



February 2020

Economic Costs of Inaction on Paradise Dam

Report prepared for

Bundaberg Regional Council, Wide Bay Burnett Regional Organisation of Councils,
Regional Development Australia Wide Bay Burnett, Bundaberg CANEGROWERS,
CANEGROWERS Isis, and Bundaberg Fruit and Vegetable Growers

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
BIS	Bundaberg Irrigation Scheme
CAPEX	Capital expenditure
CBA	Cost-benefit analysis
DNRME	Department of Natural Resources, Mines and Energy (Queensland)
DPI	Department of Primary Industries (Queensland)
CG	Coordinator General (of the Queensland Government)
FTE	Full-time equivalent (employment)
GRP	Gross regional product
GVAP	Gross value of agricultural production
Ha	Hectare
HP	High Priority (water)
LGA	Local Government Area
ML	Megalitre (i.e. 1,000 kilolitres or 1 million litres)
MP	Medium Priority (water)
PV	Present value
ROL	Resource Operating Licence

Executive Summary

Background

Bundaberg Regional Council, Wide Bay Burnett Regional Organisation of Councils, Regional Development Australia Wide Bay Burnett, Bundaberg CANEGROWERS, CANEGROWERS Isis, and Bundaberg Fruit and Vegetable Growers have commissioned Adept Economics, assisted by QEAS, to investigate the economic costs of inaction on Paradise Dam by the Queensland Government. The Paradise Dam is in the Bundaberg region and was opened in 2005 with a capacity of 300,000 megalitres (ML) of water.

In September 2019, Sunwater, a Queensland Government-owned corporation, started releasing water from Paradise Dam to address what it considered were dam safety concerns. The height of the dam wall will be reduced and the dam's capacity will be substantially cut. There is a large amount of concern in the Bundaberg community regarding the potential economic and social impacts on the region and the rest of Queensland.

Importance of Paradise Dam for water security which underpins investment and production

Paradise Dam is one of six storages in the Bundaberg region, and at its originally intended capacity of 300,000 megalitres (ML) is the second largest storage (after Fred Haigh Dam which has 562,000ML of capacity). Paradise Dam was originally intended to provide supplementary water, to act as an insurance policy for times of drought and water shortages. The volatility of rainfall from year-to-year means that such an insurance policy can be highly valuable and provide comfort to growers, allowing them to plan and invest.

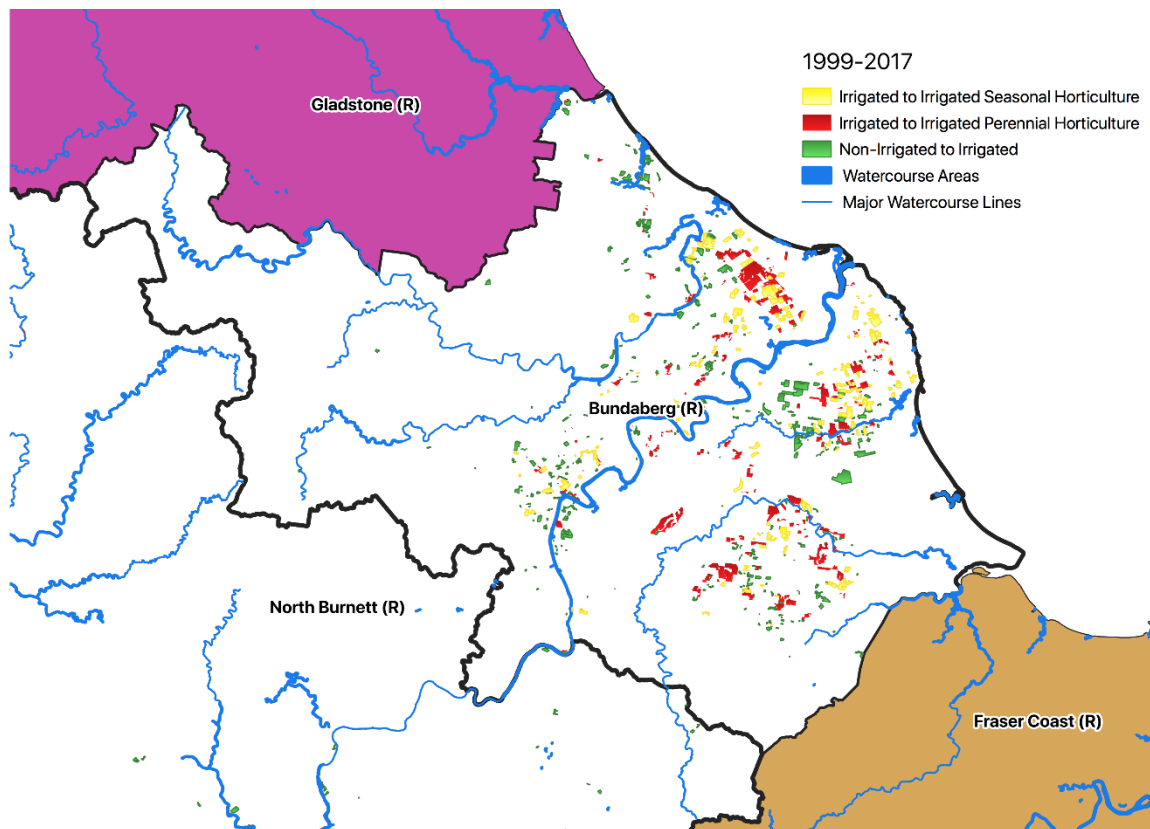
Water security is essential for the Bundaberg region. Regarding the Bundaberg Irrigation Scheme (BIS), Sunwater noted in 2018 that:

The original intent of the scheme was to supply water for irrigation of Sugar Cane as a supplement to rainfall. At least 50 per cent of customers have diversified into tree crops, or small crops. There is also pressure placed upon the scheme to deliver water on a 24/7 basis 365 days per year.¹

¹ Sunwater, 2018, *Asset Management Plan—Bundaberg Supply—Service Contract BBB: Financial Years 2019 to 2014*, p. 15.

This statement from Sunwater underlines the need for water security in the Bundaberg region. The diversification of irrigated agriculture, particularly into tree crops, a type of perennial horticulture, is evident in changes in land use over the last two decades in the Bundaberg region (Figure 1).

Figure 1. Changes in land use in Bundaberg region, 1999 to 2017



Source: Queensland Government Land Use Mapping Program data.

Economic opportunities in the Bundaberg region

The diversification into higher value tree crops is helping to increase the value of agricultural production in the Bundaberg region, which is being supported by increasing global demand associated with a growing global middle class. Opportunities for Bundaberg growers to export more to overseas markets are bolstered by Free Trade Agreements which have come into effect in recent years, particularly agreements with China, Japan, and South Korea.²

² IBISWorld, 2019, *Citrus Fruit, Nut and Other Fruit Growing in Australia*, Industry Report AO139, p. 15.

IBISWorld reported that Australian export revenues in the Citrus, Fruit, Nut and Other Fruit Growing industry “is expected to grow at an annualised 14.6% over the five years through 2019-20.”³

The *Invest in Bundaberg 2020* prospectus identified four future growth industries, three of which are closely related to agriculture:

- Ag tech;
- Bioproducts;
- Defence; and
- Advanced food.⁴

Bundaberg Regional Council is supporting the development of an Ag tech sector in Bundaberg through its planned transformation of a former administration building in Bargara, a beachside suburb, into a “Regional Hub for Agtech prototyping and field testing”, known as the Hinkler Agtech Initiative.⁵ It is planned that the Initiative will be managed by CQUniversity Institute of Future Farming Systems.

The economic foundation provided by agriculture has allowed for the development of a thriving food and beverage manufacturing industry, crowning Bundaberg as Australia’s largest food producing region and the food and beverage production capital of the nation, including the \$156 million construction of a new “Super Brewery” by Bundaberg Brewed Drinks commencing this year. The *Invest in Bundaberg 2020* prospectus has identified a pipeline of \$4.2 billion of projects (exceeding \$2 million in size), estimated to support 3,200 jobs.⁶

As is the case for other areas in the Wide Bay Burnett region, agriculture provides an important economic foundation. In its *Regional Water Strategy June 2018 Advocacy Document*, WBBROC notes:

*The Wide Bay Burnett is Queensland’s leading irrigation region and statistics show that the economic utility of water in the WBB is around \$32 million per gigalitre [i.e. around \$32,000 per ML] consumed.*⁷

³ Ibid.

⁴ Ibid., p. 13.

⁵ Bundaberg Regional Council, 2019b, *Hinkler Agtech Initiative: A Regional Hub for Prototyping and Field Testing*.

⁶ Ibid, p. 4.

⁷ WBBROC, 2018, *Regional Water Strategy June 2018 Advocacy Document*.

To the extent that agriculture underpins Bundaberg's economy, inaction on Paradise Dam can jeopardise not only future investment in agriculture, but future investment in other sectors as well.

Views from stakeholders in the Bundaberg region

To inform the economic analysis, Adept Economics and QEAS undertook extensive community consultation within the Bundaberg region with irrigators, supply chain businesses, community groups, and the Council.

Adverse economic impacts on irrigators and broader economy

Feedback from consultation sessions indicated that Paradise Dam was a critical issue for growers in the Bundaberg Region. In general, the Paradise Dam has provided for reliability and in turn water security that has created grower certainty that has underpinned confidence to invest and employ.

According to the views of stakeholders, the potential of Bundaberg irrigated agriculture is enormous, serving as one of Australia's major food bowls. Conversely the permanent loss of capacity of the Paradise Dam was described as a potential "economy killer" given that it is hugely important for Bundaberg growers. Irrigated agriculture in the Bundaberg North Burnett region has been described as now under threat due to loss of reliability and security and in turn certainty and confidence.

There will be an impact on the whole of the irrigated agriculture value chain including nurseries, sugar mills, transport operators, packaging providers, ports, planting and harvesting contractors, fuel distributors, fertiliser and chemical retailers, farm machinery retailers, irrigation equipment suppliers, and accountants and insurance brokers.

Furthermore, if these businesses are impacted their employees will be, too, leading to a reduction in expenditure across the broader community as they will no longer be spending their wages.

Culinary agriculture and agriculture education are also expected to be negatively impacted as a result of a loss in Paradise Dam's storage capacity. Bundaberg Tourism emphasised the foundation that agriculture is providing to Bundaberg's visitor experience.

A reduction in the supply of water has led to the price of water across the BIS to rise with further rises anticipated, possibly causing it to become too expensive to acquire, pushing it out of the price range of smaller growers.

Why Paradise Dam water was not originally purchased

Consultation indicated that the Government held a view that the water from Paradise Dam had not sold in the quantity originally modelled and accordingly it was not valued by growers. Growers indicated there were several key reasons why only 24,000ML of 124,000ML of Medium Priority water allocations and 2,850ML of 20,000ML of High Priority water allocations are currently committed to customers including:

- a) It is poor planning by Government if a piece of infrastructure such as a Dam, with at least a 50 year asset life, assigns 100% of its allocation within the first 15 years of its construction;
- b) Water security provided by the dam has encouraged the transition to higher revenue tree crops such as macadamias. These trees are still in their infancy and the majority are currently too young for production, requiring less water. As these trees mature an increase in demand is anticipated;
- c) Of the 12 years since the construction of the Paradise Dam, eight years have had above average rainfall and four below average rainfall including the wettest year on record (2010);
- d) Timeframes were quite short and EOI's were required to be lodged within 28 days which was insufficient to secure finance or free up capital to purchase;
- e) Sugar prices have been suppressed which acts as a disincentive to plant more cane crop;
- f) Water sourced from Paradise Dam had additional charges associated with it and accordingly a premium attached to it, whereas water from elsewhere in the scheme is cheaper for growers. The view commonly held is that Paradise Dam water will eventually sell but it will sell last;
- g) Growers knew it was there for future use providing a benefit through reliability, security and certainty;
- h) When purchasing a permanent nominal allocation, there is no guarantee that the full nominal entitlement will be announced through the Medium Priority allocation process whereas with temporary transfer the grower receives 100% of the water; and
- i) The Scheme design was also referenced with limited peak water volume available in the Woongarra section of the distribution system.

Growers have indicated if the sale process were to occur again then there would be greater take up and several have indicated that they would be prepared to buy allocations as a means of offsetting the expense of the dam rebuild.

Stakeholder feedback indicated that in any case the Paradise Dam had acted as an economic development mechanism providing for new industries to come to the region on the knowledge of the water they could inevitably call upon.

What the Queensland Government should do

The overwhelming feedback indicated the requirement for the Government to either rectify the current dam wall or rebuild it. The challenge, however, is that the cost has to be paid by the Queensland Government, but the benefit accrues to the Bundaberg community.

Stakeholders indicated there is an underlying need to drought-proof the country, yet we are decommissioning a drought-proofing piece of infrastructure. All stakeholders interviewed believed the government's long-term economic benefit will outweigh the short-term financial cost.

Survey results

As part of the preparation of the report a survey was commissioned to canvas both irrigated business and non-irrigated business views on the importance of the Paradise Dam. This survey received nearly 300 responses, reflecting a high level of community concern regarding the potential lowering of Paradise Dam. Key survey findings included the following.

- Nine in ten growers (91.9%) indicated that the Paradise Dam was extremely important to their business and three in four non-irrigated businesses (76.9%) also indicated that it was extremely important to their business. In short growers indicated no water, no crop, no income and that it is the security that Paradise Dam provides is its greatest advantage. Non-irrigated businesses referenced that their turnover is intrinsically linked to grower activity.
- Three in every four growers (75.8%) and three in every five (62.8%) non-irrigated businesses have made investments contingent upon the availability of water from the Paradise Dam. Over \$510 million of investments made since the Paradise Dam became operational were identified as part of the survey on land, buildings, equipment and additional hectares of crops planted. Thirty-three growers identified

investments greater than \$1 million and ten growers identified investments greater than \$10 million.

- The majority of irrigated businesses anticipated either a high impact on their turnover (35%), employment (34.5%) and investment (23.3%) or severe impact on their turnover (46.3%), employment (38.7%) and investment (58.3%) if the Paradise Dam is not restored to its original capacity. The impact for non-irrigated businesses was less, but still profound indicating a prevalence of mutual dependence between the broader business community and irrigated agriculture.
- Virtually all irrigated businesses (99.2%) held the view that Paradise Dam's water resource is extremely important for the Bundaberg Community. This sentiment is also held by non-irrigated businesses (88.5%).
- Significant forward investments were highlighted relating to the ongoing expansion of tree crops together with other projects associated with the Isis Central Mill.
- Only one in ten growers (11.3%) indicated they would be able to mitigate the impact of a permanent reduction in water storage capacity of Paradise Dam.
- As a result of all of the above, virtually all growers (99.2%) and 86.5% of non-irrigated businesses indicated it was extremely important to restore Paradise Dam's capacity.
- In respect to what the Government should do, the overwhelming feedback indicated the need to either rectify the existing Paradise Dam wall or build a new dam as a priority.

Estimated costs of inaction on Paradise Dam

For this project, Adept Economics constructed an economic model for Bundaberg regional irrigated agriculture. Given the large amount of uncertainty around the impacts of inaction on Paradise Dam, and the uncertainty that already exists in agriculture due to the vagaries of the weather, it was considered important to acknowledge this uncertainty by running Monte Carlo simulations to generate confidence intervals for the estimates.

Using Adept Economics' regional economic model, **an estimated potential cost of inaction on Paradise Dam has been estimated in the order of \$2.4 billion in present value (PV) terms over the next thirty years (2020-21 to 2049-50)**, relative to the counterfactual in which Paradise Dam is assumed to be maintained in its originally intended capacity (Table 1). This is the cost to the Queensland community of a permanent lowering of Paradise Dam by up to 10m.

Table 1. PV of estimated total costs of inaction on Paradise Dam over 30 years, excluding short-run impacts

Cost item	\$ million @4% real discount rate	\$ million @7% real discount rate
Gross margin forgone due to lower investment and irrigated agricultural production	2,769.3	1,632.9
CAPEX reduction	-861.0	-570.7
Lower productivity across economy as a result of lower regional investment	378.0	288.1
Social costs (i.e. long-term unemployment, mental health, alcohol abuse, family violence)	142.8	102.5
Offsetting environmental benefit from reduced dissolved nitrogen and sediment	-2.7	-1.6
Total	2,426.3	1,451.2

Source: Adept Economics estimates, 2020.

