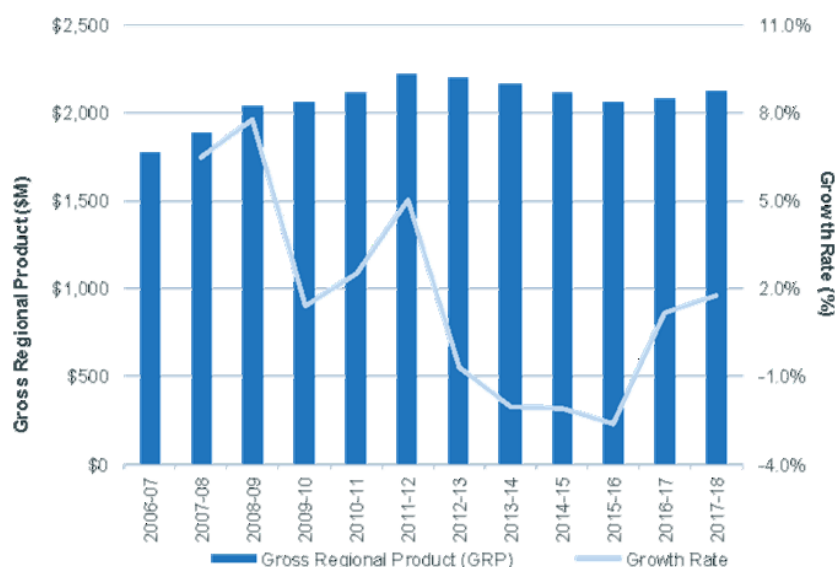
2. REVIEW OF INVASIVE PEST CONTROL SCHEME

The following sections provide an overview of the importance of the agricultural industry to the Southern Downs region and the context for Council's implementation of the IPCS.

2.1 THE SOUTHERN DOWNS AGRICULTURAL INDUSTRY

The Southern Downs Local Government Area (LGA) generated Gross Regional Product (GRP) of \$2.1 billion in 2017-18, an increase of 1.8% from the previous year. Over the period of 11 years, GRP grew by 1.6% on average per annum.

Figure 2.1. Gross Regional Product (GRP), Southern Downs LGA



Source: AEC (Unpublished).

Agriculture is the single largest contributor to GRP, generating 25.6% of total sector contribution to GRP during 2017-18. Other significant sectors in the Southern Downs LGA include (see Figure 2.2):

- Construction (7.5% of total sector contribution to GRP).
- Health care and social assistance (7.3%).
- Ownership of dwellings (7.0%).
- Manufacturing (7.0%).

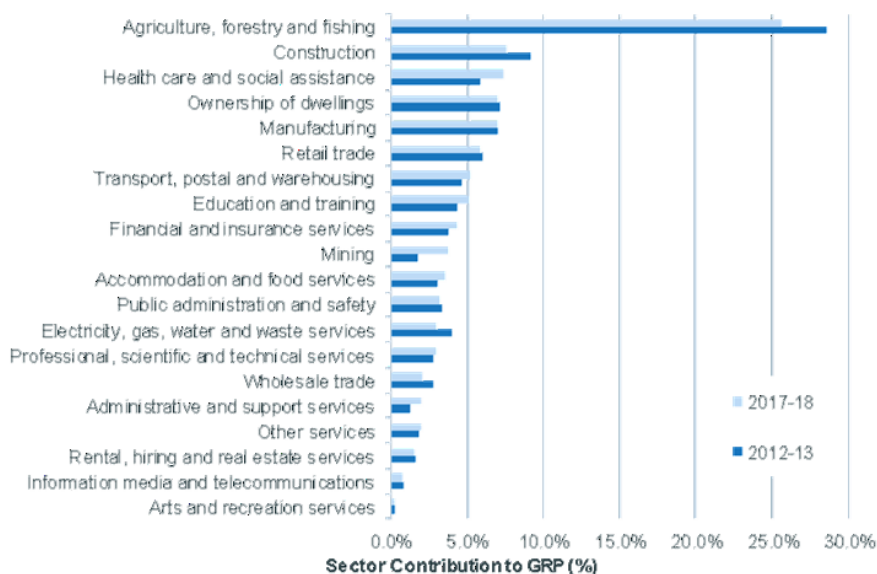
The dominant agricultural sector drives significant flow-on activity in the above listed sectors, particularly construction, ownership of dwellings (i.e. housing demand), and manufacturing. GRP is quite volatile from year to year, which is common for agricultural-focussed economies, with seasonal production and market factors having a significant impact on economic output.

Agriculture, forestry and fishing's contribution to GRP has declined by -2.9 percentage points over the past five years, while construction (the second largest contributor) declined by -1.6 percentage points over the same period of time.

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Figure 2.2. Proportion of Total Sector Contribution to GRP, Southern Downs LGA, 2012-13 vs 2017-18



Source: AEC (Unpublished).

The largest contributor to agricultural production (in terms of gross value) is horticulture, including other fruit (which includes pome fruit, stone fruit, orchard fruit and other), accounting for 30.7% of the total agricultural gross value in the region. Vegetables are the second largest contributor at 19.7% of total agricultural production value.

Southern Downs is also a significant livestock producer (predominantly beef cattle), representing over \$108 million of gross production value in 2015-16.

Table 2.1. Agricultural Gross Production Value 2015-16, Southern Downs LGA

Agricultural Product	Gross Value (\$M)	% of Total
Cereal crops	\$18.43	5.5%
Other Broadacre Crops	\$3.99	1.2%
Crops for Hay	\$8.70	2.6%
Nurseries, Cut Flowers Or Cultivated Turf	\$25.41	7.6%
Grapes (Wine & Other)	\$0.24	0.1%
Other Fruit	\$102.51	30.7%
Veg	\$65.84	19.7%
Wool	\$2.66	0.8%
Milk	\$13.28	4.0%
Eggs	\$3.30	1.0%
Livestock Slaughterings	\$89.47	26.8%
Total	\$333.83	100%

Source: ABS (2018).

2.2 MAJOR INVASIVE PEST SPECIES

Invasive pests have significant known economic, environmental and social impacts, causing detrimental damage to the agricultural industry, urban and rural residential areas, and the health of animals (and in some cases humans). The following sections identify the top five most prevalent invasive pests in the Southern Downs LGA and review their known impacts across the TBL framework, as well as providing a summary of relevant literature examining the costs of these invasive pests in Queensland and Australia.

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2.2.1 Top Five Most Prevalent Invasive Pests in Southern Downs LGA

Wild Dogs

Wild dogs can have significant negative impacts on the agricultural industry and are relatively common throughout Queensland. Impacts of wild dogs include (AWI, 2013):

- **Economic impacts:**
 - Reduced income due to loss of stock.
 - Costs to dispose of deceased animals.
 - Wild dogs transmit diseases which can infect agricultural production of sheep and cattle (including sheep measles, hydatidosis, mange, distemper, hepatitis, parvovirus, Neospora caninum and toxoplasmosis (DPI, n.a.)).
 - Changes to the stock composition with premium stock that has been built up over a number of years being destroyed.
 - Impacted properties typically have a negative impact on land values.
- **Environmental impacts:**
 - Attacks on native animals and subsequent loss of biodiversity.
 - Potential for transmission of diseases to native animals.
- **Social impacts:**
 - The repetitive predation of livestock has significant social and psychological effects on primary producers and their families. Additionally, pest animals such as wild dogs are a nuisance, damaging infrastructure and culturally important sites and displaying adverse behaviours such as disruptive noise (Invasive Plants and Animals Committee, 2017).
 - Financial stress implications due to loss of income.
 - Injury risks due to attacks to humans (particularly children).



Source: Rockhampton Regional Council (n.a.)

Rabbits

Rabbits have a significant negative and costly impact to the agricultural industry through overgrazing of crops alongside significant environmental risks to native plant species. According to a study conducted by William, Parer, Coman, Curley and Braysher (as cited in McLeod, 2012), it takes less than one rabbit per hectare to prevent the successful regeneration of many native trees and shrubs. Key identified economic, environmental, and social impacts include (McLeod, 2012):

- **Economic impacts:**
 - Grazing of field crops reducing yields and damaging soils, resulting in a reduction in farmer income.
 - Impacted properties due to warrens etc. creates a negative impact on land values.
- **Environmental impacts:**
 - Overgrazing native pastures, leading to loss of plant biodiversity.
 - Preventing vegetation from regenerating and degrading the quality of soil.
 - Cause significant land degradation by building warrens.
 - Acting as a food source for larger predators such as wild dogs, foxes and feral cats.
 - Reduced the amount of food stock available for native animals.



Source: Queensland Government (2018).

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- Increasing and spreading invasive weeds (Cooke, 2011).
- Potential spread of diseases to native animals.
- **Social impacts:**
 - Financial stress implications due to loss of income.
 - Psychological stress due to the potential for infestation.
 - Reduced natural amenity due to destruction/degradation of rural areas.