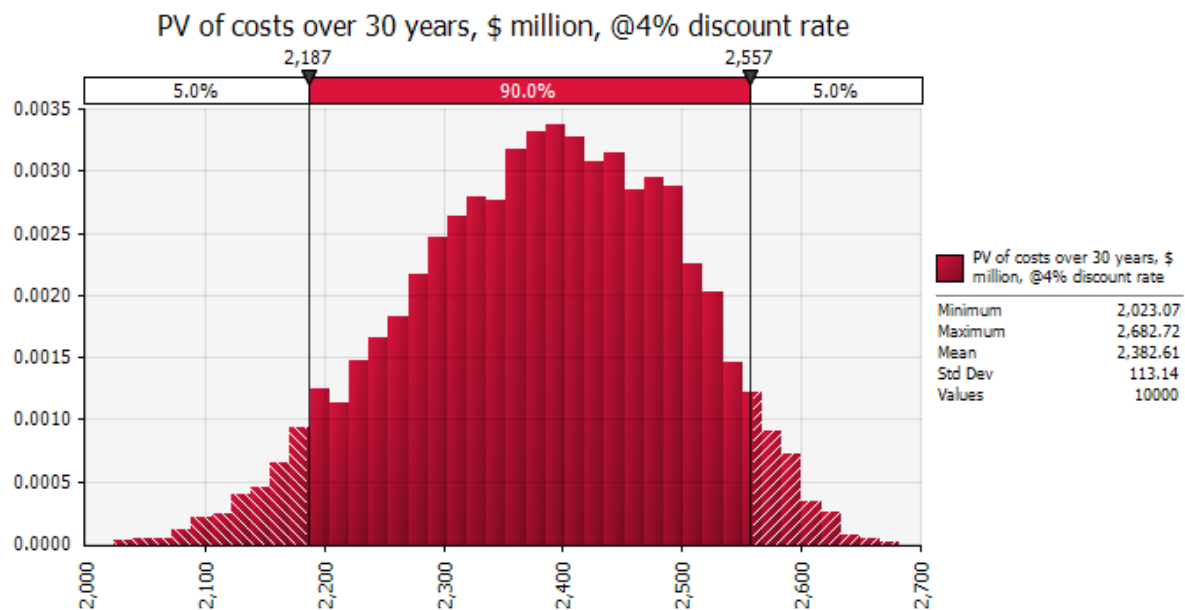
This economic cost estimate would need to be compared with the estimated cost of repairing Paradise Dam, or of undertaking alternative measures which guarantee the same degree of water security. The full cost estimate suggests a value of each ML of capacity slated to be lost in Paradise Dam of \$13,900/ML to \$14,000/ML. In terms of the total value of production lost, that amounts to a much larger number of \$48,100/ML, as approximately \$8.4 billion of production could be lost over the thirty years to 2050 if there is inaction on Paradise Dam.⁸

The Monte Carlo simulations demonstrate a wide range of potential outcomes, with a potential economic cost over 30 years of over \$2.5 billion (Figure 2). The 90% confidence

⁸ All the figures quoted in the paragraph are calculated using a 4% real discount rate.

interval for the economic cost runs from \$2.187 billion to \$2.557 billion, using a 4% real discount rate.

Figure 2. PV of total cost of Paradise Dam inaction, probability density function, @RISK Monte Carlo simulation



Source: Adept Economics estimates using the @RISK add-in to Excel.

It should be noted we have focussed on impacts in the Bundaberg LGA region. Based on consultations with WBBROC, Paradise Dam has the potential to facilitate development in the neighbouring North Burnett LGA, which would augment our estimate of the costs of inaction.

Conclusions

This study has revealed potentially considerable costs to the Bundaberg community of a permanent reduction in Paradise Dam's water storage capacity. There are also implications for the state economy, given Bundaberg's substantial contribution to Queensland's agricultural activity in total. In making its final decision on Paradise Dam, the Queensland Government should take full account of these economic and social costs. The Government is rightly concerned about the costs of any mitigation measures relating to Paradise Dam, but it should consider the full magnitude of the avoided costs which would result from such mitigation measures.

Finally, while difficult to quantify, the Queensland Government should note the negative signal sent to investors, both domestic and foreign, if governments unexpectedly reverse previous policy or infrastructure commitments. Previous Queensland Governments saw Paradise Dam as an essential part of the economic development of the Bundaberg region and State. Based on our stakeholder consultations and survey results, that view is widely shared in the Bundaberg community.

1. Introduction

1.1 Terms of reference

Bundaberg Regional Council, Wide Bay Burnett Regional Organisation of Councils, Regional Development Australia Wide Bay Burnett, Bundaberg CANEGROWERS, CANEGROWERS Isis, and Bundaberg Fruit and Vegetable Growers have commissioned Adept Economics, assisted by QEAS, to investigate the economic costs of inaction on Paradise Dam by the Queensland Government. The Paradise Dam is in the Bundaberg region and was opened in 2005 with a capacity of 300,000 megalitres (ML) of water.

In September 2019, Sunwater started releasing water from Paradise Dam to address what it considered were safety concerns. The height of the dam wall will be reduced and the dam's capacity will be substantially cut (see Box 1).

Box 1. Excerpt from media release of Minister for Natural Resources, Mines and Energy, 24 September 2019

Paradise Dam has a full supply volume of about 300,000 megalitres of water. It is currently at 75 per cent capacity holding about 215,000 ML. Of that, about 20 per cent is used by irrigators, miners and the town of Bundaberg.

A total of 105,000 megalitres will be released over 10 weeks to reduce the dam to 42 per cent of capacity. Of that about a quarter will be stored downstream in the Ned Churchward Weir and Ben Anderson Barrage. The remaining amount (about 80,000 megalitres) will be available free over the 10-week release period.

Sunwater will call tenders by November for construction works to lower the spillway by five metres. These works are expected to take until the end of 2021 and will create about 80 jobs.

Source: <http://statements.qld.gov.au/Statement/2019/9/24/dam-level-reduced-ahead-of-summer>

There is a large amount of concern in the Bundaberg community regarding the potential economic and social impacts on the region and the rest of Queensland. Building Queensland, the state government's independent infrastructure adviser, was tasked with investigating water supply options considering the Paradise Dam issue and was requested to report back by February.

1.2 Scope of the study

1.2.1 Study region

Given the study was commissioned by Bundaberg Regional Council, Canegrowers Bundaberg, and BFVG, the region we are primarily analysing is the Bundaberg Local Government Area (LGA). That said, we also consider the implications for the rest of Queensland, which is important because the ultimate decision on Paradise Dam will be made by Sunwater, a Queensland Government-owned corporation, which owns the dam (via its ownership of Burnett Water). Paradise Dam is potentially of great importance to the Bundaberg region, given it is highly specialised in agriculture, and has many hectares of irrigated agriculture (Figure 3).

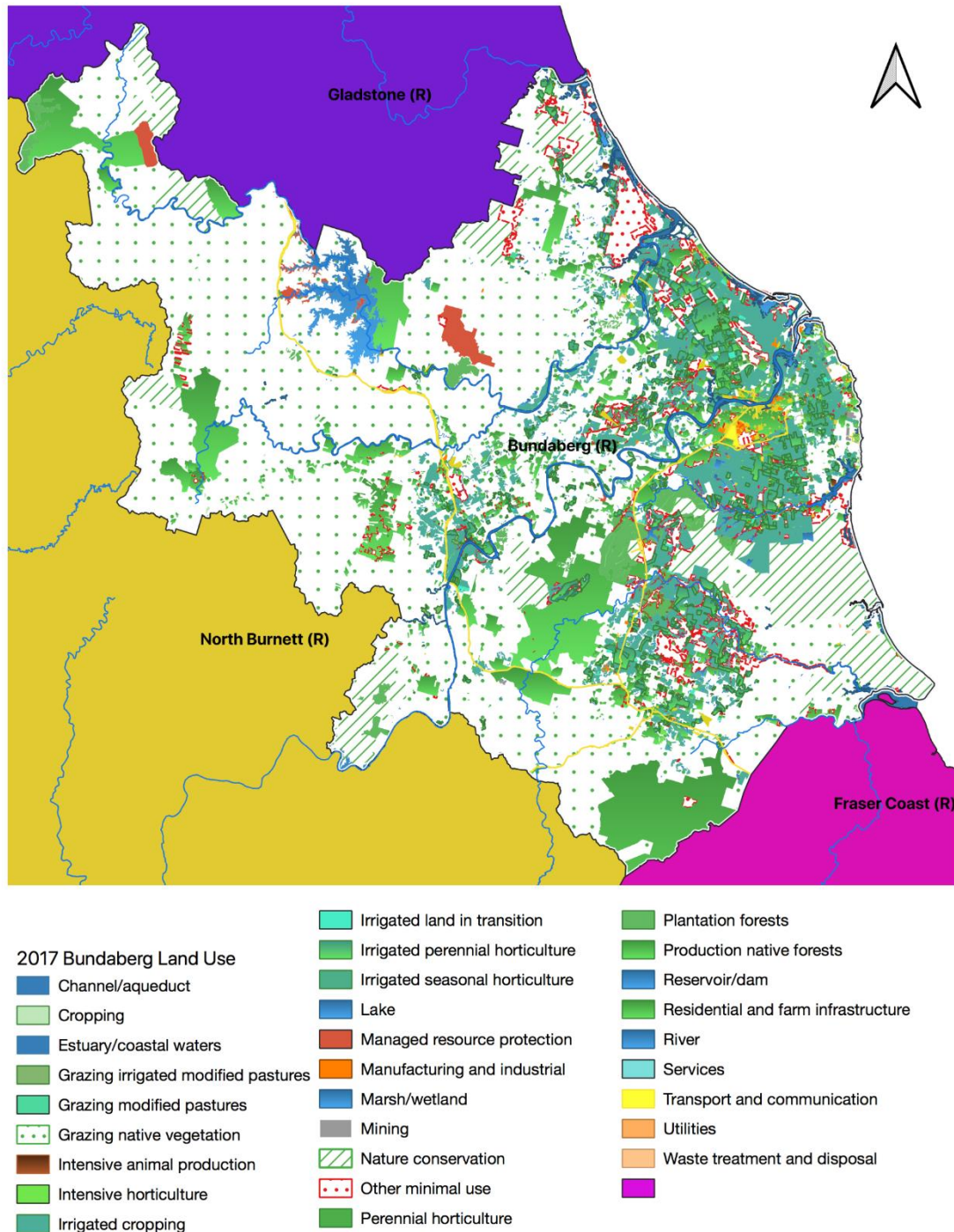
1.2.2 Limitations of the study

The report contains cost of inaction estimates, but it is not a comprehensive cost-benefit analysis (CBA). This is not possible, as we do not have estimates of the costs of different options regarding Paradise Dam. Following the release of Building Queensland's analysis, expected in February, it may be possible to undertake such a CBA, but at this time it is not possible.

The estimates presented in this study are scenario-based and driven by the assumptions made. While the scenarios and assumptions have been informed by desktop research and extensive stakeholder consultations, the uncertainty regarding Sunwater's ultimate decision and potential economic and social impacts needs to be acknowledged.

Furthermore, we have not undertaken any hydrological modelling to inform the scenarios developed and the economic analysis. The economic impact of inaction on Paradise Dam will depend in large part on future climatic conditions and what they mean for the availability of water in the Bundaberg region. Obviously, there is a large amount of uncertainty surrounding climatic conditions and water availability.

Figure 3. Study region with land use by category



Source: Queensland Government geospatial database.

1.3 Structure of the report

The report is structured as follows:

- **Section 2 Background** contains crucial information relevant to this study, including original Queensland Government expectations regarding the economic value of Paradise Dam and agricultural and broader economic trends in the Bundaberg region;
- **Section 3 Literature review** summarises our review of the relevant literature on benefits and costs of dams and dam raisings;
- **Section 4 Stakeholder consultation** contains our summary of extensive stakeholder consultations and a survey of Bundaberg region irrigators and businesses regarding Paradise Dam's water resource;
- **Section 5 Survey results** presents our analysis of responses to our survey of Bundaberg businesses on the importance of Paradise Dam's water resource;
- **Section 6 Estimates of the full cost of inaction on Paradise Dam** presents our economic modelling results; and
- **Section 7 Conclusions** concludes the study and includes recommendations for additional analysis that would be desirable.

2. Background

2.1 Paradise Dam

Paradise Dam was constructed in the early 2000s, but the idea of an additional major water storage in the Bundaberg region has dated back to at least the 1960s. The potential of the region for irrigated agriculture has been recognised by successive Queensland Governments, and hence construction of Paradise Dam was eventually approved following an Environmental Impact Statement and an assessment by the Coordinator-General (CG) of the project in 2002. The CG emphasised the potential economic benefits of Paradise Dam, then referred to as the Burnett River Dam, as discussed in the next sub-section.

2.1.1 Coordinator-General's Report on the Environmental Impact Statement for the proposed Burnett River Dam

The CG Report on the Environmental Impact Statement for the Burnett River Dam was prepared in accordance with s. 35 of the SDPWO Act and Part 5 of the SDPWO Regulation to evaluate the impact assessment documentation. The report drew on information enclosed in the draft EIS, supplementary reports, comments from key Government agencies and submissions received throughout the drafting process.

The CG identified many key determining factors regarding the operation of a Burnett River dam. Of particular importance in the report was the potential economic and social impacts, and impacts on aquatic and terrestrial flora and fauna.

In terms of potential economic impacts, the CG viewed the expansion in the region's agricultural industry as beneficial to direct and indirect job creation, referencing an estimated 10,000 new jobs in the Burnett region.⁹ The CG acknowledged that the projected market expansion that allowed for such employment growth was unproven, but believed that "water infrastructure development will encourage investors in the region to examine and invest in additional opportunities".¹⁰ Overall, the CG was satisfied with the economic modelling and concurs with the positive outcomes utilised in the 2001 *Indicative Economic Impacts of Additional Water Storage Infrastructure in the Burnett Region* report.

⁹ CG, 2002, p. 8. The relevant economic study of the proposal was NECG, 2001, *Indicative economic impacts of additional water storage infrastructure in the Burnett Region*, report prepared for Burnett Water.

¹⁰ p. 8

The CG considered concerns relating to construction and inundation, but the dam's projected benefits realised through employment, and population and economic independence decidedly outweighed these potential downsides.¹¹ Indeed, the net benefits of the dam were estimated at between \$1.7 billion and \$2.9 billion, in large part due to an increase of over \$1 billion in agricultural production.¹²

2.1.2 Queensland Government expectations regarding Paradise Dam

The Queensland Government at that time was very positive about the potential economic impacts of the Paradise Dam, initially known as the 'Burnett River Dam'.¹³ Following the Australian Government's final environmental approval of the project, then Queensland Minister for State Development Tom Barton tabled a statement in the Queensland Parliament on 20 February 2002 noting:

...the approval will open the way for substantial economic development for the region...

...The Federal Government approval of the Burnett River Dam provides the environmental clearances for the development of four water storages for the region. It has been estimated these water storages will open the way for net benefits of the region in the order of \$1.7 billion to \$2.9 billion producing 900 full-time jobs during the construction phase of all the proposed projects. Consultants have estimated the region will benefit significantly with further employment opportunities as a result of the new infrastructure including 7500 jobs in agricultural production...

...The reasons why the Government wants this project to proceed are obvious—increasing available water supply and improving the reliability of water will provide the platform for growth and development of value-added services and products. In simple terms, Mr Speaker, it will bring and retain jobs in the Bundaberg region.¹⁴

The project team notes that if the current Queensland Government is now arguing that Paradise Dam at its full capacity is not essential to achieving the originally stated objectives, it should reconcile this view with those previously held by the State Government of the day in

¹¹ p. 52-54

¹² p. 56.

¹³ Paradise was the name of a ghost town on the site of the dam.

¹⁴ *Ministerial Statement: Minister for State Development, Tom Barton, February, 2002*, tabled in the Queensland Legislative Assembly on 20 February 2002, no. 2141.

2002. The two viewpoints in the project team's opinion are too disparate and warrant some reconciliation.

2.1.3 The role of Paradise Dam in supporting water security in the Bundaberg region

Paradise Dam is one of six storages which are components of the Bundaberg Irrigation Scheme. The major water storage in the region is the Fred Haigh Dam (Table 2).

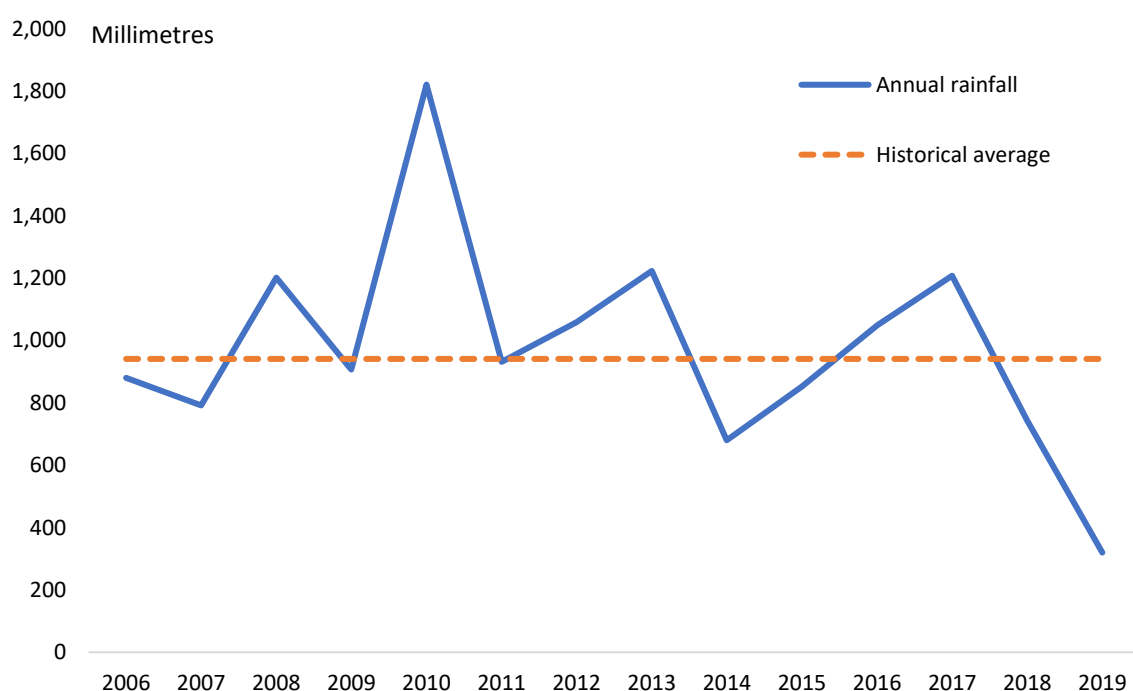
Table 2. Bundaberg water supply facilities

Facility	Function	Capacity (ML)
Fred Haigh Dam	Supplies Kolan Barrage and Gin Gin Main Channel	562,000
Paradise Dam	Supplies Burnett River	300,000*
Bucca Weir	Regulates flow and supplies riparian landholders	11,600
Ned Churchward Weir	Stores water for release into Ben Anderson Barrage and riparian landholders	29,500
Ben Anderson Barrage	Supplies Wongarra and Isis systems	30,300
Kolan Barrage	Supplies Abbotsford and Gooburrum systems	3,810

*Source: Sunwater, 2018, p. 7. * originally intended capacity of Paradise Dam.*

Paradise Dam was designed to provide supplementary water, to act as an insurance policy for times of drought and water shortages. The volatility of rainfall from year-to-year (Figure 4) means that such an insurance policy can be highly valuable and provide comfort to growers, allowing them to plan and invest.

Figure 4. Annual Rainfall at Bundaberg Airport Station, 2006-2019



Source: Australian Bureau of Meteorology website.

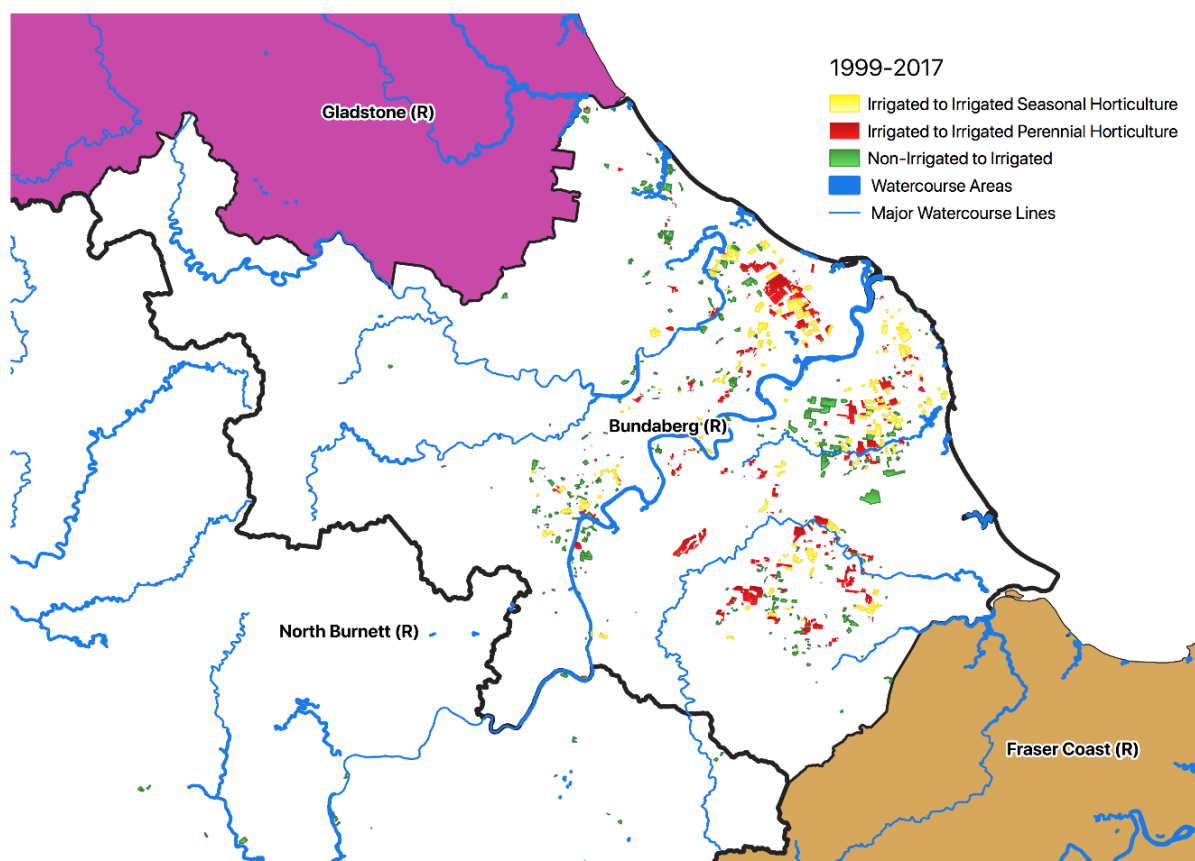
Water security is essential for the Bundaberg region. Regarding the Bundaberg Irrigation Scheme (BIS), Sunwater noted in 2018 that:

The original intent of the scheme was to supply water for irrigation of Sugar Cane as a supplement to rainfall. At least 50 per cent of customers have diversified into tree crops, or small crops. There is also pressure placed upon the scheme to deliver water on a 24/7 basis 365 days per year.¹⁵

¹⁵ Sunwater, 2018, *Asset Management Plan—Bundaberg Supply—Service Contract BBB: Financial Years 2019 to 2014*, p. 15.

This statement from Sunwater underlines the need for water security in the Bundaberg region. The diversification of irrigated agriculture, particularly into tree crops, a type of perennial horticulture, is evident in changes in land use over the last two decades in the Bundaberg region (Figure 5). Those areas in Figure 5 shaded as red and green particularly south of the Burnett River indicate the enabling function and activation resulting from the Paradise Dam.

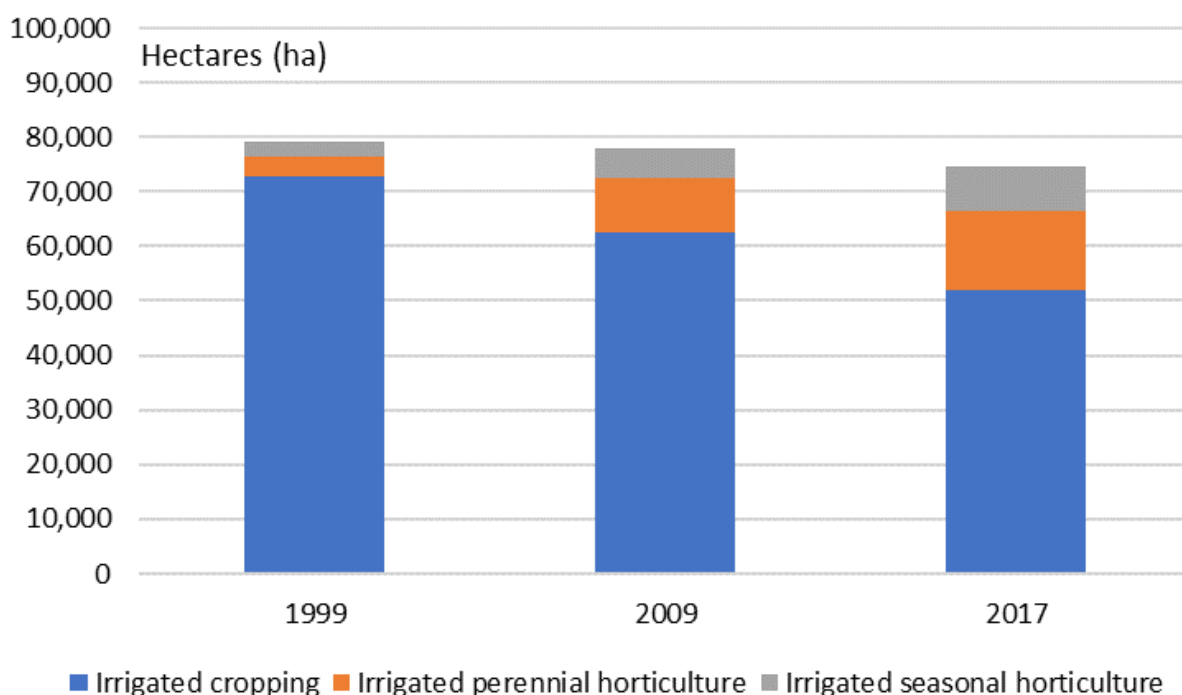
Figure 5. Changes in land use in Bundaberg region, 1999 to 2017



Source: Queensland Government Land Use Mapping Program data.

It appears that while the amount of land under irrigation has appeared relatively stable, there has been a large switch away from land being used for irrigated cropping (i.e. sugar cane) and towards the use of land for irrigated perennial horticulture and irrigated seasonal horticulture, which is providing a higher gross margin (i.e. revenue less variable costs, and excluding fixed costs and depreciation) per ML of water than sugar cane (Figure 6).

Figure 6. Land used for irrigation by Secondary Australian Land Use and Management category, Bundaberg LGA



Source: Adept Economics analysis of Queensland Government geospatial data.

To illustrate, the average gross margin for sugar cane since 2005 of \$1,200/ha (based Bundaberg CANEGROWERS estimates) compares with a reported average gross margin for 2017 and 2018 of \$6,900/ha for mature macadamia farms as reported in the Queensland Government *Macadamia Industry Benchmark Report*.¹⁶

Avocados may be even more profitable, with a 2018 report from New Zealand providing an estimated profit of approximately \$44,800 AUD/ha for mature trees, with the breakeven point reached after five years.¹⁷ Estimates of the gross margin per ha of irrigated crops such as sweet potatoes and tomatoes have been made in the order of \$2,000/ha to \$3000/ha.¹⁸

While different crops have different risk profiles, and moving into new crops typically requires new capital investments, it is obvious that such large differences in gross margins are

¹⁶ Queensland Government, 2019, *Macadamia Industry Benchmark Report*, p. 22.

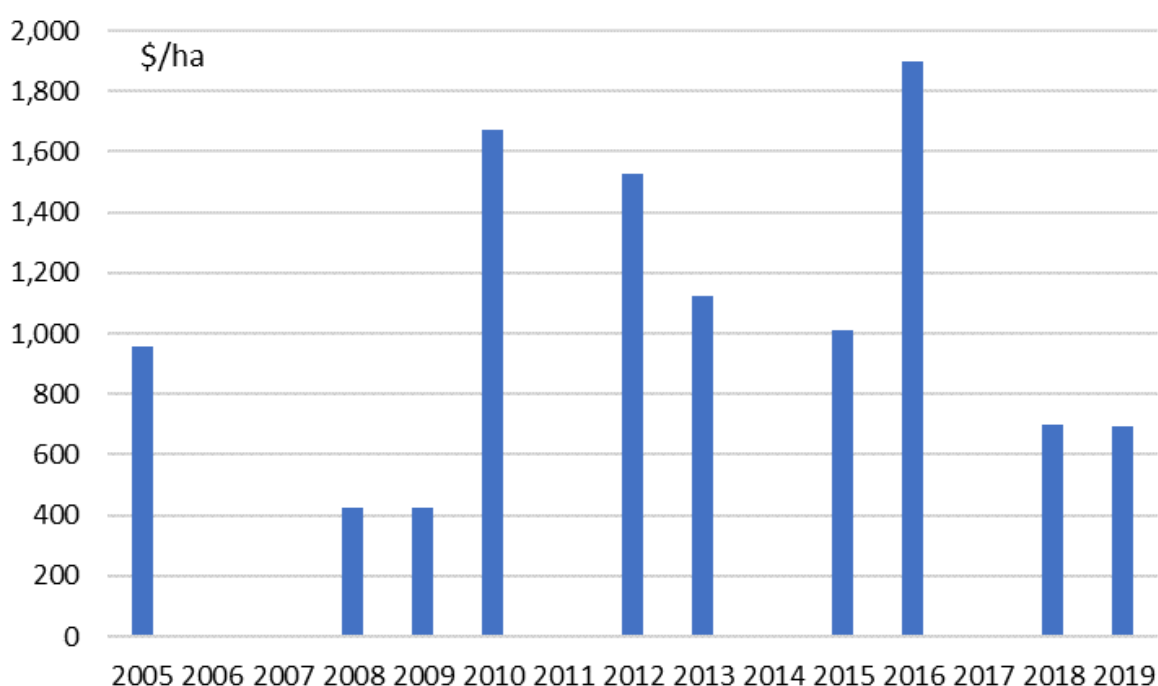
¹⁷ Howard, R., 2018, *Avocado economics stack up*, agrihq.co.nz, 7 March 2020

¹⁸ Based on gross margins analysis presented in various spreadsheets from agricultural departments available online.

prompting a switch, and new investment in the cultivation of more profitable crops, as has occurred in the Bundaberg region.

Incidentally, the gross margin for sugar cane is highly volatile from year-to-year (Figure 7), largely as a result of volatility in the global sugar price and to some extent in weather conditions which influence the sugar content of cane.

Figure 7. Gross margin for ratoon sugar cane, representative cane farm in Bundaberg region



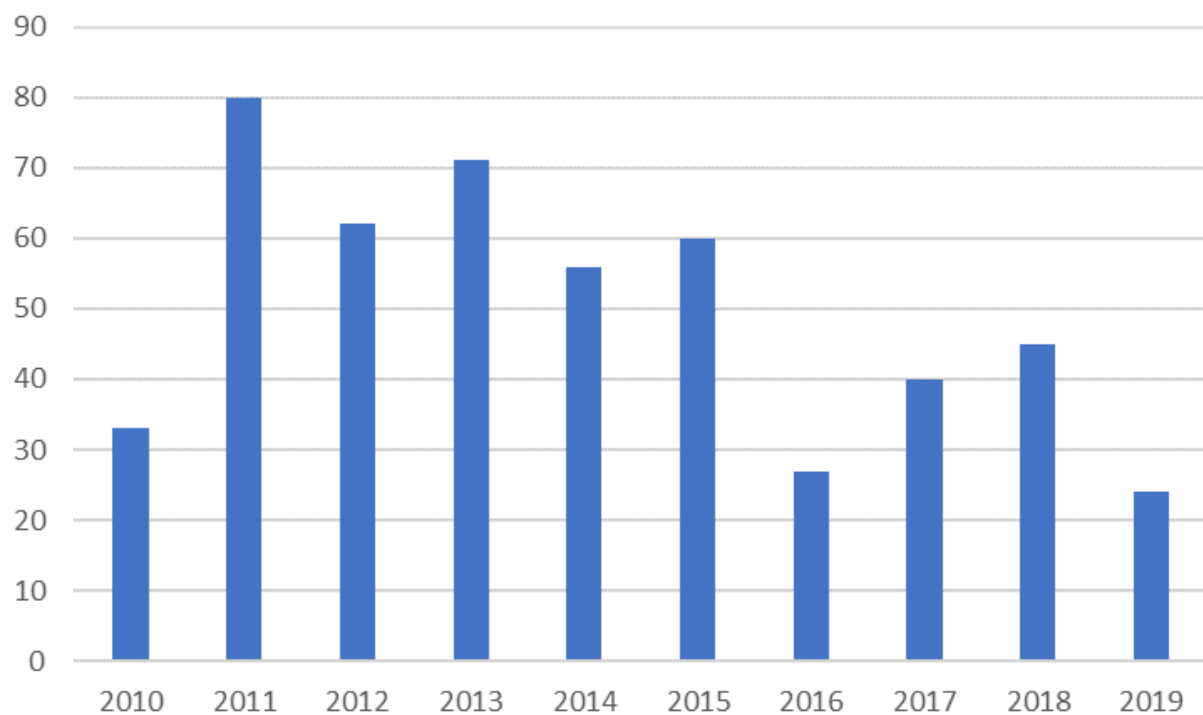
Source: Bundaberg CANEGROWERS gross margin analysis. Note: gross margin estimates are unavailable for 2006, 2007, 2011, 2014, and 2017.

Further evidence of the large amount of investment occurring in the Bundaberg LGA over the last decade as a result of the water security provided by Paradise Dam can be found in farm related development approvals. Bundaberg Regional Council records revealed 498 development approvals relating to farm sheds over the ten years of 2010 to 2019. Activity was particularly high in the first half of last decade (Figure 8).

While 2019 approvals were lower than approvals in 2018, the Bundaberg Regional Council believes this is mostly related to the prevailing drought rather than any uncertainty relating to

the Paradise Dam.¹⁹ Section 4 of this report discusses investment impacts that are considered will occur as a result of uncertainty relating to the Paradise Dam.

Figure 8. Farm-shed-related development approvals by Bundaberg Regional Council



Source: Bundaberg Regional Council, 2020.

Recent customer entitlements for Bundaberg Supply and Bundaberg Distribution customers are set out in Table 3. In 2018-19, approximately 154,000 ML of water was delivered to BIS irrigators, amounting to 77% of their entitlements and 65% of water available for irrigation.

¹⁹ Bundaberg LGA has been drought-declared since 1 May 2019 and is one of 41 LGAs fully drought declared, according to the Queensland Government (<https://www.longpaddock.qld.gov.au/drought/drought-declarations/>)

Table 3. Customer Water Entitlements and Deliveries, Bundaberg Irrigation Scheme, 2018-19

Customer segment	Water entitlements (ML)	Available water (ML)	Water Deliveries (ML)	Water deliveries / entitlements (%)
Industrial	386	862	177	45.9
Irrigation	199,310	235,987	153,991	77.3
Urban	9,571	9,571	4,522	47.2
Other	46	46	22	47.8
Sunwater	171,016	139,724	30,991	18.1
Total	380,329	386,189	189,703	49.9

Source: Sunwater 2018-19 Annual Report, p. 92.

The bulk of water entitlements are for Medium Priority (MP) water, which comprises 88% of water entitlements. Irrigations predominantly rely on MP water. This means they are vulnerable to weather conditions, as unless 100 % of High Priority (HP) nominal water entitlements can be met there cannot be any announced MP.