African Boxthorn

African boxthorn is an aggressive weed that is covered in spiny thickets and can spread by birds or animals carrying the seed. The species is tough, meaning it is able to grow in a range of climatic conditions and has the ability to regrow from root segments (Natural Resources Northern & Yorke, 2019). Therefore, to eliminate the pest and prevent regeneration, care must be taken during the removal process. The weed causes environmental, economic and social impacts including (Agriculture Victoria, 2019):



Source: Southern Downs Regional Council (Unpublished)

- **Economic impacts:**
 - Impacting stock due to the spiny thickets hindering mustering and stock movement.
 - Reducing productive potential and yields.
 - Presence typically has a negative impact on land values.
 - Dense infestations have the potential to injure stock and people, leading to loss of productivity and financial costs for treatment.
- **Environmental impacts:**
 - Dense covering can create shade and crowd out vegetation and prevent regeneration.
 - Commonly harbour other invasive pests such as rabbits.
- **Social impacts:**
 - Dense infestations likely to impact recreation and potential to injure people, leading to reduced amenity.
 - Financial stress implications due to loss of income associated with reduced production land.

Blackberry

Blackberry is a highly invasive pest which is covered in spiny thickets and can quickly crowd out native vegetation (Government of SA, 2015). In addition to reducing land productivity and hindering recreational activities, negative impacts also include (Agriculture Victoria, 2017a):



Source: Southern Downs Regional Council (Unpublished)

- **Economic impacts:**
 - Dense and impenetrable tickets and are often situated along waterways, impacting access to watering points for stock.
 - Due to its rapid growth, the weed spreads across land relatively fast impacting vegetation and pasture.
 - Presence typically has a negative impact on land values.
- **Environmental impacts:**

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- Provides shelter and acts as a food source for other invasive pests.
- The pest can become a significant fire hazard due to the large amount of dead canes.
- Due to its rapid growth, the weed spreads across land relatively fast impacting native vegetation.
- **Social impacts:**
 - Degradation of natural habitats and reduced natural amenity.
 - Loss of income associated with agricultural production may cause financial stress to landholders.

Velvety Tree Pear

The velvety tree pear is covered with pointy stems and is spread through animals consuming the seeded fruits. Like most of the invasive weed pests mentioned, the velvety tree pear provides a home to animals such as rabbits, harbouring the spread of other invasive pests. Additionally, the velvety tree pear will (Brisbane City Council, n.a.):



Source: Brisbane City Council (n.a.)

- **Economic impacts:**
 - Hinder stock movement and limit access for recreational activities.
 - Sharp spines may get lodged into the wool of sheep and contaminate the product.
 - The sharp spines have the potential to cause injury to both animals and humans, leading to loss of productive value of stock, reduced productivity of workers, and financial costs for treatment.
 - Presence has a negative impact on land values.
- **Environmental impacts:**
 - Rather dense infestations can compete with natural habitats, limiting the growth and regrowth of vegetation.
 - The tree pear provides a harbour for other invasive pests.
- **Social impacts:**
 - Dense infestations can reduce recreational activity and cause injuries to people as a result of the sharp spines, leading to reduced amenity.
 - Can negatively impact income due to loss of stock or crops, causing financial stress.

2.2.2 Costs of Invasive Pests

A desktop review of previous studies has been conducted in order to quantify the potential cost of similar invasive pests. Table 2.2 below identifies a review of studies and subsequent identified impacts. For comparative and modelling purposes, the potential costs are presented on a per hectare or per head basis.

Key points of note arising from the literature review include:

- There is significant variation in benefits/costs based on the types of pests and agricultural properties:
 - Weed infestations typically generate the highest associated costs (e.g. tree pear and blackberry).
 - Higher value/intensity horticultural and cropping operations generally gain a greater economic return on a per ha basis compared to extensive grazing or similar activities.
- There are often high up-front costs associated with control, while benefits tend to be longer term in nature.

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Table 2.2. Studies Identifying the Cost of Invasive Pests (\$2019)

Study	Invasive Pest/s	Notes	Impact Total Cost (\$2019)	Imputed Cost (\$/ha or \$/head Impacted)
Cost of Pest Animals in NSW and Australia, 2013-14 <i>Ross McLeod (2016)</i>	Rabbits and wild dogs	Economic cost of invasive pests in 2013-14 dollars achieved by adding production losses and expenditure on management at the farm and government levels. Production losses are valued using both fixed price and economic surplus methods.	Average production loss cost in QLD for rabbits is \$86.47 million and for wild dogs is \$48.59 million.	<ul style="list-style-type: none"> • Cost to the beef industry <ul style="list-style-type: none"> ○ Rabbits - \$7.03 p/head ○ Wild Dogs - \$3.90 p/head • Cost to the sheep and lamb industry¹ <ul style="list-style-type: none"> ○ Rabbits - \$1.26 p/head ○ Wild Dogs - \$0.96 p/head
Impact of Weeds on Australian Grain Production <i>Llewellyn et al (2016)</i>	Invasive weeds	Collection of primary data from 600 grain growers was used to derive control and production loss parameters across 13 major agroecological zones. The report includes the cost of yield loss due to weeds, grain contamination costs and control costs. The major crop types include wheat, barley, oats, canola, pulses and sorghum.	Invasive weeds were estimated to cost Australian grain growers an estimated \$3,497 million. <ul style="list-style-type: none"> • \$154/ha for expenditure losses • \$119/ha for control costs 	<ul style="list-style-type: none"> • \$154/ha for expenditure losses • \$119/ha for control costs
Major Economic Costs Associated with Wild Dogs in the Queensland Grazing Industry <i>L. Hewitt (2009)</i>	Wild dogs	Economic cost of wild dogs on the Queensland grazing industry (2008-09 dollars). Costs collected from surveys by producers, saleyards, processors and State and Local governments. Costs include those associated with stock losses, wild dog management, bites from wild dogs and disease impacts.	Wild dogs cost the Queensland grazing industry approximately \$82.57 million in 2008-09.	<ul style="list-style-type: none"> • Cost to Cattle Producers - \$4.25 p/head • Cost to Sheep/Goat Producers² - \$10.86 p/head
Economic and Environmental Impacts of Rabbits in Australia <i>Invasive Animals CRC (2012)</i>	Rabbits	Approximate cost to agricultural enterprises (per rabbit, per year) adapted from DPI&F (2008).	Approximate cost (/rabbit/yr) (\$): <ul style="list-style-type: none"> • Wool - \$2.11 • Store cattle (property bred) - \$2.74 • Trading cattle (grow out for 12 months) - \$3.25 • Stud cattle - \$15.87 • Broccoli (/ha) - \$11.30 • Lettuce (/ha) - \$2.68 • Lucerne (irrigated, /ha) - \$7.76 • Wine grapes (/ha) - \$74.21 	As per previous column.
The Economic Impacts of Vertebrate Pests in Australia	Rabbits and wild dogs	Annual loss in consumer surplus and producer surplus, highlighting the overall economic surplus on	Loss in agriculture measured by economic surplus in QLD:	<ul style="list-style-type: none"> • Cost to the beef industry <ul style="list-style-type: none"> ○ Rabbits - \$10.17

INVASIVE PESTS CONTROL SCHEME EVALUATION



Study	Invasive Pest/s	Notes	Impact Total Cost (\$2019)	Imputed Cost (\$/ha or \$/head Impacted)
<i>Gong et al. (2009)</i>		the agricultural industry.	<ul style="list-style-type: none"> • Rabbits - \$127.17 million • Wild dogs - \$27.46 million 	<p>p/head</p> <ul style="list-style-type: none"> ○ Wild Dogs - \$2.03 p/head • Cost to the sheep and lamb industry¹ <ul style="list-style-type: none"> ○ Rabbits - \$2.77 p/head ○ Wild Dogs - \$1.53 p/head
Annual Costs of Weeds in Australia <i>Ross McLeod (2018)</i>	Invasive weeds	<p>'Residual weed-related production losses are valued using both fixed price (loss-expenditure) and economic surplus methods, along with farmer expenditure on control measures. Farm level control methods include herbicides, costs of herbicides application, cultivation and integrated weed management practices. Annual losses and weed control costs are estimated for winter crops (wheat, oats, barley, canola), legumes, summer crops, cotton, rice, horticulture and livestock industries (dairy, wool, sheep-meat and beef) using production and price data averaged over the five-year period to 2018' (McLeod, 2018, p. 4).</p>	Estimated to cost on average \$5.08 billion across Australia	<p>Mean annual economic surplus weed costs (Total costs of weeds \$/ha)</p> <ul style="list-style-type: none"> • Wheat - \$149 • Oats - \$140 • Barley - \$149 • Canola - \$157 • Lupins - \$141 • Field Peas - \$144 • Chickpeas - \$170 • Sorghum - \$169 • Maize - \$255 • Triticale - \$139 • Sunflowers - \$150 • Soybeans - \$183 • Cotton - \$409 • Sugar - \$232 • Rice - \$220 • Fruit - \$532 • Vegetables - \$443 • Dairy - \$117 • Beef/Veal - \$2 • Lambs/Mutton - \$5 • Wool - \$5

¹ Calculated by dividing the total cost of wool and sheep/lamb by the total number of sheep and lamb

² Total Number of sheep & lamb used to calculate \$ per head

Source: ABS (2018), AEC.

INVASIVE PESTS CONTROL SCHEME EVALUATION



2.3 THE SOUTHERN DOWNS INVASIVE PESTS CONTROL SCHEME

The IPCS was introduced by the Southern Downs Regional Council in 2017/18 as an innovative approach to reducing the impact of invasive pests on the region's productivity, biodiversity and amenity. Landholders are required to abide by the scheme and identify and take necessary measures to control invasive pests on their land.