Table 4. Water entitlements by priority, Bundaberg Irrigation Scheme, 2018-19

Customer segment	High Priority (ML)	Medium Priority (ML)	Total water entitlements (ML)
Irrigation	1,260	198,050	199,310
Urban	9,208	313	9,521
Industrial	103	283	386
Sunwater	33,801	137,265	171,066
Other	17,671	111,801	129,472
Total	44,372	335,957	380,329

Source: Sunwater Network Service Plans for Bundaberg Bulk Water Service Contract and Bundaberg Distribution Service Contract.

The 380,329 ML water entitlements in Table 4 comprise 181,224 ML of entitlements to bulk water from water storages including Paradise Dam and 199,105 ML of entitlements to water from the distribution system only. Regarding Paradise Dam specifically, in a statement last year after the announcement regarding the dam safety concern, Sunwater noted:

In total, there is 144,000ML yield allocations from the dam made up of 124,000ML of Medium Priority water allocations, of which only approximately 24,000ML is currently committed to customers, and 20,000ML of High Priority water allocations with 2,850ML sold to date.²⁰

²⁰ Sunwater, 2019, *Paradise Dam Improvement Project Overview Report*, p. 3.

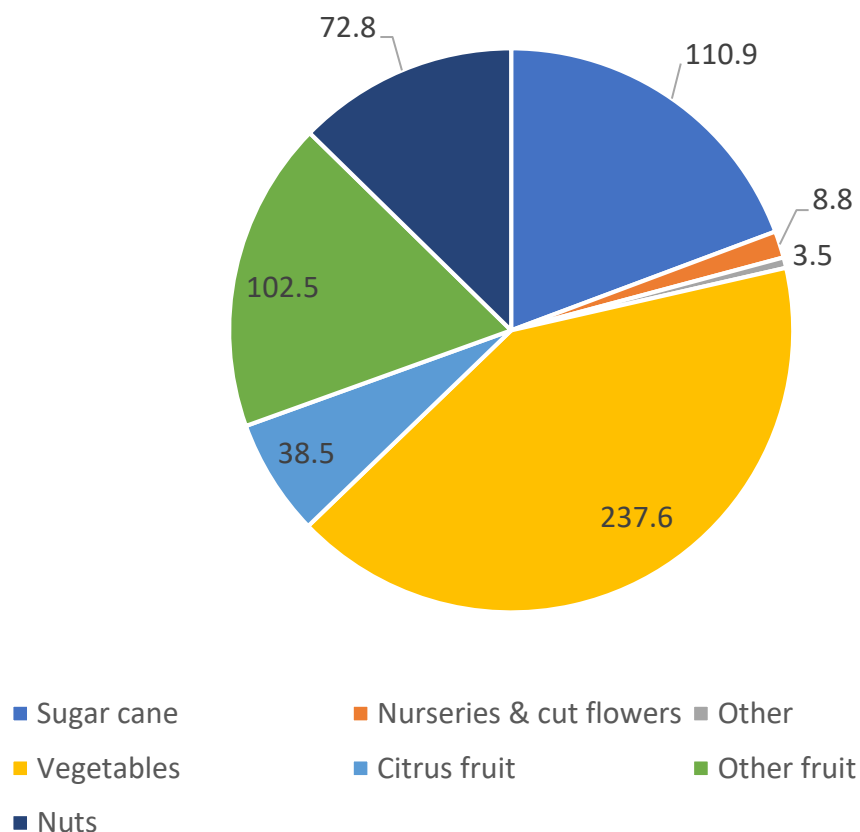
Stakeholder consultations have revealed that although take-up of the water appears low, there are good reasons why that is the case, as discussed in section 4.

2.2 Agricultural employment and production in the region

In 2015-16, agricultural production in the Bundaberg LGA was \$613.4 million.²¹ Of this the bulk of production worth \$575 million was accounted for by crops of some kind (i.e. excluding wool, eggs, milk, and livestock slaughterings). Vegetables accounted for the largest share, followed by the other broadacre crops category, the vast bulk of which was sugar cane (Figure 9). Of the \$102 million of other fruit, avocados accounted for \$69 million. Of the \$72 million of nuts, macadamias accounted for \$69 million. There was much greater variation in the vegetables category, which included a mix of tomatoes, potatoes, sweet potatoes, and capsicum, among other vegetables.

²¹ Data quoted in this paragraph are sourced from *economy.id*, which uses ABS 2015-16 Agricultural Census data.

Figure 9. Agricultural production (excluding wool, eggs, milk, and livestock slaughterings), Bundaberg LGA, 2015-16, \$ million

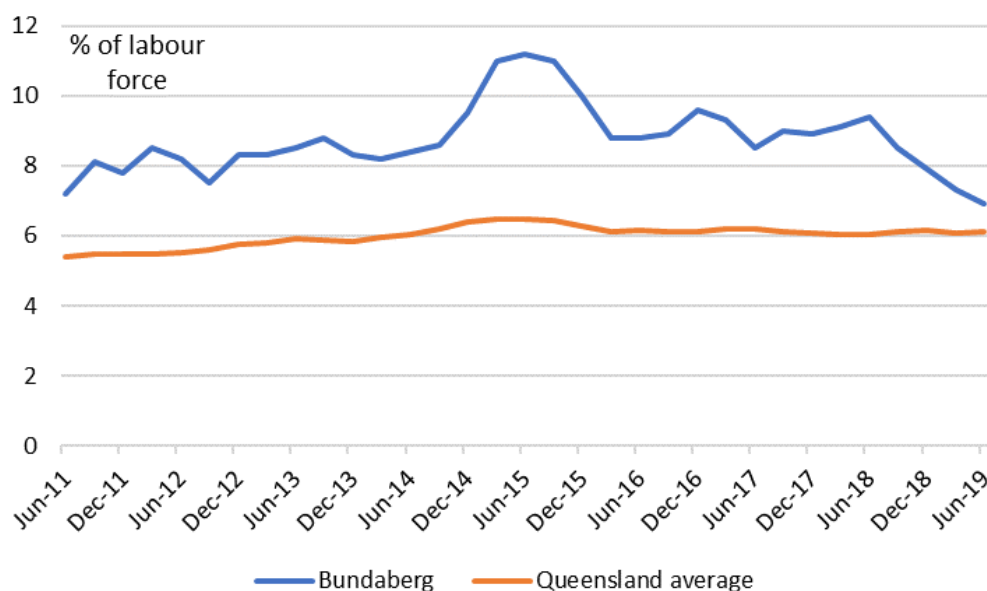


Source: *economy.id*, which uses ABS 2015-16 Agricultural Census data.

2.3 Broader economic performance of Bundaberg region

Similar to other regional Queensland economies, the Bundaberg regional economy has a higher unemployment rate than the state average (Figure 10). In the middle of the last decade, the unemployment rate reached a peak of over 11%, while the state unemployment rate peaked at only 6.5% during the slowdown at the end of the mining investment boom of the first part of the decade.

Figure 10. Unemployment rate, four-quarter moving averages, Bundaberg vs Queensland average



Source: Australian Government Department of Employment, Skills, Small and Family Business
Smoothed estimates for LGAs and Adept Economics calculations of Queensland average based on
ABS Labour Force Survey data.

Consultations with Bundaberg Regional Council and a local community services organisation revealed that Bundaberg's high unemployment rate in the past has left a legacy of long-term unemployed people who are heavily reliant on government support and community services. Consultations indicated that decision makers need to appreciate the impacts on unemployment, with all its economic and social costs, of a potential future decline in economic performance in Bundaberg associated with a shock to the irrigated agriculture sector.

There appears to be a systemic issue of high unemployment across the whole Wide Bay Burnett region. In December 2019, the region had an unemployment rate of 7.9% compared with a state average of 6.1%.²² In years past, it has had the highest unemployment rate in Queensland and has been in the top three nationwide.

²² Queensland Government Statistician's Office, 2019, *Regional labour force – region summary, December 2019*.

Associated with high unemployment is socio-economic disadvantage. Bundaberg and other Wide Bay Burnett regional councils have relatively high levels of socio-economic disadvantage compared with the rest of Queensland (Table 5). Over half the people living in Wide Bay as a whole, and nearly half of people in Bundaberg, are in the most disadvantaged quintile (fifth) of Queensland's population.

Table 5. Index of Relative Socio-Economic Disadvantage data, 2016

Area	Proportion of population in most disadvantaged quintile	Proportion of population in least disadvantaged quintile
Bundaberg	47.3%	2.3%
Cherbourg	100.0%	0.0%
Gympie	46.1%	0.0%
Fraser Coast	59.4%	0.0%
North Burnett	57.1%	0.0%
South Burnett	60.4%	1.5%
<i>Wide Bay SA4</i>	<i>54.1%</i>	<i>0.9%</i>
Queensland	20.0%	20.0%

Source: ABS, 2016, Census of Population and Housing.

2.4 Economic opportunities

Economic activity in Bundaberg is influenced largely by the region's unique strategic benefits, predominantly its geography. The region boasts the fifth most equable climate in

the world which, alongside the water security and reliable irrigation provided by the Burnett river, has produced one of Australia's largest agricultural food bowls. Further, the proximity to the coast has allowed the establishment and use of the Port of Bundaberg as well as bringing in significant tourism due to the nearby Great Barrier Reef, both notable boons to the economy.

Geography aside, Bundaberg's major economic infrastructure is a significant driver of economic performance. As well as the port, the region is home to an airport, three hospitals, and a university (CQUniversity). In addition to the obvious economic benefits of the infrastructure, its existence has assisted the development of a diverse industry base, reducing the risk that homogeneity brings to an economy.

Bundaberg's current economy has been shaped by its geography. Unsurprisingly, this has resulted in a strong agricultural foundation and tourism industry. Bundaberg's agriculture sector is supported by its historical reputation as having a high level of security. For instance, consider the *Invest in Bundaberg 2020 Prospectus*, which notes:

Bundaberg's agricultural industry is expanding each year. The region already produces over \$1 billion in agricultural output per annum, yet could produce more with investment in local farming systems.

While crops such as macadamias and avocados have driven growth in the region's agriculture sector in recent times, crops such as speciality nuts, medicinal cannabis and others are expected to deliver future waves of growth.

These crops, and others will take advantage of the region's perfect conditions for all year round growing and stable water supply.²³

The economic foundation provided by agriculture has allowed for the development of a thriving food and beverage manufacturing industry, which has enabled Bundaberg to become Australia's largest food producing region and the food and beverage production capital of the nation.

This is evidenced by examples including the \$156 million construction of a new "Super Brewery" by Bundaberg Brewed Drinks commencing this year. The brewery will "boast state of the art facilities for brewing and bottling, distribution, innovation labs, corporate offices and a major new tourism venture," and deliver 147 ongoing jobs on completion.

²³ Bundaberg Regional Council, 2019a, *Invest in Bundaberg 2020: Australia's best kept secret*, p. 12.

Furthermore, the *Invest in Bundaberg 2020* prospectus has identified a pipeline of \$4.2 billion of projects (exceeding \$2 million in size), estimated to support 3,200 jobs.²⁴

Healthcare, another of Bundaberg's major industries, is to receive significant investment in the coming years, with all three hospitals planning major expansions. The Friendly Society Hospital is currently getting new cardiac facilities for a cost of \$26 million, while the Queensland Government plans to replace the Bundaberg Base Hospital with a new hospital by 2027 – expected to be valued between \$500 million and \$1.5 billion.

The *Invest in Bundaberg 2020* prospectus identified four future growth industries, three of which are closely related to agriculture:

- Ag tech;
- Bioproducts;
- Defence; and
- Advanced food.²⁵

Bundaberg Regional Council is supporting the development of an Ag tech sector in Bundaberg through its planned transformation of a former administration building in Bargara, a beachside suburb, into a “Regional Hub for Agtech prototyping and field testing”, known as the Hinkler Agtech Initiative.²⁶ It is planned that the Initiative will be managed by CQUniversity Institute of Future Farming Systems. The Initiative is part of the Council's *Invest in Bundaberg 2020* vision. For instance, *Bundaberg Now* has reported:

Mayor Jack Dempsey said the concept complements the Bundaberg Region's status as the premier food producing district in Australia.

“Ag tech has the ability to drive innovation and productivity across our farming sector by mixing like-minded entrepreneurs, innovators and researchers in one co-located facility,” he said.²⁷

Ultimately, it needs to be borne in mind that agriculture, at around 10% of the regional economy in terms of employment, is foundational for the local economy, and the health of the agricultural sector is dependent on water security. This has been recognised by Regional

²⁴ Ibid, p. 4.

²⁵ Ibid., p. 13.

²⁶ Bundaberg Regional Council, 2019b, *Hinkler Agtech Initiative: A Regional Hub for Prototyping and Field Testing*.

²⁷ Gorey, M., 2020, “Ag tech vision revealed for Bargara site”, *Bundaberg Now*, 17 January 2020.

Development Australia (RDA) Wide Bay Burnett, which in its *Regional Roadmap 2016-2019* observed:

*It is imperative that reliable and secure water is available in order to have vital growth of food production in the region and is just as important for industrial use. The Federal government's policy objective is to double agriculture production and the Queensland government has a strong objective to generate jobs, particularly in regional areas where agriculture production is often the dominant sector.*²⁸

The Queensland Government should recognise the importance given to water security in regional areas by local councils and the federal government.

2.5 Global trends in demand and supply for agricultural commodities

An extensive literature search was undertaken on global trends in demand, supply and trade; mainly of official government sources from Queensland, Australia and overseas. The key themes are presented below. Generally, global demand for agricultural commodities is being propelled by ongoing population growth and the growing global middle class. Supply will increase too due to greater cultivation and productivity improvements and should limit price increases to 10% in real terms over 2007 levels, according to ABARES estimates discussed below.²⁹

2.5.1 Queensland DAF medium-term forecasts

According to Queensland's Department of Agriculture and Fisheries (DAF), Queensland agriculture is forecast for 2020-25: to grow by 32% above \$200m for avocados, 17% above \$126m for macadamias and 1% above \$61m for sweet potatoes; but to decline by 19% below \$1259m for sugar.³⁰ Incidentally, the DAF *AgTrends 2019-20* reports highlights the importance of Bundaberg as one the predominant locations for growing high-value macadamias and avocados in Queensland.³¹

²⁸ RDA Wide Bay Burnett, 2016, *Regional Roadmap 2016-2019*, p. 29.

²⁹ Linehan, V., et al., 2013, *Global food production and prices to 2050: Scenario analysis under policy assumptions*, Australian Bureau of Agricultural and Resource Economics and Sciences.

³⁰ Queensland DAF, 2019, *Queensland AgTrends 2019-20: Forecasts and trends in Queensland agricultural, fisheries and forestry production*.

³¹ Ibid., p. 39.

2.5.2 ABARES long-term projections

In ABARES central scenario, the key projections for 2007 to 2050 are as follows:

- global agrifood demand rises 75% over the period, with prices rising 11.5% overall;
- agrifood production rises over the period by 92% in China and 84% in Asia overall;
- global agrifood consumption rise is accounted for by 46% China and 72% Asia;
- global agrifood consumption rise is 44% accounted for by fruit and vegetables;
- global agrifood trade rises 149%, mostly meat, fruit and veg with China and Asia; and
- global agrifood productivity growth of 1% per annum, with Australian fruit and vegetables at 0.7% per annum.³²

Incidentally, the ABARES study observes:

*Projected increases in Australian agricultural production and exports reflect the commodities where Australia has a comparative advantage. Australia needs to remain competitive to meet the opportunities provided by higher global agrifood demand. Land and water constraints are inherent in Australian agriculture. If Australia is to remain responsive to changes in world agrifood markets and provide those foods most in demand in expanding markets, it will have to maintain productivity growth through ongoing investment in research and development.*³³

Measures such as Bundaberg's Hinkler Agtech Initiative are aligned with need for ongoing investment in R&D. ABARES is right to highlight the significance of "water constraints", and any reduction in water security can jeopardise the ability of Australian farmers to seize the opportunities provided by global food demand.

2.5.3 OECD-FAO international medium-term forecasts

In 2019, OECD-FAO jointly published their latest forecast report *Agricultural Outlook 2019-2028*.³⁴

Regarding agricultural commodities consumption for 2019 to 2028:

- demand is driven by population, income, prices, preferences, cultures and policies;
- demand will increase between 1.2% per annum and 1.9% per annum, including 1.8% per annum for sugar;

³² Linehan, 2013.

³³ Ibid., p. 2.

³⁴ OECD/FAO, 2019, *OECD-FAO Agricultural Outlook 2019-2028*, OECD Publishing, Paris/Food and Agriculture Organization of the United Nations, Rome.

- demand for higher-value crops (e.g. sugar) will grow faster than that for lower-value staples.

Regarding agricultural commodities production for 2019 to 2028:

- land and water are major inputs, but production have outpaced both population and land use since the 1960s, due to greater innovations and yields;
- growth will be greatest in China, Latin America, India and Africa; and
- sugar will expand by 13%, much more so in India than in Brazil.

But this global growth is forecast for 2019-28 to include 1-2% per annum declining prices for most agricultural commodities; medium-value sweet potatoes and sugar driven by population growth in Africa; and high-value avocados and macadamias driven by income growth in Asia.

2.5.4 Implications for Bundaberg

Two key implications for the Bundaberg area from these global trends as determined by Adept Economics are:

1. There are large economic benefits on offer for sweet potato, avocado, macadamia and sugar that may be forgone due to higher costs and reduced supply if the current “Paradise Dam Inquiry” results in a 5m reduction in the dam spillway;
2. The case for the other major action being explored in this Inquiry, i.e. alternative water supply options for irrigators, are not only bolstered by these agricultural trends, but also by the Commonwealth Government’s willingness to fund new, and upgrades to, state and local dams as demonstrated in the 2015 *Agricultural Competitiveness White Paper*.³⁵ Sound Cost Benefit Analysis should address these two implications.

In addition there are opportunities for Bundaberg growers to export more to overseas markets, bolstered by Free Trade Agreements which have come into effect in recent years, particularly agreements with China, Japan, and South Korea.³⁶ IBISWorld reported that Australian export revenues in the Citrus, Fruit, Nut and Other Fruit Growing industry “is expected to grow at an annualised 14.6% over the five years through 2019-20.”³⁷

³⁵ Australian Government, 2015, *Agricultural Competitiveness White Paper: Stronger Farmers Stronger Economy*.

³⁶ IBISWorld, 2019, *Citrus Fruit, Nut and Other Fruit Growing in Australia*, Industry Report AO139, p. 15.

³⁷ Ibid.

3. Literature review

3.1 Economics of water infrastructure

Water Infrastructure

Water infrastructure includes all constructed systems, such as dams, levees, reservoirs and associated irrigation canals and water supply networks, that contribute toward economic, social and environmental activities. The benefits of efficient water infrastructure are extensive and distributed across many sectors of society. For example, the Stockholm International Water Institute (SIWI) recognise a number of beneficiaries from advanced water infrastructure including consumers, and agricultural and industrial sectors. There is broad consensus about the positive and negative impacts incurred by large water infrastructure schemes that can be seen in Table 6 below.

Table 6: Positive and negative impacts of large water infrastructure

Positive impacts	Negative impacts
Biodiversity and ecosystem services: water infrastructure can be designed to preserve biodiversity and provide environmental benefits. For example, Myalup-Wellington Water Project. ³⁸	Relocation of population directly affect by infrastructure.
Recreational and touristic use; for example, the Canal de Provence in France	Effects on communities' socio-economic status and their livelihoods: for instance, the impact on fisheries downstream of a dam.
Flood control: by effectively managing reservoir and dam levels, flood damage can be prevented.	Public health impacts
Health benefits, such as access to a sanitized water supply.	Cultural heritage loss.
Productivity benefits, such as electricity services and agricultural growth.	Reduction in biodiversity.
Water reliability.	Trapping of sediments.
Reduction in carbon emissions: through the use of hydropower and reduction in transport times	Ambient environmental quality may be negatively affected.

³⁸ Infrastructure Australia (2017) *Project Evaluation Summary: Myalup-Wellington Water Project*. Australian Government, Australia.

In the past, water infrastructure has been undervalued due to misunderstandings about overall societal benefits and environmental impacts. According to an expert workshop convened by the United Nations on water economics and financing in 1998:

*The economics of water resources rarely influence water policy, even in water-short regions. As a result, the principal asset of the water resource base remains highly undervalued and readily used without much concern for its value to others, the structural role of water in the economy and its situ value as an environmental asset.*³⁹

After pushes from international organisations such as the World Health Organisation (WHO), Organisation for Economic Co-operation and Development (OECD) and the United Nations (UN), water infrastructure is now being viewed with greater appreciation.⁴⁰

Growth in water scarcity, water-borne diseases and water sanitation issues around the world have also played a role in promoting the development of sustainable and reliable water services. As these issues are less prevalent in advanced economies, water infrastructure is seen to be particularly beneficial for developing economies.

Having said this, advanced economies are still heavily reliant upon efficient water infrastructure. In 2015 the American Society of Civil Engineers released a report that projected a \$4 trillion loss in America's GDP due to water infrastructure deficiencies, and that an investment of \$4.8 trillion would be required over the next twenty years to maintain a state of good repair.⁴¹

Dam raisings

A total of nine dam wall raising proposals have been identified in Australia in the past 10 years, seven of which are documented in Table 7. Due to information availability and project similarity with the Paradise Dam proposal, case studies of the Wyangala and Burdekin Dams were be conducted by Adept Economics.

³⁹ Extracts of Proceedings of the Expert Group Meeting for the United Nations Commission for Sustainable Development 6 (Harare: 1998), published in UNDESA.

⁴⁰ <http://www.oecd.org/water/reports-full-list.htm>, <https://www.unwater.org/unwater-publications/#>, https://www.who.int/water_sanitation_health/publications/en/

⁴¹ <https://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf>, monetary figures in US 2015 dollars.

Table 7. Review of Dam Wall Raisings

Dam Name	Project Initiation Date	Dam Type	Project Stage
Warragamba Dam	May 2017, NSW Government Hawkesbury-Nepean Valley Flood Risk Management Strategy.	Urban – primary reservoir for water supply of Sydney	Project feasibility/ business case complete
Wyangala dam	2014, NSW Government State Infrastructure Strategy Review.	Non-urban – flood mitigation, hydro-power, irrigation, water supply	\$32 million economic and environmental impact study
Burdekin Falls Dam	Most recently, 2017 Falls Dam raising: feasibility study by Lee Benson for the Department of State Development, Manufacturing, Infrastructure and Planning.	Urban and non-urban usage – agricultural hubs, industry, and urban demand in Townsville.	September 2019, QLD Government approved a Detailed Business Case for the Burdekin Falls Dam Improvement Project. Complete Strategic Business Case, assisted by Building Queensland, currently in the pipeline.
Wivenhoe Dam	March 2014, Wivenhoe and Somerset Dams Optimisation Study by Queensland Flood Commission.	Predominantly urban supply of potable water for the Brisbane and Ipswich regions.	November 2019, \$1 million feasibility study to investigate water supply options made available.
Clarrie Hall Dam	December 2015, Tweed Council approved planning phase for raising dam wall.	Urban – primary function is to store drinking water for the Tweed.	July 2019, finalizing Environmental Impact Statement for raising the Clarrie Hall Dam wall.
Toonumbar Dam	2005, Submission to IPART Review on Bulk Water Prices 2005 by Toonumbar Water Users Association	Non-urban – agricultural production – and potential urban – town water supply for Rous Water or Richmond Valley Council.	December 2019, Kyogle Council call on NSW Government and WaterNSW to commit to raising wall.
Storm King Dam	2016, Queensland Government Stanthorpe Regional Water Supply Security Assessment.	Integral for Stanthorpe's urban and non-urban water supply.	November 2019, engagement of GHD and the Synergies Group to finalise approvals and business case.

Wyangala Dam

Wyangala Dam lies on the meeting point of the Lachlan and Abercrombie rivers about 320 kilometres west of Sydney. The dam has a storage capacity of 1,217,000 ML and is currently 11.3% filled.

The Dam was originally built to regulate variable flows from the Lachlan River in the early 1900s and was later developed into the state's second major irrigation dam in 1928. The Wyangala Dam supports large areas of pasture, Lucerne, cereals, oilseeds and legumes, as well as smaller areas of cotton and wine.

The original Dam featured a 58.8 metres high wall, a surface area of 25.2 square kilometres and stored 374,860 ML. The dam has since undergone a series of improvements. In 1971, a spillway capable of withstanding severe floods was built, the wall was raised 23.5 metres, the storage capacity was almost quadrupled, and various reinforcements were installed. In 2009, further upgrades were implemented in order to meet modern dam safety standards.⁴²

Concern for flood mitigation is a recurring theme in every Wyangala Dam wall improvement. The Minister for Primary Industries and Regional Water, Niall Blair, emphasised the dual challenge of drought security and flood management in a media statement in 2018,

*[Raising the dam wall] will increase the capacity to hold water in periods of surplus and deliver controlled release when water is needed. Crucially, it provides increased capability to manage flood events.*⁴³

The most recent economic and environmental study (2018) investigated two proposals: a new dam near Cranky Rock on the Belubula River and raising the Wyangala Dam by 10 metres. Ultimately, raising the dam wall was considered the superior option.

Burdekin Dam

Extensive studies in the 1970s found that the continuing economic development of the Burdekin Basin, and its powerful sugar industry, was dependent on additional water supply. In response to these studies, the Burdekin Falls Dam was finished in 1987 at a cost of \$125 million.

The Dam harnesses the Burdekin River and water outlets from the surrounding mountainside on Lake Dalrymple and is currently sitting at 63.11%. It covers nearly 7% of

⁴² <https://buildingqueensland.qld.gov.au/projects/burdekin-dam-raising/>

⁴³ <https://www.nswnationals.org.au/raising-dam-wall-considered-by-nationals-in-government/>

the state with a storage capacity of 18,600,000 megalitres, making it the largest water storage asset in Queensland. Today, the Burdekin Dam is the primary source of water for agricultural and industrial sectors for much of Townsville and greater Central Queensland.

In 2017, Sunwater invested \$5.36 million to upgrade foundation drainage to reduce up-lift pressure and improve water supply efficiency. On 3 September 2019, Premier Annastacia Palaszczuk announced that the publicly owned Sunwater would initiate a \$16 million detailed business case into raising the Burdekin dam wall. The Premier explained that the project:

[I]s not only boosting the Townsville region's water security [but] it's part of our Powering North Queensland Plan... to create 200 jobs during construction and generate enough electricity to power 30 000 homes.⁴⁴

The proposed two metre wall raising would increase capacity by 590,000 ML and support another 10,000 hectares of production. Mining activities in the Bowen and Galilee basins, agricultural production, industry usage and future urban demand in Townsville are the key drivers of need in the current business case.⁴⁵

Paradise Dam

Mainstream Economics and Policy undertook a similar exercise for Paradise dam estimating it had a benefit-cost ratio of 0.40.⁴⁶ Again, the assumptions are not fully documented, and it appears to assume a very high externality cost, and one much higher than suggested by another report co-authored by Mainstream Economics and Policy for the Australian Government Department of Environment and Heritage Protection.⁴⁷ This will be explored further in developing the assumptions for the economic analysis in Section 5.

3.2 Water availability and agricultural production

There is a clear link between water availability (and water reliability/security) and agricultural production.

⁴⁴ <http://statements.qld.gov.au/Statement/2019/9/3/government-drives-multimillion-dollar-water-infrastructure-for-ng>

⁴⁵ <https://buildingqueensland.qld.gov.au/projects/burdekin-dam-raising/>

⁴⁶ Ibid, p. 5.

⁴⁷ Alluvium et al., 2016, *Costs of achieving the water quality targets for the Great Barrier Reef*, report prepared for the Australian Government Department of Environment and Heritage Protection.

In its *Wide Bay Burnett Water for Economic Development Scoping Study*, Marsden Jacob Associates (MJA) observed:

*The region is witnessing an increasing demand for higher reliability water supply, arising predominantly from substantial growth in perennial tree crops and increasing intensification of high-value crops. This is supporting economic development, but it is also adversely affecting some established industries, such as sugarcane production.*⁴⁸

MJA's qualification is that having more reliable water supports the growth of perennial tree crops which are of higher value per ML of water applied than sugarcane, and hence there has been a shift in crop type from sugarcane to perennial tree crops such as macadamias.

According to pricing data and economic theory, water is more valuable when it is more reliable. Eminent US economist Arnold Harberger has noted:

*...dam water is more valuable than river water. This is because the dam managers have some degree of control over when the stored water will be delivered to the farms. Obviously they will try to time their deliveries so as to come as close as they can to giving farmers water at the times they want it most.*⁴⁹

3.3 Implications of literature review for the study

The literature demonstrates that investments in dams can yield substantial economic and social benefits, but dams need to be evaluated on a case-by-case basis. A range of economic, environmental, and social impacts need to be considered in a comprehensive CBA.

⁴⁸ Marsden Jacob Associates, 2018, *Wide Bay Burnett—Water for Economic Development Strategy*, prepared for the Queensland Department of State Development, Manufacturing, Infrastructure and Planning.

⁴⁹ Harberger, A., 2009, *Introduction to cost-benefit analysis Part V: Applications to irrigation projects*, p. 12.

4. Stakeholder consultations

4.1 Consultation strategy

As part of this study a detailed consultation process was commissioned to talk to local businesses and other stakeholders about the importance of the Paradise Dam. A detailed survey was commissioned and run over the period 14 January – 31 January 2020 with 283 responses. The questions asked as part of the survey are provided in appendix A.

In addition, the project team held detailed one-on-one interviews in Bundaberg on Wednesday 15th January, Thursday 16th January and Friday 17th January 2020 to meet with parts of the irrigated agriculture value-chain, both upstream and downstream. In total, 22 organisations or individuals were consulted as part of the project (see Appendix B). This section provides a summary of the consultation that was conducted together with background research conducted to supplement this feedback, and to gain a greater understanding of the issues raised. Sections 5 provides the results from the survey.

4.2 Position of Commissioning Organisations

4.2.1 Bundaberg Regional Council

Bundaberg has a secure and reliable irrigated water supply, plus an average rainfall of 1,110mm per annum. The Bundaberg Irrigation Scheme (BIS) covers over 57,500 ha in the Bundaberg, Childers and Gin Gin areas. Accordingly, local growers enjoy a sustainable competitive advantage over nearly all other areas of Australia's food bowl.

Public safety is of paramount importance to the Council. However, the Paradise Dam was built to drought-proof the Bundaberg Region and to provide confidence in future investment. Water security is vital for the Bundaberg Region's prosperity, growth, economic development and investment attraction.

In the Council's view, the Queensland Government should promise to rebuild the dam to its original capacity or greater. The Government must guarantee they will do whatever it takes to reinstate the water that's been lost from Paradise Dam and to ensure long-term water security in the Bundaberg Region.

4.2.2 CANEGROWERS Isis, Bundaberg CANEGROWERS, Bundaberg Fruit and Vegetable Growers

The agreed position of the organisations representing irrigators in the region is presented in Box 2.

Box 2. Joint Industry statement – 6 January 2020

As growers, irrigators and business owners we are very concerned about the safety of our community, we are also concerned with the long-term viability of our community, jobs for our community and investment in and development of our region.

It is our belief that options for remediation on Paradise Dam need to be explored further. Our region, your business and your family cannot afford for our dam's capacity to be reduced on the basis of testing not being comprehensive enough.

1. We do not want to see one Megalitre lost from the Bundaberg Irrigation Scheme
2. We will outline the major economic impacts to the region and co-fund this work
3. We will represent our members on the Paradise Dam Community Reference Group (PDCRG)

Agriculture plays such a critical role in our economy and as a region we need to understand exactly what it will mean if water security is not reinstated. It's not just about what we have now, it's the future opportunities that could be lost to the region due to a lack of water security. Few regions in Australia have a competitive edge like we do to generate agricultural produce, we should not let this edge go by allowing the dam's capacity to not be reinstated."

It is also accepted and understood that dam safety is the most important issue followed very closely by water security.

Source: Bundaberg CANEGROWERS Ltd, CANEGROWERS Isis, and Bundaberg Fruit and Vegetable Growers, 2019, Paradise Dam - Joint Statement Agricultural Peak Bodies, Bundaberg Region, 6 January 2019.

4.3 State of play

Stakeholder consultations indicated a predominantly positive future and as part of this future Bundaberg's \$4.3 billion economy is highly reliant on irrigated agriculture. In 2018-19 agriculture employed 3,095 residents (approximately 8.5% of all employed persons) and over \$1.1 billion in output providing \$442 million in industry value add which is approximately

12.6% of the local economy. Much of this economic importance is directly linked to the Paradise Dam.⁵⁰

The region is estimated to produce approximately 25% of Australia's produce, offering a tapestry of crops in addition to the region's renowned sugarcane production. Most recently the region surpassed other macadamia capitals to become Australia's largest macadamia growing region. Stakeholder consultations indicated a surge in investment in macadamia crops in recent years. At least 40 crops are grown in the Bundaberg-North Burnett region, including sugar cane, macadamias, avocados, sweet potatoes, and watermelons, among many others (Appendix 3).

While crops such as macadamias and avocados have recently driven growth in the region's agriculture sector, crops such as speciality nuts, medicinal cannabis and others are expected to deliver future waves of growth. These crops, and others will take advantage of the region's ideal conditions for all year round growing.

Stakeholders identified a range of strengths of the region that are relevant to irrigated agriculture and related industries, as well as opportunities flowing from those strengths (Table 8).

⁵⁰ <https://economy.id.com.au/bundaberg>

Table 8. Strengths and opportunities of Bundaberg’s irrigated agriculture

Strengths	Opportunities
Climate conducive to year-round food production	Strengthen connection with iconic flavours
Diversity of produce; 25% of Australia’s fresh produce	Develop distinctly Bundaberg North Burnett culinary brand i.e. can only be experienced here
Famous iconic brands	Develop culinary experiences (as opposed to produce lists)
Australia’s macadamia capital	Self-drive and packaged culinary trails
Red dirt, patchwork green fields,	Culinary experiences packaged with
Raw, real, authentic, relaxed, Australian	tourism operators and accommodation
Easy access from SEQ	Partnerships with wider industry bodies
Emerging food + café culture	(e.g. CANEGROWERS, BFVG)
Emerging food tours + farm gates	

Source: Stakeholder consultations and desktop review.

From its natural produce, the region is famous for iconic companies such as Bundaberg Rum and Bundaberg Brewed drinks.

Stakeholders indicated a spectrum of irrigated agriculture business health, ranging from those experiencing significant new investment, exporting overseas and adopting sustainable practices through to those experiencing considerable challenges relating to high electricity prices, commodity prices and climatic conditions.