The scheme includes a pest management levy and an upfront concession fee. Those who comply with the IPCS retain their concession and those who do not have their levies collected and invested in strategic initiatives to provide additional regional benefits. Council promotes best practice control methods and helps landowners to achieve this through advice and assistance, with a focus on reducing the impacts of invasive pests in the Southern Downs region. In 2018-19, the IPCS included 5,309 properties (regardless of the use of the land applied) within certain general rating categories (see Table 2.3).

Landholders are responsible for pest management on their properties; however, Council do provide a list of contractors for those who are unable or unwilling to undertake the work themselves if requested. The IPCS requires landholders to make a reasonable attempt to control and remove invasive pests, preventing future impact on their land and the potential spread to neighbouring properties. Key invasive pests present in the Southern Downs LGA are outlined in section 2.2.1 above.

The scheme has been established to reduce the number of invasive pests in the region to directly benefit primary producers and residential and commercial properties in rural areas, with flow on benefits to the wider community. Considering the importance of agricultural production to the Southern Downs, control of invasive pests is critical to the regional economy as well as the environment.

The scheme is funded by a special rate in which non primary production properties and primary production properties are charged different amounts as per the table below.

Table 2.3. IPCS Levy Breakdown

Rating Category	Speciate Rate (cents in the dollar of ratable value)	Notes
Residential 4 Commercial and Industrial – Rural Extractive Special Uses Other	\$0.30	The minimum annual amount charged is \$500 and maximum \$6,000
Agriculture and farming 1,2 & 3 Horticulture 1,2 & 3 Private Forestry	\$0.50	The minimum annual amount charged is \$500 and maximum \$6,000

Source: Southern Downs Regional Council (2019)

3. IMPACTS OF THE INVASIVE PESTS SCHEME

The following sections review the data provided by Council (including comparison data of the IPCS in 2017 and 2018 as well as online survey responses; a summary of information received from Council is provided in Appendix B) to analyse the impact of invasive pests in the Southern Downs before and after the implementation of the IPCS.

3.1 RESULTS OF COMPARISON DATA PROVIDED

Council provided key outputs from the 2017-18, and 2018-19 Control Works forms¹ and summary data submitted by landholders in an excel spreadsheet format. A summary of the data included within the control works forms is listed below.

The number of control works forms issued between 2017-18 and 2018-19 decreased by approximately 500 forms. The number of forms submitted highlighting there is no pest presence on the landholders' property has increased slightly over the two year period (by 30 properties) and accepted no pest status has increased substantially, highlighting a decrease in the prevalence of invasive pests since the implementation of the IPCS.

The number of reminders has decreased by approximately 650, with landholders adjusting to the administrative process of the IPCS. Additionally, the percentage of control work forms received increased by approximately 3%.

Table 3.1. Control Work Forms Comparison Data

Control Work Forms	2017/18	2018/19
CWF issued	5,815	5,309
Reminders issued	2,168	1,519
CWF received	5,280	4,954
NO Pest status	1,758	1,788
Accepted NO Pest	1,492	1,747
Supplementary Issued	465	457
Supplementary Reinstated	120	182
Northern IPCS Area Property Identification Numbers (PID's)	1,862	1,721
Central IPCS Area PID's	1,606	1,379
Southern IPCS Area PID's	2,344	2,209

Source: Southern Downs Regional Council (Unpublished).

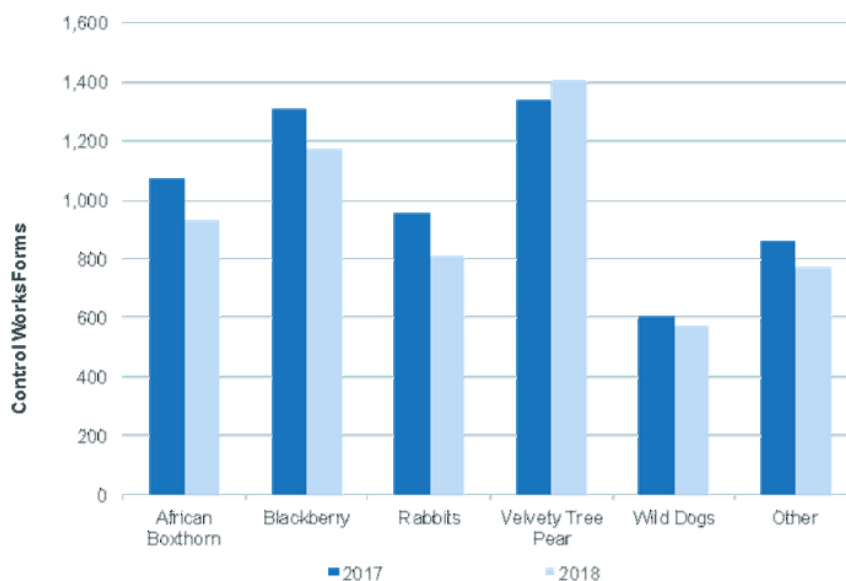
Figure 3.1 indicates that of the five most prevalent invasive pests in Southern Downs. The most prevalent invasive pests are the invasive plants (African boxthorn, blackberry and velvety tree pear) with a significantly larger number of control work forms being submitted over the two years compared to pest animals of rabbits and wild dogs (7,240 forms for invasive plants vs 2,943 forms for invasive pest animals). Since the implementation of the IPCS, control work forms highlighting the impact of rabbits has decreased the most of the five most prevalent invasive pests, by 146, closely followed by African boxthorn and blackberry decreasing by 145 and 135 respondents respectively. Velvety tree pear is the only invasive pest in the top five most prevalent invasive pests to record an annual increase in control works forms submitted since the implementation of the IPCS.

¹ Control Works forms are provided to residents by Council to complete and are designed to capture information regarding whether invasive pests are on the property, their extent, proposed control works for the coming period, and anticipated completion date for proposed works.

INVASIVE PESTS CONTROL SCHEME EVALUATION



Figure 3.1. Individual Pest Comparison



Source: Southern Downs Regional Council (Unpublished).

Since the implementation of the IPCS, the number of inspections has increased by approximately 340, with the percentage of properties assessed increasing from 73.9% in 2017 to 92.7% in 2018. The increase in inspections suggests an increase in engagement by Council, resulting in landholders applying stricter control methods to ensure they comply with the IPCS.

Table 3.2. Number of Inspections

Inspections	2017	2018
Inspections	684	1,023

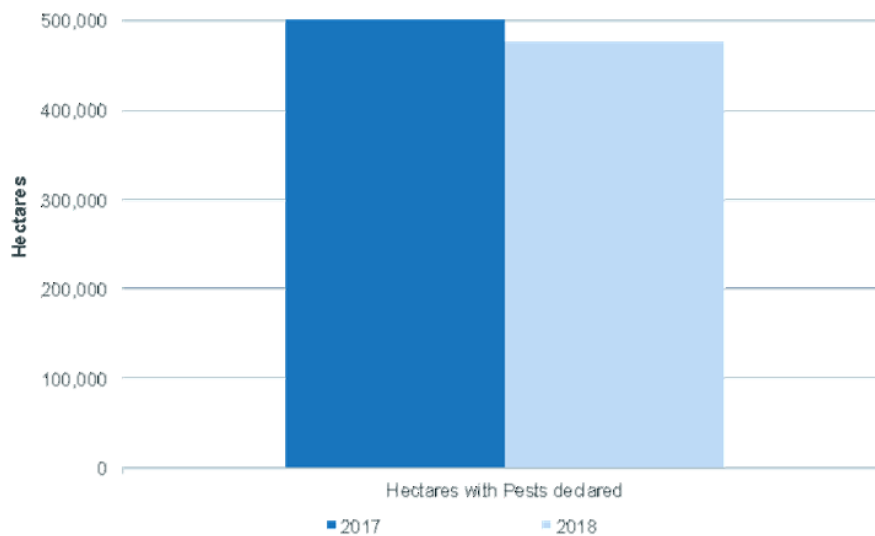
Source: Southern Downs Regional Council (Unpublished).

From 2017 to 2018, the area of land with pests declared in the Southern Downs has decreased by 23,815ha, indicating that the IPCS is successfully decreasing the prevalence of invasive pests within the region.

INVASIVE PESTS CONTROL SCHEME EVALUATION



Figure 3.2. Hectares with Pests Declared, Southern Downs



Source: Southern Downs Regional Council (Unpublished).

Since the implementation of the IPCS, landholders' level of awareness of both invasive pests and their impacts have increased by 16 percentage points to reach 71%. The increased awareness of landholders influences stricter control methods and as a result, leads to the decline of invasive pest infested land.

Table 3.3. Level of Awareness of Invasive Pests

Indicator	Pre-IPCS	Since IPCS
Level of Awareness	55%	71%

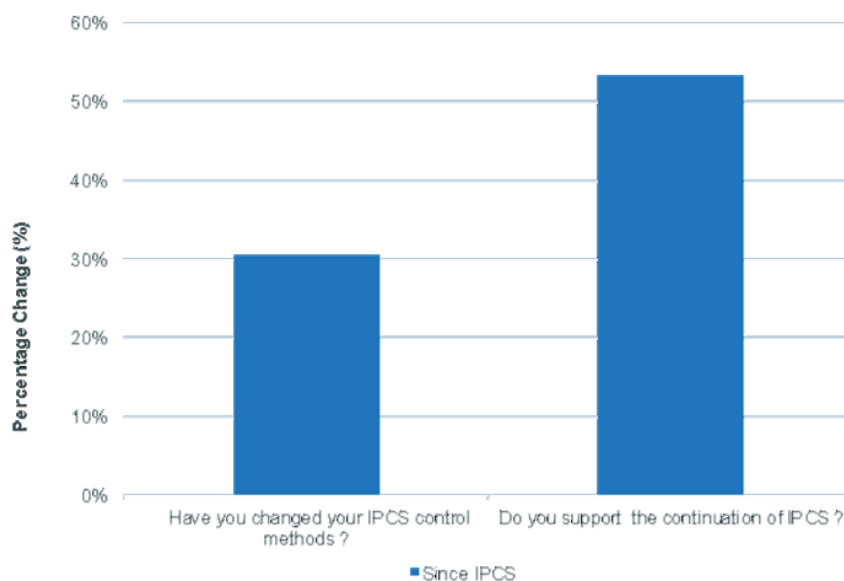
Source: Southern Downs Regional Council (Unpublished).

Since the implementation of the IPCS, control methods have changed by 30.5% compared to pre-IPCS. The majority, approximately 53.5%, of landholders, supports the continuation of the IPCS and think the scheme is of value to the Southern Downs region and particularly the agricultural industry.

INVASIVE PESTS CONTROL SCHEME EVALUATION



Figure 3.3. Percent of Landholders that have Changed Methods



Source: Southern Downs Regional Council (Unpublished).

3.2 INVASIVE PESTS CONTROL SCHEME SURVEY

Results of the IPCS survey were provided online and are open to the public. It must be noted that some of the questions included in the survey are also included within the comparison data, and information provided by Council outlined in section 3.1 may not align with the data presented from the survey results below. The survey and control work forms differ in sample size which will impact the direct comparability of the results. The survey consisted of 155 participants, with headline numbers including:

- 32.9% of respondents listed both tree pear and blackberry to be the two most invasive pests that cause the most impact.
- Since the implementation of the scheme, those respondents who are very aware of invasive pest impacts and control methods increased by 15.6 percentage points. This is approximately in line with the change in awareness indicated through control works forms of 16 percentage points.
- A significant portion of respondents (approximately 69%) have not changed the way they control invasive pests on their property since the scheme implementation, while approximately 31% of survey respondents indicated they have changed the way they control invasive pests. This aligns with the 30.5% of landholders indicating they have changed control methods since the introduction of the IPCS outlined through the comparison data (see Figure 3.3).
- An average of 26ha per property have been treated for pests that were previously infested.
- Since implementation, respondents have spent an additional \$3,258 on average for invasive pest control.
- A significant portion of respondents (87.58%) have not engaged the services of a contractor to carry out control work since implementation.
- 84.97% of respondents know where to go to access best practice control information for invasive pests.
- 53.69% of respondents support the continuation of the IPCS in the Southern Downs region. This aligns with the approximately 53.5% of landholders indicating they support the continuation of the IPCS outlined through the comparison data (see Figure 3.3).

INVASIVE PESTS CONTROL SCHEME EVALUATION



3.3 FINANCIAL PERFORMANCE

Over the past five years of financial data, it can be seen that Council have experienced consecutive financial losses ranging from approximately \$960,000 to over \$1.45 million annually to carry out invasive pest control (total nominal losses of approximately \$6 million over the period of five years). The largest loss was experienced in 2018-19 of approximately \$1.45 million (the second year of operation for the IPCS) attributed largely to an increase in combined pest animal and plant expenses of approximately \$480,000 from 2017-18 to 2018-19.

During the second year of IPCS operation (2018-19), IPCS levy revenue (less concession) decreased compared to the previous year by approximately \$23,000. This was a result of a decrease in levy revenues of approximately \$500,000, though this was partially offset by a decrease in concessions paid by Council to landholders that complied with pest management initiatives of approximately \$436,000.

Expenditure on invasive animals peaked during 2018-19 and is expected to decrease by approximately \$275,000 throughout 2019-20, while expenditure on invasive plants are budgeted to increase by approximately \$27,000 over the same time period.

The large spike in invasive animal and plant expenses from the first year of the IPCS implementation to the second are largely attributed to expenses which include materials, chemicals and hardware (increasing by approximately \$182,000), plant hire expenses (increasing by approximately \$85,000), control services (increasing by approximately \$69,000) and wages (increasing by approximately \$68,000).

Although costs during 2018-19 increased, Council waived fees for the hire of powered spray equipment and cactus injectors by landholders in order to assist those impacted by drought in the region.

Table 3.4. Financial Performance of Invasive Pest Management, Southern Downs Regional Council

Revenue	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20 ¹
IPCS (Levy less concession)				\$152,400	\$129,035	\$200,000
Grant Revenue		\$164,000	\$41,000	\$255,413	\$188,975	\$112,000
All other Revenue	\$24,348	\$5,374	\$14,063	\$7,563	\$99,883	\$3,000
Total Revenue	\$24,348	\$169,374	\$55,063	\$415,376	\$417,893	\$315,000
Expenditure						
Pest Animal	\$369,346	\$269,848	\$297,019	\$428,437	\$708,173	\$433,236
Pest Plant	\$520,391	\$754,301	\$524,983	\$564,630	\$763,394	\$790,800
Pest Mgt Precept	\$364,983	\$362,196	\$374,801	\$384,609	\$394,822	\$404,541
Total Expenditure	\$1,254,720	\$1,386,345	\$1,196,803	\$1,377,676	\$1,866,389	\$1,628,577
Profit / Loss	-\$1,230,372	-\$1,216,970	-\$1,141,741	-\$962,300	-\$1,448,496	-\$1,313,577

¹ 2019/20 budgeted.

Source: Southern Downs Regional Council (unpublished).

From the implementation of the IPCS initiative until the current year, IPCS revenue has been used to offset existing costs contained in the Council's pest management budget. However, from this year forth, the IPCS revenue will fund new activities including: deer control (\$15,000), wild dog aerial baiting and provision of meat bait for ground baiting (\$30,000), increased wild dog spur fence maintenance and patrol (additional \$32,500), control of weeds on roads (additional \$30,000), IPCS administration assistance (additional \$5,000).

It must be noted that an additional \$1 million in grant funding was received in June 2019 from the Australian Government for wild dog exclusion fencing activities. This funding was an advanced payment and will be recognised against the program(s) in the 2019-20 financial year as the expenses occur. Additionally, Council was recently approved for \$700,000 of funding from the Queensland Government's Feral Pest Initiative (round 3) for cluster fencing. The funds will be expended over a two and a half year period from the current financial year (2019-20). However, the above funds are not included in the table above as they were not recognised in Council's budget for 2019-20. Inclusion of these grants would lift both revenue and expenditure on pest management by Council, but as these amounts are expected to effectively offset (i.e. the grant funding is anticipated to be fully expended on provision of fencing for which the funds were received) the overall impact on profit/ loss is not anticipated to differ significantly.

4. STAKEHOLDER ENGAGEMENT

Telephone consultations were held by AEC with a small section² of stakeholders, including the Local Government Association Queensland (LGAQ), Department of Local Government, Racing and Multicultural Affairs (DLGRMA) QLD, and the Queensland Treasury Corporation (QTC) and landholders involved in the IPCS to consider their views on the success of the scheme, its TBL benefits, and potential areas for improvement.

Individual responses to consultations are not provided. Rather, the following section outlines a collection of responses across key areas of inquiry as a summary of input from the consultees.

Success of the IPCS

Stakeholders were generally supportive of the IPCS in its objectives to reduce the impacts of invasive pests in the Southern Downs region. Council staff were generally identified as being knowledgeable regarding pest control processes and seen as partners in supporting the control of invasive species.

A small selection of stakeholder comments includes:

- "The Council rep is good to deal with and knowledgeable about pest control, he is helping us get on top of our prickly pear problem."
- "Keep up the good work."
- "We understand what Council is trying to do."
- "We need to be pest free in this day and age. The future is all about clean and safe food production."
- "We are happy with the process."
- "The scheme hasn't really changed our approach to managing pests, but it has brought it front of mind."

Costs and Benefits of the IPCS

Landholders typically focussed on the economic/financial costs and benefits of the scheme but when questioned were aware of the broader environmental and social/community implications of the scheme. A number of landholders found it challenging to quantify the costs of implementing the scheme, given that activities were undertaken internally or using a mix of hired and internal labour and equipment.

Stakeholder comments included:

- "It's hard to assess the costs of control as we try to do as much as we can ourselves."
- "It's a big community benefit getting on top of dogs and pear trees, Council should be paying us for what we are doing."
- "We're on top of our pests which is good for growing and our land values."
- "It's not just the farm properties that are impacted, but also Council lands, QRail and other places."
- "It's a big effort to get on top of the boxthorn, but it should pay off in the long run."
- "Raising awareness of the issue is one of the biggest things the scheme has achieved."

² 22 landholders and three broader agencies at the time of writing.