More specifically, consultation indicated enormous potential with macadamia crops that are anticipated to triple over the next ten years. The recent and predicted scale of investment in macadamias as indicated by stakeholders is underpinned by the water security provided by the Paradise Dam. Value-chain businesses indicated that that they had experienced up to 90% growth in the past decade with approximately half of that attributed to water security. On the negative side, stakeholders indicated the drought was having a severe impact on many businesses with agricultural equipment supply businesses reporting up to a 25% reduction in turnover associated with it.

4.4 Importance of Bundaberg Irrigation Scheme and the Paradise Dam's water resource

4.4.1 For Growers

Feedback from consultation sessions indicated that Paradise Dam was a critical issue for growers in the Bundaberg Region. In general, the Paradise Dam has provided for reliability and in turn water security that has created grower certainty that has underpinned confidence to invest and employ.

The BIS has been referred to as the region's most important enabling piece of infrastructure that has activated significant output, employment and investment that has in turn supported social prosperity for the broader Bundaberg community. The BIS has been referred to as the largest sustainable competitive advantage that the region has.

A key advantage of the BIS is the reliability provided for producers to be able to time the application of water to their crop particularly for nut growing. As a result, the BIS directly and positively influences yield and quality of crops.

These aspects have been particularly important given the widespread and prevailing drought conditions that exists for much of Australia's food bowl. It is believed the BIS will become an even greater sustainable competitive advantage with the potential impact of climate change.

Irrigated agriculture value chain businesses indicated that they had experienced excellent growth in their business that in their view is inextricably linked to agriculture and in turn the water security provided by the BIS and Paradise Dam.

4.4.2 For the Bundaberg Community

Stakeholder consultation indicated very strong community support for agriculture and a perceived social licence to operate that is higher than for other industries and professions. Irrigated agriculture is generating wealth, driving economic growth and supporting jobs, wages and the livelihood of thousands of Bundaberg residents.

Stakeholder consultation indicated that irrigated agriculture had not only been critical in supporting local businesses, but the community had benefited as well due to employment and stimulus across the value chain.

Irrigated agriculture has a significant value-chain both upstream and downstream including nurseries, sugar mills, transport operators, packaging providers, ports, planting and harvesting contractors, fuel distributors, fertiliser and chemical retailers, farm machinery

retailers, irrigation equipment suppliers, and accountants and insurance brokers. As an example of this value chain - one dollar in economic activity in cane growing supports an additional \$6.40 elsewhere in the economy.⁵¹ Feedback indicated a vibrant and competitive irrigated agriculture sector is crucial to the prosperity and growth of Bundaberg.

Feedback indicated that the contribution is not only the economic importance of irrigated agriculture but also how it acts as a foundation for prosperity across the community. Irrigated agriculture has been a large part of many Bundaberg residents' lives and a major contributor to the city. Stakeholder consultation indicated that irrigated agriculture had been hugely important to the fabric of the area because of the history and tradition through considerable family linkages and generational linkages.

Water security and Paradise Dam helped underpin irrigated agriculture and was described as hugely important for the region and the community could not afford to lose this vital asset.

4.4.3 For Bundaberg Tourism

Bundaberg Tourism emphasised the foundation that agriculture is providing to Bundaberg's visitor experience. Through Bundaberg's culinary tourism visitors can experience "one of Australia's most productive, year-round food producing regions, from the rich red soils to the shores of the Southern Great Barrier Reef."⁵²

Bundaberg Tourism's *Culinary Tourism Strategy for Bundaberg North Burnett Tourism 2018-20* aims to link growers with resulting food and tourism, so-called "agritourism". The *Destination Tourism Plan 2019-2022* highlights recent investment and future investment's underpinned by irrigated agriculture including:

- 139 Room Ramada Airport Hotel \$25 million;
- Bundaberg Rum Redevelopment \$8.5 million;
- Bundaberg Brewed Drinks Barrel Visitors Centre \$2 million;
- Macadamias Australia Expansion Visitor Facility \$12 million; and
- Bundaberg Brewed Drinks Farm and Super Brewery \$156 million.

⁵¹ QEAS, 2019, *The economic contribution of the Sugarcane Industry to Queensland and its regional communities: A report analysing the economic importance of the sugarcane value chain to communities across Queensland*, prepared for CANEGROWERS.

⁵² <https://images.impartmedia.com/bundabergregion.org/A--PAGES/corporate/pdf/BNBT-Culinary-Tourism-Strategy-2018.pdf>

Feedback indicated that a thriving irrigated agriculture sector underpinned by water security from the Bundaberg Irrigation Area including Paradise Dam is vital for culinary agriculture and for the above to occur.

4.4.4 For Flood Mitigation

Feedback indicated that the Paradise Dam does serve some flood mitigation purpose, which meant that the ex-tropical cyclone Oswald flooding in 2013 was not as severe and did not last for not as long. This flood mitigation would have an economic value attached to it. That said, a GHD report for Bundaberg Council in 2014 suggests the flood mitigation value of Paradise Dam is low. GHD observed:

Reducing the full supply level (FSL) of Paradise Dam (i.e. lowering the water level below 100% prior to the wet season), or installing flood gates for controlled discharge of flood waters, would have negligible impact on a flood equivalent to the 2013 event. Sensitivity testing undertaken as part of the Burnett River Flood Study indicates that if Paradise Dam were completely empty prior to January 2013, the peak flow rate downstream would have been reduced by only 2% (a reduction in peak flood levels of approximately 0.15m relative to the Bundaberg gauge).⁵³

Hence, it may not be necessary to consider the potential for flood mitigation in the economic analysis.

4.5 Water allocations

4.5.1 Announced versus Nominal

Stakeholder feedback emphasised the importance of recognising the difference between 'nominal' allocations as opposed to 'announced' allocations. At the start of the 2019-20 water year, the announced allocation for Southside nominal entitlement holders/growers (defined as south of the Burnett River) was 71%. This has been revised up to 100% in February due to the routine water balance calculations used to determine announced allocation.⁵⁴

Growers indicated that on average over a 10-year period they rely on or require approximately 80% of their nominal allocation being 'announced'.

⁵³ GHD, 2014, *Burnett River Floodplain Action Plan Preliminary Options Assessment Report*, p. 35.

⁵⁴ Consultation session with CANEGROWERS Bundaberg held Wednesday 15 January 2020.

There exists substantial scepticism that the Government through Sunwater can honour all existing nominal allocations without considerable reduction in actual ‘announced’ allocations.

Accordingly, there is substantial concern that the announced allocations may be permanently lower for Southside growers. This is evidenced in recent prices paid for temporary water transfers. There is capacity for unused announced water allocations to be sold as a temporary transfer and based on stakeholder feedback recent prices have escalated considerably on concerns of a scarcity of water for Southside growers.

Fears were expressed that if the prevailing dry conditions were to continue coupled with a lack of water available from Paradise Dam for Southside growers then this would have a drastic impact on agricultural crops. That is, a reduction in Paradise Dam water coupled with average rainfalls would lead to serious reduction of yield and quality of crops. The combination of two would be disastrous, according to many stakeholders.

4.5.2 Paradise Dam’s latent demand

In addition, there is concern particularly from macadamia growers that there is minimal opportunity to reduce water application to the tree without jeopardising its long-term yield. This in effect creates a legacy of continued water application for the duration of the tree’s lifespan. Feedback indicates that as a result of this there exists a significant prospect of increased water demand as recently planted macadamia trees reach maturity (estimated at 12 years) when their water requirement is at its highest. There are concerns young trees may not get to optimal maturity and yield. This is important given the break-even period is five to seven years for growers. Stakeholders indicated that macadamias require approximately 11 to 14 ML per hectare with typically 4 ML sought from natural rain and the remainder sourced from irrigation.

4.5.3 Why Paradise Dam water was not originally purchased

Consultation indicated that the Government held a view that the water from Paradise Dam had not sold in the quantity originally modelled and accordingly it was not valued by growers. Growers indicated there were several key reasons why only 24,000ML of 124,000ML of Medium Priority water allocations and 2,850ML of 20,000ML of High Priority water allocations are currently committed to customers including:

- a) It is poor planning if a piece of infrastructure such as a Dam with at least a 50 year asset life (more likely 100 years) assigns 100% of its allocation within the first 5 years of its construction;

- b) Water security provided by the dam has encouraged the transition to higher revenue tree crops such as macadamias. These trees are still in their infancy and the majority are currently too young for production, thus requiring less water. As these trees mature an increase in demand is anticipated;
- c) Of the 12 years since the construction of the Paradise Dam, eight years have had above average rainfall and four below average rainfall including the wettest year on record (2010)⁵⁵ ;
- d) Timeframes were quite short and EOI's were required to be lodged within 28 days which was insufficient to secure finance or free up capital to purchase;
- e) Sugar prices have been suppressed which acts as a disincentive to plant more cane crop;
- f) Water sourced from Paradise Dam had additional charges associated with it and accordingly a premium attached to it, whereas water from elsewhere in the scheme is cheaper for growers. The view commonly held is that Paradise Dam water will eventually sell but it will sell last;
- g) Growers knew it was there for future use providing a benefit through reliability, security and certainty;
- h) When purchasing a permanent nominal allocation, there is no guarantee that the full nominal entitlement will be announced through the Medium Priority allocation process whereas with temporary transfer the grower receives 100% of the water; and
- i) The Scheme design was also referenced with limited peak water volume available in the Woongarra section of the distribution system.

Growers have indicated if the sale process were to occur again then there would be greater take up and several have indicated that they would be prepared to buy allocations as a means of offsetting the expense of the dam rebuild.

Stakeholder feedback indicated that in any case the Paradise Dam had acted as an economic development mechanism providing for new industries to come to the region on the knowledge of the water they could inevitably call upon.

⁵⁵http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=039174

4.5.4 Need for certainty

Growers indicated that over the past 10 years they have relied on approximately 80% on average announced allocation for the irrigation needs and this metric guides their future requirements. However, growers have expressed frustration over an absence of reliable information from Sunwater on what this is expected to become under the various options for the Paradise Dam going forward. Growers indicated they need to be informed of the full story in order to have certainty for investment decisions.

4.6 Paradise Dam as a driver of investment

Stakeholders indicated investment is paramount for the region and the reason why investment has occurred is because of water security and the price of water. Consultation indicated that the BIS and the Paradise Dam for Southside growers was the most important reason why growth in agricultural output has out led any other region in Australia (in particular for macadamia crops). The level and scale of investment that has occurred and is anticipated to occur is according to stakeholder consultations directly based on the reliability of the BIS.

Recent example investments cited as being linked to the water security provided by Paradise Dam in addition to those cited in Section 4.7.3 and 5.3 include:

- a) Investments that have occurred on the Southside of Bundaberg are particularly linked to the Paradise Dam. Feedback from the Australia Macadamia Society indicated approximately 80% of growers were established after the construction of the Paradise Dam, and over the next 10 years investment in processing handling and value add to macadamias products is anticipated to exceed \$1 billion. Greensill Farming, PSP Investments and Stahmann Farms were cited as examples of the large-scale investments coming to Bundaberg and occurring in primary production on the basis of water security. Another specific example cited was Bundaberg Macadamia Processing which received \$5.148M in Commonwealth funding to establish a macadamia cracking, value adding & tourism facility.⁵⁶

⁵⁶ <https://www.grants.gov.au/?event=public.GA.show&GAUUID=CE7AA3A7-095F-BC54-EAD06E890325826C>

- b) Orora Limited's recently opened 4,200 square metre corrugated packaging, cold storage, and transport purpose-built facility at Bundaberg, in partnership with AHG Refrigerated Logistics.

4.7 Potential economic impacts of Paradise Dam inaction

4.7.1 General economic impact

According to the views of stakeholders, the potential of Bundaberg irrigated agriculture is enormous, serving as one of Australia's major food bowls. Conversely the permanent loss of capacity of the Paradise Dam was described as a potential "economy killer" given that it is hugely important for Bundaberg growers. Irrigated agriculture in the Bundaberg North Burnett region has been described as now under threat due to the loss of reliability and security and in turn certainty and confidence.

4.7.2 Specific economic impacts

Economic impacts from permanently reducing Paradise Dam's water resource have been identified by stakeholders across a range of areas including the following.

Uncertainty that is reducing investment

Uncertainty is leading to capital expenditure being placed on hold until growers know what is going on. There is generally enough water this year but uncertainty over whether there will be enough in future years is undermining investment decisions. Water was described as 'certainty' and without it you can't grow, and accordingly the Paradise Dam has been a security blanket for the community and the region.

All industries have been described as being impacted but in particular the rapidly growing macadamia industry (and other tree crops including avocados and citrus) has stood out as being very vulnerable. There is a particular degree of exposure with macadamias. For many crops if the water is unavailable then the grower can decide not to plant, but growers cannot do that with macadamia trees. Feedback indicated that young macadamia trees will need significantly more water in future years. Due to uncertainty any plans for further planting are being reconsidered on the Southside until the Paradise Dam issues resolved. As an indication \$100,000 per hectare has been referenced to develop a macadamia ready orchard that could be jeopardised together with the approximately two to three jobs for every 50 hectares of macadamia crop. It is anticipated that the macadamia industry had anticipated in excess of \$1 billion of industry investment over the next decade.

Sugarcane growers are equally vulnerable as feedback indicated that the permanent loss of water capacity from the Scheme might impact on the financial viability of one of Bundaberg's three sugar mills. Cane growers are concerned as it may affect the financial viability of a Mill if they can't get enough cane. This would cascade an economic shock to many sugarcane farmers regardless of their exposure to a reduction in water resource from the Paradise Dam.

Grower and value chain workforce

Feedback indicated that some businesses were no longer replacing employees who have left through natural attrition because of the Paradise Dam uncertainty. This is of particular concern given the region's high unemployment rate.

Value chain

There will be an impact on the whole of the irrigated agriculture value chain including nurseries, sugar mills, transport operators; packaging providers, ports; planting and harvesting contractors; fuel distributors; fertiliser and chemical retailers; farm machinery retailers; irrigation equipment suppliers; and accountants and insurance brokers. Furthermore, if these businesses are impacted their employees will be too leading to a reduction in expenditure across the broader community as they will no longer be spending their wages. Value chain businesses indicated that they had not had transactions cancelled, but there were purchasing decisions that had been delayed as a result of the Paradise Dam uncertainty.

Agritourism and education

Culinary agriculture and agriculture education, based on consultation, is also expected to be negatively impacted as a result of a loss in Paradise Dam's storage capacity.

Rising water prices

With a reduction in the supply of water the price of water across the BIS has risen and will further rise possibly causing it to be too expensive to acquire pushing it out of the price range of smaller growers. Feedback indicated the significant increase in water prices is causing stress for farmers to be able purchase water that are in turn clamouring for allocations of water. Consultation indicated that temporary water trades have risen as a result of Paradise Dam uncertainty. This rise is from between \$30 – \$40 per megalitre to \$250 – \$400 per megalitre and permanent water entitlements were now selling at \$1,900 to \$2,000 a megalitre which is pushing it out of the price range of many growers. Accordingly,

growers are under stress at moment from expectation of not being able to purchase water at reasonable price that is adding to the underlying financial stress from lack of rainfall at present.

Small growers pushed out

Smaller growers may have water but the rising price means it may be more financially attractive (particularly for canegrowers experiencing low sugar prices and high costs of electricity) not to plant and instead sell their announced or nominal water entitlements, and that will have a potentially perverse impact on employment and the value chain.

Grower consolidation

It is believed bigger growers will take advantage of an opportunity to acquire smaller farms that are exposed to this issue on the Southside.

Land values

There is a view that this will potentially affect land values on the Southside. Part of the value of properties in the region is directly linked with their nominal and announced allocation of water. Properties have been purchased directly based on their allocations of water. Land values are going down on reduced productivity of land but also on the possibility of announced allocations reducing. There are reports of property sales already being lost as a result of Paradise Dam uncertainty.

Overall loss to scheme

There is a prevailing fear by growers that if the Bundaberg region does not retain access to the water then it will be reallocated to other areas by the Government and permanently lost to BIS together with its economic benefit.

4.7.3 Future investment

There is concern that a loss in Paradise Dam storage capacity will not allow for growth. Proposed greenfield sites particularly in the macadamia industry are in jeopardy with investment attraction now seriously impeded. For growers, feedback indicated that the only investment going forward will be in trying to reinforce water security on existing land and investments. Existing investment and business opportunities that could be threatened include:

- Macadamia and avocado farming, nuts and berry farming, feedstock for bioenergy and bioproducts;

- Development and use of technology in agriculture that is assisting farmers with world leading, non-invasive and precision agricultural techniques;
- Turning existing feed stocks, and agricultural waste, into viable forms of bioenergy and bioproducts;
- Advanced food and beverage manufacturing including Bundaberg Sugar, Bundaberg Rum and Bundaberg Brewed Drinks, Kalki Moon Gin Distilling and Brewing and Bargara Brewing Company, Farm Fresh Fine Foods and Gin Gin & Dry Gourmet Dried Foods; and
- Niche health and wellness food products.

More broadly, feedback indicated the investment pipeline may become uncertain. Potential projects with their business case potentially eroded as a result of Paradise Dam uncertainty include:

- International air freight expansion: upgrading the Bundaberg Regional Airport to international air freight designation with a value of \$70-80 million;
- Port of Bundaberg: future expansion of the port shipping sugar, molasses and other commodities;
- Bundaberg Brewed Drinks Super Brewery: building a new super brewery in Bundaberg that will support this locally owned company expand into new overseas markets with a value of \$156 million;
- Ag Tech Precinct: establishing Australia's first Ag Tech Prototyping Precinct that will act as a national Ag-tech centre of excellence, attracting innovators, researchers and industry in the testing and rapid prototyping of Ag Tech that will deliver improvements in local and national agricultural farming systems; and
- Bundaberg State Development Area: 5,000 hectares of land intended for future employment use.

4.7.4 Southside vs Northside impacts

Southside growers are particularly exposed to any reduction in Paradise Dam's water resource. Feedback indicated land was acquired on the Southside with subsequent capital investments made, trees purchased in nurseries, crops planted and locals employed. Growers indicated this would never have been made if they knew Paradise Dam's water was going to be permanently reduced.

4.8 Community reaction

There are concerns over the impact of a subsequent decline in agricultural output and the impact on the broader community. Stakeholder feedback indicated the dam has a described 'connectivity' to the region with a lot of people aware the issue that it is an enabling asset that activates the region.

Stakeholders indicated that notwithstanding the underlying need for dam safety the community were incredulous over the decision to empty the Paradise Dam and that emptying the dam in driest period in recent memory does not make sense. This issue has arisen in one of the worst droughts in Australia's history and seriously impedes a vital asset designed to insulate the region's irrigated agriculture from such an event.

At the most basic level the concern is that if they don't have adequate water then the crop is gone. The dam issue is adding to the stress for farmers, with some considering sale of their farm if reduced water capacity risks of loss of income and bankruptcy. That could impact on mental health and may possibly be linked to the prevalence of farming suicides.

There are concerns over the implications on future investment if irrigators no longer have secure reliable water resource together with fears that the issue is already having an impact on land values.

There is a sentiment that there is an absence of accurate information out there and no one knows what is going on. In general, there is no real answer from the Government or a permanent solution being offered – 'No one really knows what the future holds'.

The Bundaberg community urgently requires more industry and job creation. The region needs more industries that will employ local people and will employ unskilled persons. Consultation indicated it was unfathomable that a Government would seek to impede the one industry that has been the main stay of employment and opportunity for Bundaberg. In

summary, there is enormous worry and this is the last thing the region needs with high unemployment.

4.9 Ability to mitigate impact of Paradise Dam inaction

4.9.1 Mitigation measures

Key variables impacting on the ability to mitigate a reduction in water availability are the recent history of flooding and drought that has eroded the balance sheets of many growers. In addition, the price of electricity has impeded the ability of growers to pump water and canegrowers have experienced low commodity prices for sugar.

Feedback from growers indicates that there are remedial strategies available that can potentially reduce the impact of a loss in water from the Paradise Dam. These strategies include:

- a) Increase on farm storage of rainfall and when there are releases from the catchment;
- b) More investment in soil monitoring equipment;
- c) Purchasing of more efficient irrigation equipment;
- d) More emphasis on irrigation scheduling;
- e) Preparedness to pay more for water – cost per ML;
- f) Buying up existing nominal allocations;
- g) Concentrating water on best cane land; and
- h) More conservative crop layouts.

Some growers indicated that necessity was a catalyst to be more efficient with water. However, feedback also indicated that because of prevailing drought conditions many growers have already sought to maximise the efficiency of their irrigation equipment and that big strides have already been made.

Annual cropping enterprises indicated that they would largely reduce or scale down the amount of crop planted to be commensurate with the availability of water. This however would have implications on reducing earning potential and ability to apportion fixed costs over a higher crop size leading to reduced profitability and viability.

For the large growers they believe it is better for them to develop their own water storage as that is guaranteed to deliver the water they want instead of having to rely on what Sunwater allocates. However, consultation indicated that most of farms do not have dams as the topography is not suitable and there is not enough room for them.

An argument was put forward around the economy of scale in construction of a single dam and the ability to mitigate water loss through evaporation, etc.—i.e. a single 300,000ML dam is more efficient than 15 – 20 ML dams.

4.9.2 Measures to mitigate lack of financial viability

While most feedback indicated concern there was degree of resilience indicated by some growers. The large growers interviewed have the scale and diversification to be able adjust to potential new arrangements through more conservative farming practices without significant impact to their investment or viability. However, in the main the anticipated 16% announced allocation for next year was generally believed by most growers to be insufficient even with improvement in irrigation equipment and its efficiency.

Feedback indicated that from a farm practice point of view when a grower or farm is squeezed they will:

- a) Refinance or seek additional funding to get through an additional season (bank lending practices have tightened on primary producers) or accessing superannuation;
- b) Cut labour costs,
- c) Invest in more efficient methods of irrigating:
- d) Look at what they are planting with perhaps a move to more short-term crops such as melons or zucchinis that have a short lead time:
- e) Look at their assets including changing use of the asset; selling the asset completely and doing something else; and
- f) Selling some of the asset for alternative usage (e.g. residential development).

This is anticipated to be the response criteria for growers who are exposed to a permanent loss of water from the Paradise Dam.

4.10 Importance of restoring Paradise Dam to its original and intended capacity

Stakeholders indicated there were a range of reasons as to why the Paradise Dam's original and intended capacity should be restored.

- a) It is extremely important to rebuild the dam because first and foremost it sets the confidence in the region and its permanent reduction would see the erosion of the region's largest sustainable competitive advantage;

- b) Stakeholders believe there is an economic imperative to do so as evidenced in section 4.7. Paradise Dam is considered vital to the continued growth of irrigated agriculture and the region. Bundaberg region is significantly reliant on agriculture and Paradise Dam water security is imperative to that. Irrigated agriculture is the biggest single generator of wealth and employment that trickles down to the rest community;
- c) The Queensland Government should think of the wealth of land that could have productivity and value add to it with the addition of water and the economic stimulus this would have that would create increased tax receipts for it,
- d) If the Queensland Government does not restore the Paradise Dam then it will be paying in the long term through social security and increased health expenditure particularly in mental health.
- e) Stakeholders believe the Queensland Government has a moral duty to reinstate the capacity of the dam. Consultation indicated that growers on the Southside, in particular, had invested with knowledge they would have water security.
- f) Stakeholders also indicated that it would be a terrible waste of taxpayer money to write off or write down the Government's investment in the dam; and
- g) Some stakeholders indicated that Bundaberg does not get the level of capital spend commensurate with the region's importance and what they contribute to the Queensland Government's consolidated revenue.

Feedback has indicated that that the dam does not need to be rebuilt immediately but a public commitment by the Queensland Government and Sunwater to do so will neutralise industry and community concerns and restore future security that in turn provides certainty and confidence.

4.11 Options for Government

The overwhelming sentiment indicated the requirement for Government to either rectify the current dam wall or rebuild it. The challenge, however, is that the cost has to be paid by the State Government, but the benefit accrues to the Bundaberg community.

The Queensland Government is believed to be cash constrained and highly reliant on dividends from its Government-owned corporations and does not have the cash reserves to rebuild the dam. However, stakeholders believe that that this is a short-sighted view and the Queensland Government is not thinking about the future.

Stakeholders indicated there is a underlying need to drought-proof the country yet we are decommissioning a drought-proofing piece of infrastructure. All stakeholders interviewed believed the government's long-term economic benefit would outweigh the short-term financial cost.

Consultation revealed that further testing of the dam needed to be considered and that testing to date had been insufficient and there was hope that the issues may not be as bad as originally anticipated. However, if the dam wall is irreparably compromised then it should be rebuilt below the existing dam wall and improved. Stakeholders indicated that this was an opportunity to not only restore the capacity of the Paradise Dam, but also improve and increase it to potentially 120% of the original capacity.

There has been some willingness on the part of the farmers to bring forward their investment decisions to buy Paradise Dam water if reconstructed. That is growers would kick in some of the money to rebuild the dam through them buying water allocations.

Alternatives suggested included building other weirs on the river or placing fixed gates on other smaller dams. However, stakeholder feedback indicated that it is important to consider the impact of any changes in irrigation arrangements and the impact it may have on culturally significant sites, as the Government has a cultural duty of care towards the region's Aboriginal people.

Finally, stakeholders highlighted the imperative to place the right information out there and the need to address misconceptions that are eroding investment certainty.

5. Importance of Paradise Dam to Your Business Survey results

As part of the preparation of the report a survey was commissioned to canvas both irrigated businesses' and non-irrigated businesses' views on the importance of the Paradise Dam. The survey was run over the period 14th January – 31st January 2020 with 283 responses received.

The survey was distributed by Bundaberg Fruit and Vegetable Growers, the Bundaberg Chamber of Commerce, Bundaberg CANEGROWERS and CANEGROWERS Isis to their respective memberships. The survey provided both quantitative and qualitative questions and 1,318 individuals comments were received in relation to the Paradise Dam. Summary data on the characteristics of survey respondents are provided in Appendix D.

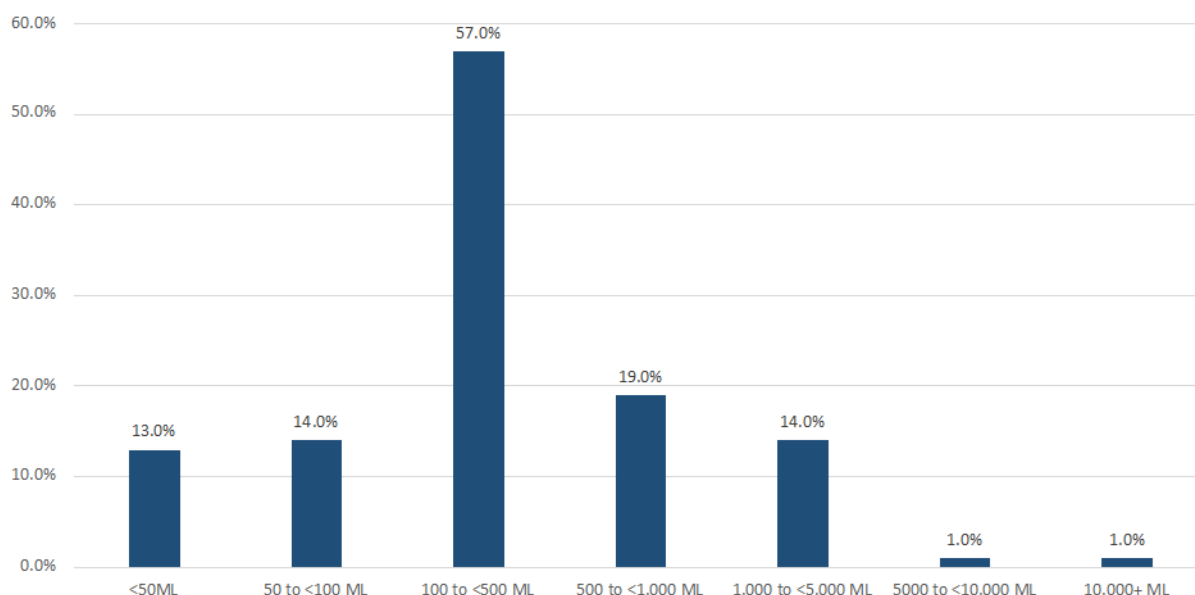
5.1 How and when water is used from the Bundaberg Irrigation Scheme

Nearly two in three surveyed growers used between 100 and 500 ML from the BIS on an annual basis. The average amount of water used 487 ML but the median was only 257 ML as a result of a number of growers with larger water requirements. For example, the largest 10 users of water accounted for 41% of the total water accessed from all irrigated business respondents (Figure 11).

This water was used solely for the purposes of irrigation of crops to supplement rainfall and was also stored in dams, ponds and tanks on each farm. The water was used for the irrigation of various crops including citrus fruit, table grapes, sugar, sweet potatoes, macadamias, avocados, dragon fruit, potatoes, bananas, soya beans, watermelons and pumpkins.

Water was also used for the washing of fruit and vegetables after harvest and before packaging. Methods of water application ranged from winches, sprinklers, booms and lateral irrigators. low pressure overhead irrigation and trickle/drippers.

Figure 11. Megalitres used by Irrigated business in 2018-19



Source: The importance of the Paradise Dam to your business Survey

Box 3. Quotes from growers on importance of irrigation

"It's a vital key foundational component or agronomic input that ensures we are reliably able to meet our customers' needs and demands." Grower

"We have solid set irrigation installed to cover our whole property. We are 100% reliant on the scheme for our vegetable production. our crops are watered almost daily from seeding through to harvest. A large percentage of our nutrition program is also fertigated through the irrigation system."

Grower

Historically, the announced water allocation for each grower has been taken unless there has been exceptionally good rainfall. Even then it has often been stored on the farm for future usage. Growers through the survey indicated that whilst the original intention of the BIS was to supplement rainfall the drought had caused the BIS to become the mainstay of current irrigation in the region. Some growers (particularly macadamia growers) also indicated that permanent water allocations had been purchased in advanced for future requirement.

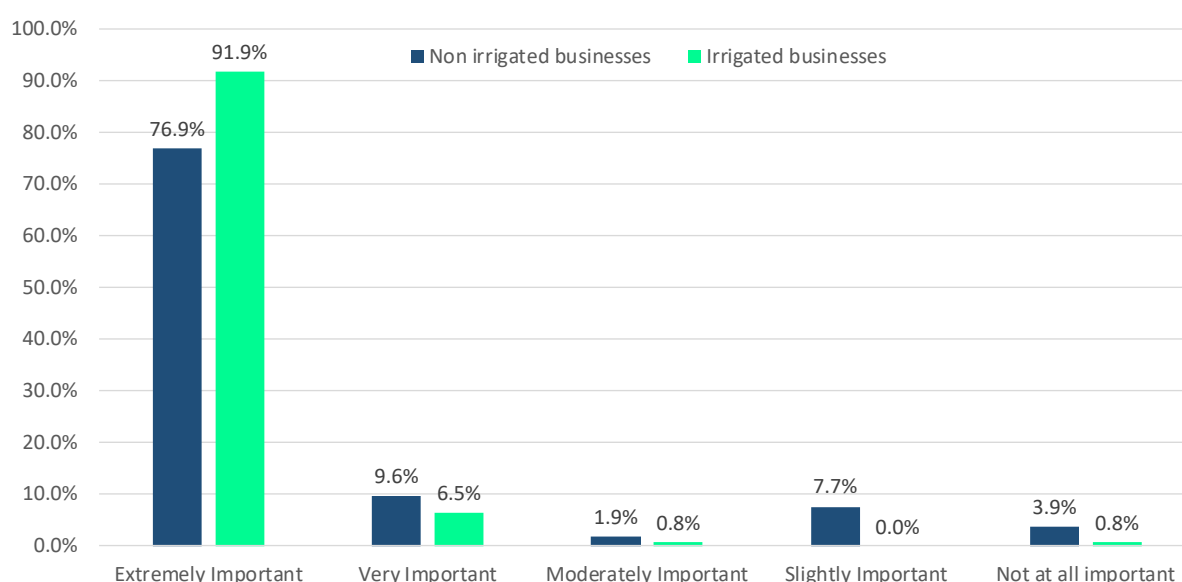
Many growers indicated that in addition to their permanent allocation they had also purchased temporary allocations. Some growers indicated that they purchased additional nominal allocations in the knowledge that they would lose a portion through the actual

announced allocation. On those occasions where near 100% announced allocation was provided, water surplus to farm requirements has been temporarily sold to other growers.

5.2 Importance of the Paradise Dam's water resource to your business

Respondents were asked to consider how important Paradise Dam's water resource was to their business. For irrigated businesses nine in ten growers (91.9%) indicated that the Dam was extremely important to their business. For non-irrigated businesses three in four respondents (76.9%) also indicated that it was extremely important to their business.

Figure 12. Importance of the Paradise Dam's water resource to business



Source: *The importance of the Paradise Dam to your business Survey*

In its purest sense irrigated businesses indicated “no water, no crop, no income”. However, it is the security that Paradise Dam has provided to growers that was referenced as its greatest advantage (Box 4).