INVASIVE PESTS CONTROL SCHEME EVALUATION



Issues/Opportunities for Improvement

When asked for areas of improvement or recommended changes to the scheme, feedback typically fell into the following categories:

- **Ensuring consistency within IPCS requirements across properties:** Some landholders felt they were doing the right thing, but poor controls on neighbouring properties would lead to a reoccurrence of the pests in future years.
- **Smaller industrial/commercial properties being included in the scheme:** Some smaller landholders felt their smaller industrial/commercial properties should fall outside the IPCS, given their modest scale and the scheme's intent to support agricultural production.
- **Consideration of greater use of biological controls:** Some landholders identified a greater utilisation/incorporation of biological control such as the Cactoblastis Moth would be effective in controlling invasive pests such as prickly pear.
- **Stress associated with the scheme implementation:** Some landholders felt significant stress associated with potentially receiving a supplementary rate notice through the scheme despite their efforts to comply. It was noted by a number of landholders that implementing controls during the drought was extremely challenging both financially and practically (as it was difficult to tell which weeds were alive and needed to be eradicated).
- **Notices being directed via mail and to the landholder:** Some landholders which were based outside of the Sothern Downs (either leasing their properties or run via a manager) expressed a desire to create an option for scheme communications to be sent to a nominated manager/operator via electronic methods (SMS or email). It was noted that the mail notices to the ratepayer often led to a lag in actioning control activities in these instances.
- **Desire for ongoing landholder input into control activities:** Some landholders identified a wish to have greater/ongoing input into future control activities funded by the scheme. Such engagement was seen as a key means to ensure ongoing landholder support for the IPCS.

Views of Broader Stakeholders

Broader stakeholders were generally supportive of the IPCS as an innovative approach for local governments to resource pest control activities. Stakeholders acknowledged the initial pushback from the community/landholders with the introduction of the scheme, however noted that the consensus has since moved more towards general acceptance of the scheme and its objectives.

Comments from (QTC, LGAQ, and DLGRMA) stakeholders included:

- The Department did review the process under the legislation. The process and program are legislatively compliant.
 - At the beginning of the IPCS program, DLGRMA were aware of the complaints from the community, however these have since reduced significantly over time.
 - Recognise Council's planning in development of the program, supported with community engagement, information and direct support for reporting and control works.
 - DLGRMA conducted meetings/conversations with Council and the Pest Control Advisory Group in order to develop an appropriate program and implementation.
 - Council has confirmed its commitment to its responsibilities and to pursue other Government agencies which will provide further support for the IPCS in the Southern Downs region (e.g. Transport and Main Roads and National Parks and Wildlife).
- Conversations with other Councils and through presentations at workshops/conferences indicate there is a general interest in the program and how it could be applied by other Councils.

INVASIVE PESTS CONTROL SCHEME EVALUATION



- A key question for the program remains: How will Council deal with non-compliant landholders? Presently, only the IPCS Levy is applied – no work is done by Council on private land.
- It is up to individual Councils how they address invasive pest issues. However, there certainly appears to be aspects of the scheme which could be applied by numerous Councils across Queensland seeking to resource their control activities.
- Southern Downs Regional Council has benefitted significantly from grant funding to support the scheme, it's important to understand how the scheme will fare in the absence of significant support.
- In order to support the success of the program in the future, it is crucial for ongoing engagement.
- Southern Downs has been suffering one of the worst droughts in the region's history, creating significant negative implications for agricultural producers. As a result, it is important to be sensitive to producer difficulties.
- Council should be supported for their innovative and proactive approach to invasive pest management.
- It has been noted that Council has put a significant amount of resources into the implementation of the IPCS to benefit all residents living within the Southern Downs. If the scheme were to end, the time and money injected into this program over the past few years to deliver benefits to the region would be wasteful.

5. FUTURE PROJECTIONS

The following section provides scenarios of projected future spread of invasive pests with and without the IPCS.

In projecting the potential future impacts of the IPCS it must be noted that limited data was available to develop these projections over the period of 10 years. The IPCS has only been operating for two years, which is an insufficient length of time to develop a reliable estimate of the impact the IPCS is having in reducing the spread of invasive pests.

Data regarding the spread of invasive pests prior to implementation of the IPCS was also not available, nor the level of control effort and expenditure, and therefore it is not possible to estimate the rate of spread of invasive pests pre-IPCS nor understand how the spread may have progressed without the IPCS. However, anecdotal evidence based on discussions with Council and landholders indicates the spread of the top five invasive pests in the Southern Downs was increasing year on year.

In consideration of the limited information regarding the spread of pests and control effort expenses before the implementation of the scheme and short period of data regarding the spread of pests since the implementation of the IPCS, a scenario-based approach has been adopted to demonstrate the potential impacts of the IPCS. Additional data is required to provide a more accurate understanding of the impacts of the IPCS. It is intended that these projections and assessment of impacts will be continually updated as additional data is made available to better understand the impacts of the IPCS.

Impacts of the IPSC

Between 2018 and 2019, the impacted land in the Southern Downs region decreased by 23,815ha. The future impacted land area has been projected over a period of 10 years (from 2020-30) based on this decline in 2018-19, across three alternative scenarios:

- **Low Scheme Impact** - Declining landholder input over time and diminishing returns to control works over time result in lower hectare reductions in invasive pests as the scheme matures. Remaining impacted growers continue to limit their involvement within the scheme.
- **Medium Scheme Impact** - Continued control works, with landholders implementing the current control methods over the next 10 years and returning a similar yield in pest reduction.
- **High Scheme Impact** - Significant landholder engagement within the scheme and ongoing increases in pest eradication success as management controls are adopted and the ongoing economic, environmental and social benefits begin to flow through to landholders.

The above initial projection scenarios were workshopped with Council staff involved in the IPCS and were considered reasonable given the limited data available, however are subject to significant uncertainty. As an ongoing process AEC will provide an editable projection template to Council. This will enable additional data points for IPCS performance can be monitored³, particularly the implications of any diminishing reductions in invasive pest prevalence over time.

Key results from the initial projections developed indicate that:

- The low impact scenario assumes that, with lower engagement, infested pest land will continue to decrease by a cumulative 148,000ha by 2030. Control methods begin to decrease from 2024 resulting in a smaller decrease in invasive pest land.
- The medium scenario indicates that invasive pest land will continue to decrease by approximately 24,000ha per year, decreasing by a total of approximately 300,000 by 2030.

³ Including projected implications for the Cost Benefit Assessment developed in Chapter 6.

INVASIVE PESTS CONTROL SCHEME EVALUATION



- The high demand scenario assumes that over a period of 10 years, invasive pest land will decrease by approximately 415,000ha by 2030.

What Would Occur Without the IPCS

Without the IPCS, there is significant potential for an increase in pests and subsequently infested pest land over a period of time. Although landholders may still undertake some form of control from time to time, invasive pests have the potential to spread faster than irregular and infrequent control methods. A number of studies highlight the potential spread of invasive pests, including:

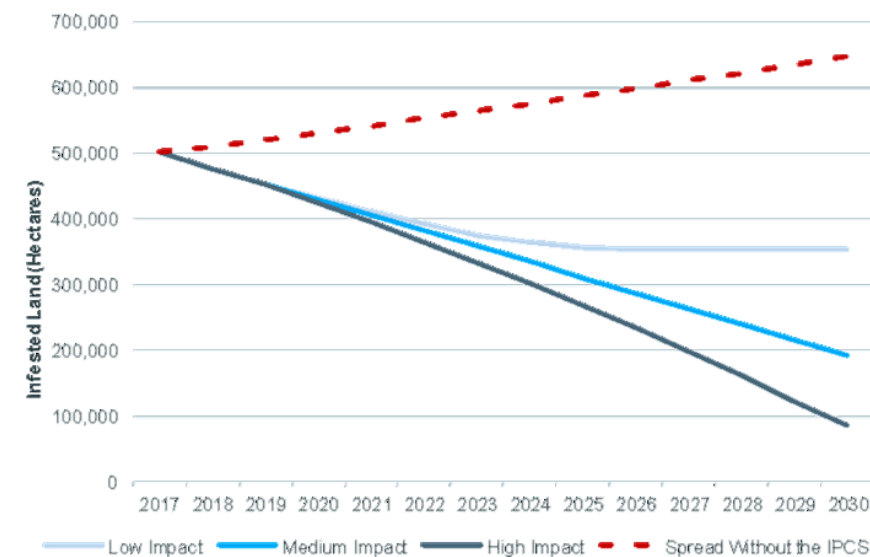
- Rabbits are able to breed year round in good conditions, with the ability to produce 11 young per year in marginal areas and up to as many as 25 or more in favourable conditions (DPIF, 2008).
 - Rabbits have the ability to reproduce more than five times per year, producing up to five young per litter (Centre for Invasive Species Solutions, 2011).
 - Historically, rabbit invasion varied from 10-15km per year in wet forested country to over 100km per year in the range lands (Agriculture Victoria, 2017b).
- Wild dogs have the ability to breed twice within a year, however they are more likely to have one litter with an average of five pups (range between 1 to 10) (Agriculture Victoria, 2017c).
- Invasive weeds can easily be spread via both animals, water and the wind, dispersing seeds 20 to 30 kilometres from the plant itself (Queensland Government, 2016).

While it is difficult to accurately assess the potential spread of invasive pests in the absence of the scheme given the available data, the impacts of a conservative and hypothetical increase of 2% per annum is illustrated shown in Figure 5.1. Anecdotal, the increasing prevalence of invasive pest impacts in the Southern Downs was a key reason of the implementation of the IPCS.

Comparison of Scenarios

The following figure compares the three scenarios of reduction in invasive pests through ongoing implementation of the IPCS, compared to a scenario of what might have been expected to occur without the IPCS assuming an annual increase in spread of 2% per annum.

Figure 5.1. Historic and Projected Hectares Impacted by Invasive Pests



Source: Southern Downs Regional Council (Unpublished), AEC.

6. COST BENEFIT ASSESSMENT

6.1 METHOD AND APPROACH

This assessment provides an overview of the net economic costs and benefits associated with the IPCS between the financial years ending 30 June 2018 to 30 June 2047.

All years presented in the cost benefit analysis are for financial years ending June. The costs and benefits have been assessed against three real discount rates (4%, 7%, and 10%) with the focus primarily on the standard 7% discount rate.

The geographical scope of the project impact is the Southern Downs LGA. Costs and benefits assessed in this analysis relate to this catchment.

The following scenarios were compared in this assessment:

- **The base case:** which assumes the IPCS was not implemented. Under the base case, the Southern Downs community will be without a scheme which is best designed to reduce the prevalence and better control invasive pests than likely alternatives. As outlined in section 5, there is limited data available to appropriately estimate either the control effort that may have been undertaken without the IPCS nor the spread of invasive pests. Anecdotally, it is understood the spread of invasive pests was increasing, however, to be conservative it has been assumed in the base case that the spread of invasive pests would remain at around 500,000 ha. Estimates of the cost for controlling pests by landholders have not been developed due to insufficient information available. To offset this, the costs of control for landholders in the project cases (below) have only incorporated an "additional" cost for control to landholders as a result of the IPCS implementation.
- **The project cases:** which assumes the Invasive Pests Control Scheme remains in place, reducing the area within Southern Downs impacted by invasive pest species and supporting key economic, environmental and social benefits to the Southern Downs community. Outcomes under the project case are reported under the high, medium and low future impact scenarios as shown in section 5. As indicated in the description of the base case above, only the marginal increase in control effort/ costs (from existing/ what would occur without the IPCS) is included as part of the project cases to offset the exclusion of the control costs in the base case.

Impacts on the spread of invasive pests, as well as costs of implementing the IPCS for both Council and landholders, has only been examined over a ten year period to 2030. Beyond this time period it is assumed the spread of invasive pests remains at 2030 levels for each scenario, while costs for managing pests revert to historic levels for maintenance and upkeep. As only the marginal increase in costs for implementing the IPCS are included in the assessment, from a modelling perspective this results in an assumption of no additional costs compared to what would otherwise occur in the base case after 2030.

While the costs of implementing the IPCS and reduction in spread of pests delivered is only examined over a ten year period, the longer term economic, social and environmental benefits from the reduction in spread delivered over this ten year period are examined over the full 30 years of the cost benefit analysis.

The cost benefit analysis below provides guidance on the net impact of the project cases against the base case.

Decision Criteria:

The Net Present Value (NPV) and Benefit Cost Ratio (BCR) will be the primary decision criteria for the economic appraisal. The NPV of a project expresses the difference between the present value (PV) of future benefits and PV of future costs, i.e.: $NPV = PV \text{ Benefits} - PV \text{ Costs}$. The BCR provides the ratio between the PV of benefits and PV of costs, i.e., $BCR = PV \text{ Benefits} / PV \text{ Costs}$.

Where the economic appraisal results in a:

- Positive NPV and BCR above 1: the project will be deemed as being desirable
- NPV equal to zero and BCR of 1: the project will be deemed neutral (i.e., neither desirable nor undesirable)

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- Negative NPV and BCR below 1: the project will be deemed undesirable.

The Internal Rate of Return (IRR), which indicates the discount rate which would return an NPV of \$0 and a BCR of 1, is also reported.

Additional details regarding the approach used for this cost benefit analysis is presented in Appendix A.

6.2 QUANTIFICATION & VALUATION OF COSTS & BENEFITS

6.2.1 Costs

Implementation Costs

Implementing the IPCS has cost Council \$1.4 million (2017-18) and \$1.9 million (2018-19) in the initial years⁴ and are projected to cost \$1.6 million per annum going forward to 2030. Scheme implementation costs have been incorporated into the model from 2018 through to 2030. It has been assumed the cost to Council to implement the IPCS would not differ between projection scenarios.

Scheme costs have only been assessed over 10 years (compared to a 30 years CBA analysis period) in line with the terms of reference for the IPCS evaluation. Beyond this time period it is assumed the costs for managing pests revert to historic levels for maintenance and upkeep (while the spread of pests remains at 2030 levels). While it is acknowledged that control works would continue to be undertaken beyond the 10 year period, as only the marginal increase in costs for implementing the IPCS are included in the assessment, from a modelling perspective this results in an assumption of no additional costs compared to what would otherwise occur in the base case after 2030.

It should be noted that some control works costs would still be incurred by Council in the absence of the IPCS (i.e. under the base case), which have not been incorporated in the modelling. This results in an overstatement of implementation costs for the IPCS compared to what would likely be incurred by Council without the IPCS.

On-Property Pest Management Costs

On-property pest management costs to landholders as a result of the IPCS have been included in terms of the additional costs for controlling pests since the implementation of the IPCS as identified in landholder survey results (SDRC, 2019b). The survey indicates landholder on-property pest management costs (facilitated by the IPCS) have increased by approximately \$125 per hectare of land controlled.

It is likely that impacted lands will require additional follow-up treatments/ controls beyond the initial year in order to remain pest free. To account for this, follow up control costs have been assumed at half the initial rate (\$62.50/ha) for the two years post-initial control works. Beyond this point it is assumed that control/ maintenance costs for previously impacted properties would be similar to the base case scenario.

On property pest management costs have been projected across the low, medium and high impact scenarios developed in Chapter 5.

6.2.2 Benefits

Reduced Impacts of Invasive Pests

The core benefit of the IPCS is the reduction in the prevalence of invasive pests within the Southern Downs community. Potential benefits run across the TBL framework (as reviewed in Chapter 3), with key impacts as highlighted in the table below.

⁴ For the purposes of the CBA modelling, all years have been converted to current \$2019-20.

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Table 6.1. Invasive Pest Impacts

Pest Species	Economic Impacts	Environmental Impacts	Social Impacts
Wild Dogs	<ul style="list-style-type: none"> Reduced income due to loss of stock. Costs to dispose of deceased animals. Wild dogs transmit diseases which can infect agricultural production of sheep and cattle (including sheep measles, hydatidosis, mange, distemper, hepatitis, parvovirus, Neospora caninum and toxoplasmosis (DPI, n.a.)). Changes to the stock composition with premium stock that has been built up over a number of years being destroyed. Impacted properties typically have a negative impact on land values. 	<ul style="list-style-type: none"> Attacks on native animals and subsequent loss of bio-diversity. Potential for transmission of diseases to native animals. 	<ul style="list-style-type: none"> Psychological impacts on farmers if attacks on livestock are repetitive. The predation of livestock has significant social and psychological effects on primary producers and their families. In addition, pest animals such as wild dogs are a nuisance, damaging infrastructure and culturally important sites and displaying adverse behaviours such as disruptive noise (Invasive Plants and Animals Committee, 2017). Financial stress implications due to loss of income. Injury risks of attacks to humans (particularly children).
Rabbits	<ul style="list-style-type: none"> Grazing of field crops reducing yields and damaging soils, resulting in a reduction in farmer income. Impacted properties due to warrens etc. creates a negative impact on land values. 	<ul style="list-style-type: none"> Overgrazing native pastures, leading to loss of plant biodiversity. Preventing vegetation from regenerating and degrading the quality of soil. Cause significant land degradation by building warrens. Acting as a food source for larger predators such as wild dogs. Reduced the amount of food stock available for native animals. Increasing and spreading invasive weeds (Cooke, 2011). Potential spread of diseases to native animals. 	<ul style="list-style-type: none"> Financial stress implications due to loss of income. Psychological stress due to the potential for infestation. Reduced natural amenity due to destruction/degradation of rural areas.
African Boxthorn	<ul style="list-style-type: none"> Impacting stock due to the spiny thickets hindering mustering and stock movement. Reducing productive potential and yields. Presence typically has a negative impact on land values. 	<ul style="list-style-type: none"> Dense covering can create shade and crowd out vegetation and prevent regeneration. Commonly harbour other invasive pests such as rabbits. 	<ul style="list-style-type: none"> Dense infestations likely to impact recreation and potential injuries to people. Financial stress implications due to loss of income associated with reduced production land.

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Pest Species	Economic Impacts	Environmental Impacts	Social Impacts
Blackberry	<ul style="list-style-type: none"> Dense and impenetrable tickets and are often situated along waterways, impacting access to watering points for stock. Due to its rapid growth, the weed spreads across land relatively fast impacting vegetation and pasture. Presence typically has a negative impact on land values. 	<ul style="list-style-type: none"> Provides shelter and acts as a food source for other invasive pests. The pest can become a significant fire hazard due to the large amount of dead canes. Due to its rapid growth, the weed spreads across land relatively fast impacting native vegetation. 	<ul style="list-style-type: none"> Degradation of natural habitats and reduced natural amenity. Loss of income associated with agricultural production may cause financial stress to landholders.
Velvety Tree Pear	<ul style="list-style-type: none"> Hindering stock movement and limit access for recreational activities. Sharp spines may get lodged into the wool of sheep and contaminate the product. The sharp spines have the potential to cause injury to animals. Presence has a negative impact on land values. 	<ul style="list-style-type: none"> Rather dense infestations can compete with natural habitats, limiting the growth and regrowth of vegetation. The tree pear provides a harbour for other invasive pests. 	<ul style="list-style-type: none"> Dense infestations can reduce recreational activity and cause injuries to people as a result of the sharp spines. Can negatively impact income due to loss of stock or crops.

Source: AEC

As noted in section 2.3.1, the benefits associated with a reduction in invasive pests varies significantly depending on the type of pest, the associated land uses being impacted, and the methodology for valuation applied. For this assessment, a rounded estimate of \$50/ha/annum has been applied based on Southern Downs land use (high value horticulture and cattle grazing) and reported pest mix (Table 6.1).

It should be noted that not all the productive land area of reported impacted properties may contain invasive pests, which will impact the TBL impacts. However, in the absence of more accurate impact data, the scenarios developed in chapter five have been retained as the basis for reduced prevalence of invasive pest benefits⁵. Capture of more accurate impacted area data by property and pest type is a key recommendation of this review and would improve the estimation of benefits substantially.

Benefits have been projected across the low, medium and high impact scenarios, with pest levels assumed to remain constant from 2030 to the end of the analysis period in 2047. This is based on a 10 year forward-looking analysis period with a longer timeframe to reflect the socio-economic benefits delivered by pest control that are longer term in nature. To help retain a more conservative estimate and given the limited data available, the potential impacts of the IPCS in terms of a reduction in spread of invasive pests has been compared to a base case that assumes the spread of invasive pests remains at approximately 500,000 ha over the analysis period. This is likely a conservative assumption given anecdotal evidence indicates the spread of invasive pests was increasing prior to implementation of the IPCS.

6.2.3 Costs and Benefits Not Included

There are a number of other costs and benefits the project will deliver that were not included in the cost benefit analysis which are considered qualitatively below:

- **Costs:**
 - **Potential mental stress impact of IPCS implementation on landholders:** As was noted in Chapter 4, the potential for a supplementary rates notice is a noted point of stress for landholders (particularly

⁵ Noting that reduced hectares of impacted area within a property would also proportionately impact the on-property pest management costs driver of the CBA.

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during times of drought and financial hardship). The impacts of the psychological burden of the IPCS on landholders has not been incorporated into the analysis as it is understood that Council will continue to work empathetically with landholders to support the outcomes of the scheme while minimising any adverse impacts.

- **Benefits:**

- **Benefits from IPCS revenues:** IPCS levy collection results in additional pest control activities (beyond those undertaken on-property by landholders) including on Council lands. The impacts of IPCS levies have been conservatively assumed to be a transfer of benefits between landholders and Council and have been excluded from the assessment. However, it should be noted that benefits from control works undertaken by council (including on Council-owned lands) are significant.
- **Increased economic activity from contract control works:** The IPCS promotes qualified local contractors to undertake control works for landholders to comply with the scheme. This in turn supports industry growth and employment outcomes within the Southern Downs LGA. Two additional contract businesses have established operations in the Southern Downs region post-implementation of the IPCS.
- **Potential spread of invasive pests under the base case:** The benefits of invasive pest control are based upon the reported (and projected) reduction in areas impacted under the scheme. However, it is likely that under the base case (i.e. without the implementation of the scheme) that invasive pest species would have continued to spread and impacted additional lands within the Southern Downs. The cost benefit analysis has assumed the spread of invasive pests does not increase in the base case, which is likely a conservative assumption.
- **Increased collaboration and potential application of the scheme in other areas:** The IPCS is an innovative approach for local government pest control. Broader State and other agency stakeholders consulted for this study were broadly supportive of the scheme's approach and its objectives as well as the applicability of the scheme to other LGAs across Queensland and Australia.

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6.3 COST BENEFIT ASSESSMENT

The table below outlines the Present Value (PV) of the identified costs and benefits associated with the project between the financial year ended June 2018 and the financial year ended June 2047, at discount rates of 4%, 7%, and 10%.

The CBA modelling at the discount rate of 7% is economically desirable, with:

- **The low impact scenario** returning an NPV of \$45.3 million over the 30-year assessment period, with a BCR of 1.85, and an IRR of 18.8%.
- **The medium impact scenario** returning an NPV of \$74.4 million over the 30-year assessment period, with a BCR of 2.01, and an IRR of 20.6%.
- **The high impact scenario** returning an NPV of \$95.9 million over the 30-year assessment period, with a BCR of 2.09, and an IRR of 21.7%.

The analysis indicates that the continuation of the IPCS is desirable across all scenarios and discount rates applied.

Table 6.2. Summary of Cost Benefit Analysis Results, 2018 to 2047

Real Discount Rate	PV Costs (\$M)	PV Benefits (\$M)	NPV (\$M)	BCR
Low Impact Scenario				
4%	\$56.9	\$134.4	\$77.6	2.36
7%	\$53.2	\$98.5	\$45.3	1.85
10%	\$50.3	\$76.0	\$25.8	1.51
Medium Impact Scenario				
4%	\$82.1	\$209.8	\$127.8	2.56
7%	\$73.5	\$147.9	\$74.4	2.01
10%	\$66.7	\$109.6	\$42.9	1.64
High Impact Scenario				
4%	\$99.7	\$263.9	\$164.2	2.65
7%	\$88.0	\$183.9	\$95.9	2.09
10%	\$78.9	\$134.7	\$55.8	1.71

Note: Totals presented in the table may not equal the sum of costs and benefits due to rounding.
Source: AEC

6.4 SENSITIVITY TESTING

This section examines the sensitivity of the project to key model inputs and assumptions used in the CBA. Sensitivity analysis in this section has been undertaken for the medium impact scenario using a Monte Carlo analysis across the following key assumptions used in the modelling.

- **Costs:**
 - IPCS implementation costs.
 - On-property pest control costs.
- **Benefits:**
 - Reduced impacts of invasive pests.

Each of the above assumptions has been tested in isolation with all other inputs held constant, with the results reported in Table 6.3 in terms of the modelled change in NPV resulting from the variance in the base assumptions at a discount rate of 7%. The final row of the table examines each assumption simultaneously to provide a 'combined' or overall sensitivity of the model findings to the assumptions used. Table 6.3 also outlines the distribution used allowing for a 10% confidence interval, with the '5%' and '95%' representing a 90% probability that the distribution and NPV will be within the range outlined in the table.

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Ranges tested include:

- Costs represent a maximum 40% higher and 30% lower than the base values.
- Benefits represent a normal distribution with a standard deviation of 0.2.

Table 6.3. Sensitivity Analysis Summary, Discount Rate 7% (Medium Impact Scenario)

Variable	Net Present Value (\$ Million)	
	5%	95%
Costs		
IPCS Implementation Costs	\$70.5	\$77.6
On-Property Pest Management Costs	\$60.8	\$85.4
Benefits		
Reduced Impacts of Invasive Pests	\$23.9	\$121.4
Combined	\$21.8	\$122.4

Source: AEC

The analysis indicates, at a discount rate of 7%, there is a 90% probability the project will provide an NPV of between \$21.8 million and \$122.4 million. Sensitivity testing returned a positive NPV in 99.0% of the 5,000 iterations run in Monte Carlo analysis. This means that under 99.0% of the input parameters examined in this assessment the project results in a positive NPV.

7. CONCLUSIONS AND RECOMMENDATIONS

The analysis undertaken in this review has identified that the IPCS is an important mechanism for the control of invasive pest species and support for the ongoing viability of the critical agricultural industry. Over the longer term the scheme is estimated to have significant ongoing benefits, which outweigh the costs vs. inaction.

Council has invested significant time and resources to implement the scheme and given its notable early successes and reported gradual acceptance by landholders it is the recommendation of this report that the scheme be continued.

A number of opportunities for the potential improvement of the scheme have been identified throughout the review process for Council's consideration. These include:

- **Consideration of improved mapping and scheme data capture:** This evaluation has identified a number of limitations regarding the availability of pest impact data within properties and across pest types. Improved data capture and mapping will support greater targeting of key areas and improve the capture of TBL benefits. Adoption of this recommendation needs to take into consideration appropriate budget limitations as well as the potential overburdening of landholders with survey/data capture.
- **Continuation of data capture regarding scheme impacts:** This evaluation is based on a small sample of scheme impacts, and the incorporation of future data points will help to improve the CBA and future impact projections significantly.
- **Consideration of additional actions to be taken against repeatedly non-compliant properties:** The evidence of repeat non-compliant properties as well as noted frustration of neighbouring landholders with non-compliant operators suggests that additional actions against non-compliant properties may need to be considered. This could take the form of a three-strike rule or similar, increasing fees required to be paid for non-compliance after the third infringement. Such an approach would support consistency within the IPCS requirements across all properties.
- **Consideration of adjusting the properties included within the scheme:** The noted prevalence of small commercial/industrial properties within the scheme suggests a review of properties which are included within the scheme may be considered. The limitations of appropriate ratings categories through which to apply the scheme is acknowledged in making this recommendation.
- **Consideration of alternative notice methods to support non-resident landholders:** Council should consider avenues to implement an option for a nominated manager/operator to be notified directly via electronic methods (SMS or email) to support prompt compliance with the IPCS for properties operated under lease or through employed management.
- **Consideration of avenues for ongoing landholder input and engagement into IPCS control activities:** An opportunity exists for ongoing engagement with IPCS ratepayers to collaborate on future control initiatives utilising IPCS levies. Ongoing engagement will support greater buy-in to the scheme and help promote a collaborative approach to invasive pest control.

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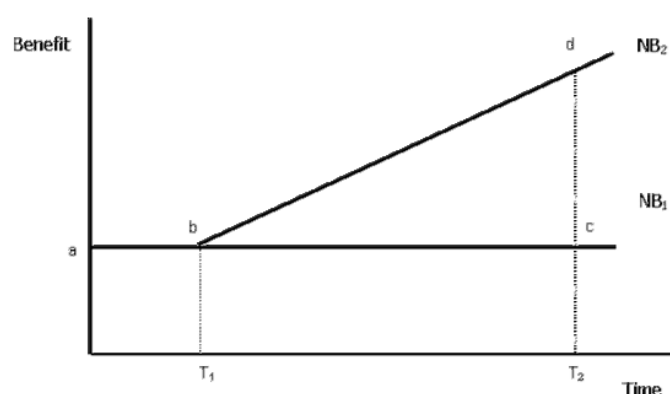
APPENDIX A: COST BENEFIT ANALYSIS METHODOLOGY

STEP 1: DEFINE THE SCOPE AND BOUNDARY

To enable a robust determination of the net benefits of undertaking a given project, it is necessary to specify base case and alternative case scenarios. The base case scenario represents the 'without project' scenario and the alternative or 'with project' scenario examines the impact with the project in place.

The base case (without) scenario is represented by line NB_1 (bc) over time T_1 to T_2 in the figure below. The investment in the project at time T_1 is likely to generate a benefit, which is represented by line NB_2 (bd). Therefore, the net benefit flowing from investment in the project is identified by calculating the area (bcd) between NB_1 and NB_2 .

Figure A.1. With and Without Scenarios



Source: AEC

STEP 2: IDENTIFY COSTS AND BENEFITS

A comprehensive quantitative specification of the benefits and costs included in the evaluation and their various timings is required and includes a clear outline of all major underlying assumptions. These impacts, both positive and negative, are then tabulated and where possible valued in dollar terms.

Some impacts may not be quantifiable. Where this occurs the impacts and their respective magnitudes will be examined qualitatively for consideration in the overall analysis.

Financing costs are not included in a CBA. As a method of project appraisal, CBA examines a project's profitability independently of the terms on which debt finance is arranged. This does not mean, however, that the cost of capital is not considered in CBA, as the capital expenses are included in the year in which the transaction occurs, and the discount rate (discussed below in Step 5) should be selected to provide a good indication of the opportunity cost of funds, as determined by the capital market.

STEP 3: QUANTIFY AND VALUE COSTS AND BENEFITS

CBA attempts to measure the value of all costs and benefits that are expected to result from the activity in economic terms. It includes estimating costs and benefits that are 'unpriced' and not the subject of normal market transactions but which nevertheless entail the use of real resources. These attributes are referred to as 'non-market' goods or impacts. In each of these cases, quantification of the effects in money terms is an important part of the evaluation.

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However, projects frequently have non-market impacts that are difficult to quantify. Where the impact does not have a readily identifiable dollar value, proxies and other measures should be developed as these issues represent real costs and benefits.

One commonly used method of approximating values for non-market impacts is 'benefit transfer'. Benefit transfer (BT) means taking already calculated values from previously conducted studies and applying them to different study sites and situations. In light of the significant costs and technical skills needed in using the methodologies outlined in the table above, for many policy makers utilising BT techniques can provide an adequate solution.

Context is extremely important when deciding which values to transfer and from where. Factors such as population, number of households, and regional characteristics should be considered when undertaking benefit transfer. For example, as population density increases over time, individual households may value nearby open space and parks more highly. Other factors to be considered include, depending on the location of the original study, utilising foreign exchange rates, demographic data, and respective inflation rates.

Benefit transfer should only be regarded as an approximation. Transferring values from similar regions with similar markets is important, and results can be misleading if values are transferred between countries that have starkly different economies (for example a benefit transfer from the Solomon Islands to Vancouver would likely have only limited applicability). However, sometimes only an indicative value for environmental assets is all that is required.

STEP 4: TABULATE ANNUAL COSTS AND BENEFITS

All identified and quantified benefits and costs are tabulated to identify where and how often they occur. Tabulation provides an easy method for checking that all the issues and outcomes identified have been addressed and provides a picture of the flow of costs, benefits and their sources.

STEP 5: CALCULATE THE NET BENEFIT IN DOLLAR TERMS

As costs and benefits are specified over time it is necessary to reduce the stream of benefits and costs to present values. The present value concept is based on the time value of money – the idea that a dollar received today is worth more than a dollar to be received in the future. The present value of a cash flow is the equivalent value of the future cashflow should the entire cashflow be received today. The time value of money is determined by the given discount rate to enable the comparison of options by a common measure.

The selection of appropriate discount rates is of particular importance because they apply to much of the decision criteria and consequently the interpretation of results. The higher the discount rate, the less weight or importance is placed on future cash flows.

The choice of discount rates should reflect the weighted average cost of capital (WACC). For this analysis, a base discount rate of 6% has been used to represent the minimum rate of return, in line with Australian Government guidelines. As all values used in the CBA are in real terms, the discount rate does not incorporate inflation (i.e., it is a real discount rate, as opposed to a nominal discount rate).

To assess the sensitivity of the project to the discount rate used, discount rates either side of the base discount rate (6%) have also been examined (4% and 8%).

The formula for determining the present value is:

$$PV = \frac{FV_n}{(1 + r)^n}$$

Where:

PV = present value today

FV = future value n periods from now

r = discount rate per period

n = number of periods

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Extending this to a series of cash flows the present value is calculated as:

$$PV = \frac{FV_1}{(1+r)^1} + \frac{FV_2}{(1+r)^2} + \dots + \frac{FV_n}{(1+r)^n}$$

Once the stream of costs and benefits have been reduced to their present values the Net Present Value (NPV) can be calculated as the difference between the present value of benefits and present value of costs. If the present value of benefits is greater than the present value of costs then the option or project would have a net economic benefit.

In addition to the NPV, the internal rate of return (IRR) and benefit-cost ratio (BCR) can provide useful information regarding the attractiveness of a project. The IRR provides an estimate of the discount rate at which the NPV of the project equals zero, i.e., it represents the maximum WACC at which the project would be deemed desirable. However, in terms of whether a project is considered desirable or not, the IRR and BCR will always return the same result as the NPV decision criterion.

STEP 6: SENSITIVITY ANALYSIS

Sensitivity analysis allows for the testing of the key assumptions and the identification of the critical variables within the analysis to gain greater insight into the drivers to the case being examined.

A series of Monte Carlo analyses has been conducted in order to test the sensitivity of the model outputs to changes in key variables. Monte Carlo simulation is a computerised technique that provides decision-makers with a range of possible outcomes and the probabilities they will occur for any choice of action. Monte Carlo simulation works by building models of possible results by substituting a range of values – the probability distribution – for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. The outputs from Monte Carlo simulation are distributions of possible outcome values.

During a Monte Carlo simulation, values are sampled at random from the input probability distributions. Each set of samples is called an iteration, and the resulting outcome from that sample is recorded. Monte Carlo simulation does this hundreds or thousands of times, and the result is a probability distribution of possible outcomes. In this way, Monte Carlo simulation provides a comprehensive view of what may happen. It describes what could happen and how likely it is to happen.

INVASIVE PESTS CONTROL SCHEME EVALUATION



APPENDIX B: SUMMARY OF PROVIDED INFORMATION

Table B.1. Summary of Information Provided by Council

Date Received	File Name	Summary
14/06/2019	Control Works Form 19/20	Blank form which is handed to residents to fill, intended to highlight: <ul style="list-style-type: none"> • Invasive pests – Y/N • Which invasive pests are on the property and to which extent • Proposed control works • Completion date for works from Sep 2019 to April 2020
14/06/2019	Copy of IPCS 17-18 Comparison Data	
14/06/2019	Copy of IPCS 17-18 Comparison Data Graphs	<ul style="list-style-type: none"> • Comparison of top 5 pests 2017-18 • No pest comparison • CWF issued and received and reminders issued and % received • Inspections assessment 2017 and 2018 comparison • Ha with pests declared 17 and 18 • Awareness level pre IPCS and Since IPCS • Changed control methods and support for continuation of IPCS
14/06/2019	Copy of List of Contractors	<ul style="list-style-type: none"> • Pest control contractors contact details
20/06/2019	Survey Responses Available https://www.surveymonkey.com/results/SM-63JO8N8WL/	<ul style="list-style-type: none"> • IPCS Survey

Source: AEC.

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OUTCOME DRIVEN