Box 4. Quotes from irrigators on importance of Paradise Dam's water resource

“The water resource is extremely important to our business so that we can continue to produce the crops in a sustainable manner to provide income for both ourselves and our employees. Without the valuable water resource, Bundaberg’s name of the ‘Produce Hub of Australia’ will no longer exist. There will be a significant impact on local business’ and employment as most farmers support all local irrigation, agricultural supplies stores, manufacturers, machinery stores, schools, etc. Without the

water resource we will no longer be able to continue employment in agriculture for the younger generations of our family and others.” Grower

“Water security. This water allows our business to operate at full capacity and having some sense of water security gives us confidence in making decisions regarding the future of our business eg. crop selections, farm expansions etc.” Grower

“Paradise dam underpins ours and this region’s economic performance. Without it this region is just another one that relays almost solely on year to year weather fluctuations. It’s reliability of supply is what has made this region successful and the main reason 100’s of millions of dollars have flowed here in recent years. If it is allowed to be reduced the region will be effectively capped out.: Grower

“Important as it gives confidence in water availability and security and long term reliability in relation to announced allocations. It also offers security in being able to temporary transfer water in years when more is required to finish of a crop and maximize productivity.” Grower

“Without guaranteed water supply our properties will suffer a major devaluation of asset worth. This will see 2 million dollars wiped from our asset base in the Bundaberg region. Without regular water supply we cannot build relationships with suppliers for expanding our business because of the lack of continuity of supply.” Grower

“We have permanent crops that require water to keep the trees alive. To maximise production we need reliable water which Paradise provides. Australia has to face competition and yield will be what keeps us competitive internationally. Secure and consistent water maximises yield.” Grower

“The addition of Paradise dam water to the irrigation scheme has given us a reliable water supply even after the 2 consecutive low rainfall years we are currently experiencing. Having a 'buffer' of unsold water gave us certainty to plan for the future. Whilst we did not buy water in 2018 when it was offered by Sunwater, we certainly intended to when there was available cash flow in our business. Having a reliable water supply in this region has seen my land increasing in value. This allows us to borrow further against these assets for further investments in irrigation infrastructure, farm machinery and new crops. Any planning for any of these investments is currently on hold until paradise dam issues are resolved. Without paradise dam, water will instantly become unaffordable to buy for a large number of producers. Permanent crops(trees) need water to survive. These producers will possibly have to procure water at 'whatever it cost it takes' to keep their orchards alive. This will leave other sectors with no hope of affording extra allocation.” Grower

“We don’t get direct access to Paradise water, however as we are part of the whole Bundaberg Irrigation Scheme we are concerned that more water may be directed out of the Monduran side to

supplement shortfalls to the Burnett/Childers area. This may lead to rostering as happened pre Paradise dam.” Grower

“At its current capacity it gives the Bundaberg area an enormous water security advantage especially since it is on the third largest catchment in Qld. This then gives farmers like us the ability to make long term decisions about investment in our business in the form of crops to be grown, as in trees and the ability to negotiate our potato contracts with longer term security. With this security it then enables us to invest in irrigation capital and general farm machinery capital with confidence. This confidence is also expressed with our families ongoing expansion regime. With this confidence it also drives a large flow on effect in the community for the business supply houses and ongoing safe employment for a large sector of the greater region.” Grower

“The development of Agricultural capability and consistently producing high quality farm commodities has relied, and even more strongly, will rely on irrigation and water management. If storms become more intense but less frequent then the ability to capture and store this water will become even more paramount to achieving this reliable food production.” Grower

For non-irrigated businesses the Paradise Dam is equally important to them (Box 5). This is intrinsically related to their own business dependency upon grower activity. The feedback indicated that if growers lost reliability and security they would in turn lose certainty and confidence leading to less business activity for non-irrigated businesses. Some non-irrigated businesses indicated up to 70% of their turnover was dependent upon agriculture.

Box 5. Importance of Paradise Dam’s water resource to other businesses

“Without water capacity and confidence, growers/producers will no longer have viable, sustainable businesses. Without growers, my organisation will not have a reliable foundation of members/clients in the region.” Bundaberg business owner

“The farmers which we supply backpackers to rely on the Paradise Dam’s water resource, and as our business wholly depends on the labour needs of farmers, the water supply is critical to our business. If the farms cannot grow crops, they will not need labour to harvest the crops, and we will have no demand for our beds, and therefore no income.” Bundaberg business owner

“Inadequate water allocation for local growers has a flow on effect down the supply chain. Less water leads to potential reduced cropping area. Reduced cropping area leads to reduced crop protection inputs and overall less financial returns for growers.” Bundaberg business owner

“Significant influence on the productivity and prosperity of the region. The confidence of the rural sector has a direct relationship to the work that we receive and indirectly through other businesses

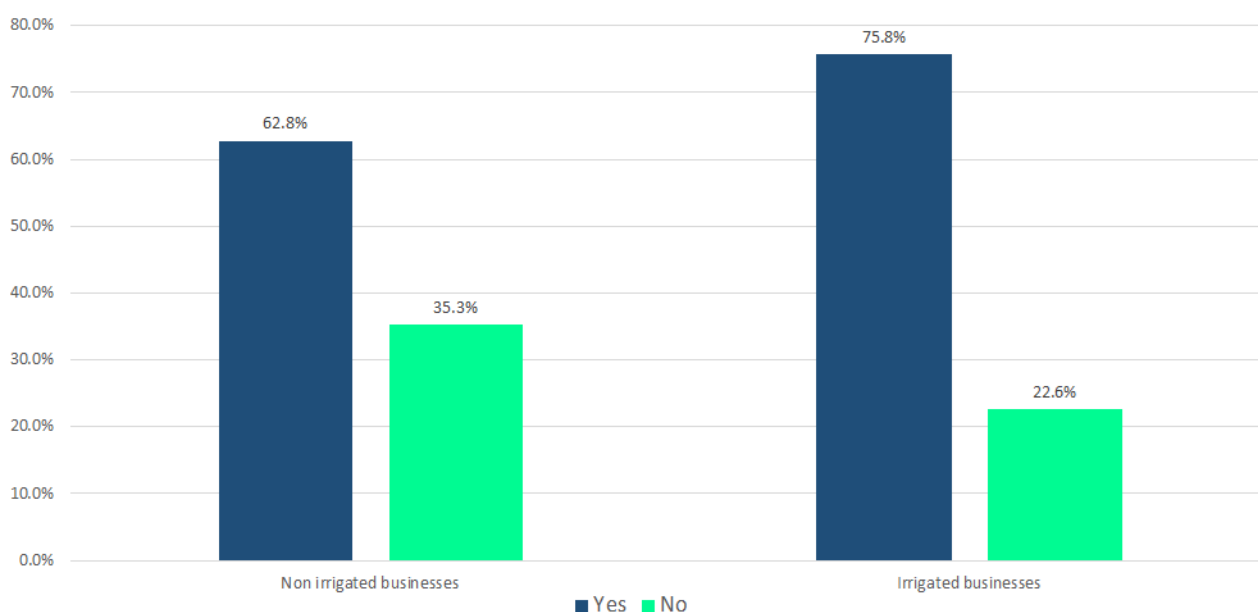
and individuals. Without water security in the region no one in the agricultural market spends money and the whole town suffers. The town only survives with the ag market growing.” Bundaberg business owner

5.3 Previous business investment contingent upon Paradise Dam

Survey respondents were asked whether their business had made investments since the Paradise Dam was built in 2005 contingent upon the availability of its water supply. For irrigated businesses three in every four growers (75.8%) have made investments and for non-irrigated businesses three in every five (62.8%) have made investments.

85 growers were able to provide detailed information relating to their investments in the region based solely on the knowledge Paradise Dam was there since it was built. Based on this information over \$ 510 million of investments were identified on land, buildings, equipment and additional hectares of crops planted. 33 growers identified investments greater than \$1 million each and ten growers identified investments greater than \$10 million each.

Figure 13. Business Investment contingent upon the availability of Paradise Dam’s water supply



Source: The importance of the Paradise Dam to your business Survey

Box 6. Comments from irrigated businesses on investments contingent upon Paradise Dam

"We have invested over 4 million dollars to date with a further 5 million slated to be spent over the next 3 years with the expectation that water from Paradise dam would be there as our trees grew and needed additional water. Most tree crops have a two+ year wait from order to when trees are received, then a further 9-11 years to reach full maturity." Grower

"Since Paradise dam was built in 2005 we have purchased and developed 10 farms and developed a major Packhouse all contingent on Paradise Dam and thus having the most reliable water supply anywhere. This investment has been well over \$50 million." Grower

"Every dollar we earn that is not spent on living expenses is invested back into the business because we have had the security of knowing we have the water required to grow our crops out year on year and the confidence to invest in machinery." Grower

"\$33,000,000. Prior to investing in Bundaberg, we had orchards in the Northern rivers, these are rain grown trees and we felt the continuity of supply could be achieved with an irrigation scheme" Grower

"We moved to the region after the completion of the dam. We moved to the region because of the structure of the complete scheme which includes Paradise Dam. We would have spent circa \$5,000,000 in land development and infrastructure for our entire winter production business." Grower

"The purchase and development of this farm will reach \$6m in 2020. We made this investment decision based on the fact water allocations haven't been lower than 71% in the last 10 years." Grower

"We approximately invested \$12m to make sure that we remain a generational business for the foreseeable future knowing that Paradise has always had great water security." Grower

"We moved to the area in 2006 because of the water security from Paradise Dam. we have invested more than \$50 million dollars including a current project of \$23 million. Millions of Dollars have been invested in the business because of the certainty of long term water security provided from the supply of water from Paradise Dam." Grower

Significant investments from non-irrigated businesses have also been made. Comments from non-irrigated businesses are featured in Box 7.

Box 7. Comments from non-irrigated businesses on investments contingent on Paradise Dam

“Over that past 10 years the population of Shalom has grown by 50%. As a result, the College has spent in excess of \$12m to keep up with enrolment demand. Many of our families are directly involved with Agri businesses and many more depend on the flow on effects. We have increased staffing significantly to meet student demand as well.”

“In partnership with the hostel we are associated with, our initial investment of \$1.6M has been augmented by a further investment of \$0.5M to expand our facilities. We did this as we were banking on continued growth of the farming sector and increased population in the region. The current proposal for Paradise Dam will send us out of business.”

“This business started in 2017 on the basis that the Bundaberg region would continue to be able to sustain horticultural, sugar cane and grazing production as it has done for many years. Around \$500k was used to commence this business.

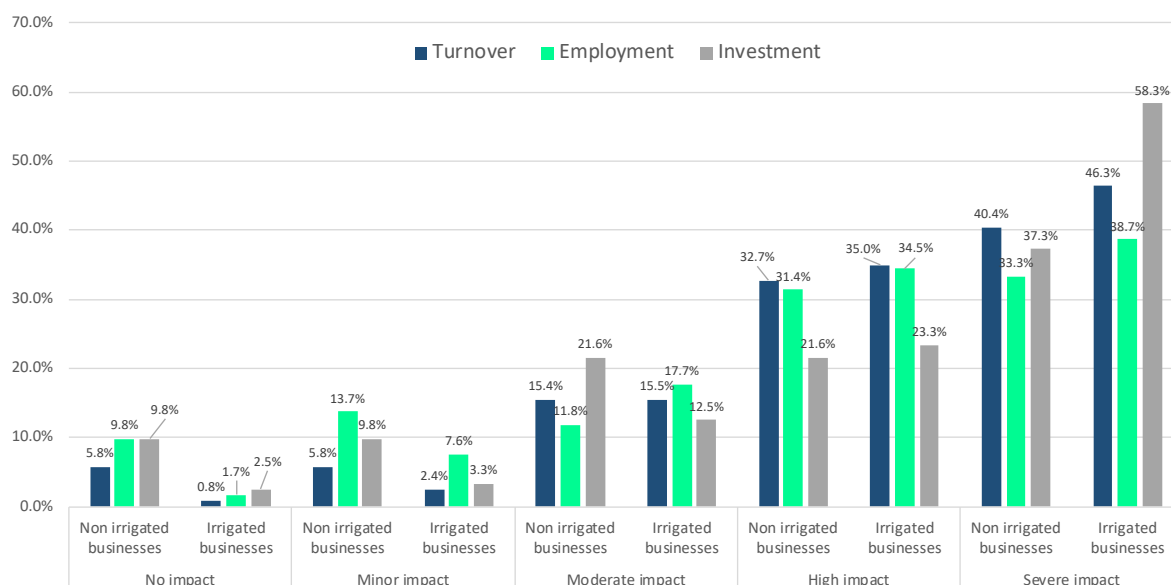
We spent \$500,000 upgrading pump, storage, environmental controls & \$100,000 on customers storage..”

5.4 Impact on business of loss in Paradise Dam capacity

Survey respondents were asked to indicate the resulting impact on their business if the Paradise Dam was not restored to its original capacity. The majority of irrigated businesses anticipated either a high impact on their turnover (35%), employment (34.5%) and investment (23.3%) or severe impact on their turnover (46.3%), employment (38.7%) and investment (58.3%). Only between 5 to 10 per cent of irrigated businesses believed a permanent loss of Paradise Dam’s capacity would have no impact or only a minor impact on them. Qualitative responses generally indicated a spectrum of resulting measures to address this downturn ranging from a minimum of cutting production to being unable to continue farming.

The impact for non-irrigated businesses was less but still profound indicating a prevalence of mutual dependence between the broader business community and irrigated agriculture (Figure 14). The majority of non-irrigated businesses indicated either a high impact on turnover (32.7%), employment (33.4%) and investment (21.6%) or a severe impact on turnover (40.4%), employment (33.3%) and investment 37.3%).

Figure 14. Impact on business if the Paradise Dam is not restored to its original capacity



Source: The importance of the Paradise Dam to your business Survey

Box 8. Comments from irrigated businesses on the impact on business of loss in Paradise Dam capacity

"Without water or with less water, our crops will be less successful, requiring less employees and restricting growth and sustainability of our agricultural venture. Our plans for expansion will be put on hold indefinitely. There will be a lot of projects that will not get off the ground and a lot of farms will close because the farmers once thought they would be able to diversify." Grower

"I choose Moderate because you cannot predict the weather. what I will say is if the drought continues the impact for the community will be severe without the security of Paradise Dam." Grower

"If capacity is not restored our productivity will decline dramatically due to the inability to irrigate as required. This will mean we can no longer afford to sustain our workforce and continuing repayments on our current investments will be difficult to say the least, let alone considering any new investment or expansions." Grower

"On a 16-50 % water allocation we will pull in our belts and direct the water we have to crops that return us the most. We will cease expansion plans in the tree crops. Sugar will become a dry land crop and the quarter million dollar stranded asset that will be my centre pivot will sit motionless. I imagine this will also call into question the viability of the already struggling local sugar mills also." Grower

"It has the potential to halve our income which obviously has big flow on effects to investments we make elsewhere. I imagine it will also have a big impact on farm valuations that consequently impact bank assessments of our viability." Grower. Grower

"Without the ability to sufficiently irrigate our crops we have no way to produce enough fruit to sustain our business. We will lose trees and will not have the ability to keep our staff employed. There will be no further expansion to our business in fact we have already put a number of projects on hold due to the lack of available water from paradise dam." Grower

"If we can't have reliable water and a certainty of being able to purchase more when we need it, we will have to start reducing our plantings, and cycle out older orchards. This will have the effect of less employees, less investment, less production, less transport required, less fertiliser and chemical inputs. This uncertainty of water means our asset base has reduced enormously; it has all become much less valuable." Grower

"We will not have enough water for the development we have planned. It was our intention to purchase more water in the years to come. Therefore, there will be a severe impact on the turnover by way of lower yields. Our investment in the region will be shelved and this will have significant impacts on the number of people we employ into the future - not just on the farms but in processing plants that we have intentions to invest in." Grower

Other businesses in the community other than irrigators are also concerned about the business impacts of a reduction in Paradise Dam's capacity (Box 9).

Box 9. Comments from non-irrigated businesses:

"Less guaranteed water results in reduced financial confidence & translates to diminished community cash flows & reduced prosperity. This also impacts upon the general mental & physical wellbeing of the community." Bundaberg business owner

"Without growers in the region, it will be more challenging to gain externally funded projects to deliver benefits to Horticulture growers in the region. There will be less growers, and the economic pressures on these businesses will increase significantly - resulting in less capability to utilise or benefit from these services." Bundaberg business owner

"In terms of employment, the organisation is a state-wide business with a minimal number of staff located directly in the region. Any future projects/services will therefore likely be conducted more remotely. In reverse however, growth in the industry has the potential to drive further investment and staffing ratios directly back into the region." Bundaberg business owner

"I would be very worried that families will move from Bundy if the economy suffers as a result in curtailing capacity of the Dam. This would mean a loss of students and staff. Our future development plans would certainly be re-visited." Bundaberg business owner

"If not rectified we foresee ourselves going out of business as a number of farms we service will be closing their doors." Bundaberg business owner

"If dam levels are not restored the farms we supply labour to will have dramatically decreased production levels, reducing labour needs of backpackers, reducing demand for our accommodation product. This will reduce our turnover, employment levels and future investment significantly." Bundaberg business owner

"Restricting the water supply has already had an effect on our farmers crops and that will only worsen with further restrictions. We already have a problem in Bundaberg with the drought and if farmers are restricted to using less than a large proportion of their allocation of water we will see more farms shutting up their doors as it will be too hard to continue. If our farms close up or reduce the need for staff we will lose our business as it is entirely dependent on farms continuing to thrive." Bundaberg business owner

5.5 Importance of the Paradise Dam's water resource to the Bundaberg community

Survey respondents were asked how important they considered the Paradise Dam's water resource was for the Bundaberg community. Virtually all irrigated businesses held the view that it was extremely important for the Bundaberg Community (Figure 15 and Box 10). This sentiment was also held by non-irrigated businesses (88.5%).

Box 10. Comments from irrigated businesses on the importance of Paradise Dam's water resource to the Bundaberg community

"Agriculture is a critical supplier of employment for permanent and travelling workers. The agricultural products are sold locally, nationally and internationally and underpin the thriving local restaurant and value adding industries - nut processing and products, avocado and other fruit products and processing plants and fresh fruit produce in supermarkets and markets. Secondary support industries- tractor and machinery suppliers, engineering works etc have grown in response to this demand and are totally dependent on agriculture for their existence and economic viability. They in turn place a greater demand on the local school, sporting, health and medical and other shopping and resources for the community that work in these industries." Grower

“Primary production of many commodities are water dependent. The ripple effect of reduced water supply will affect the ability of some businesses to survive, and most definitely employ workers to help, run, manage, and harvest product. The ripple effect will roll across all sectors, including retail employment, rural suppliers, even population growth - real estate and so on. Water lubricates all economies!” Grower

“Without the supply of water from Paradise Dam, there is extreme pressure put on all other supplies of water. These other water supplies will not sufficiently service and fulfil the demand for agricultural, commercial and residential requirements. This has negative impact on the entire community.” Grower

“Reliability of the water supply in this district underpins things like but not limited to - Job security - more higher paying and better work with the new higher value crops being planted in the district. Housing values, Flow on effects to agricultural support industries.” Grower

“This community is built on rural agriculture and without necessary water there will be a guaranteed collapse of the industry devastating farmers their employee’s and all of the downstream companies who rely on the business that comes from agriculture.” Grower

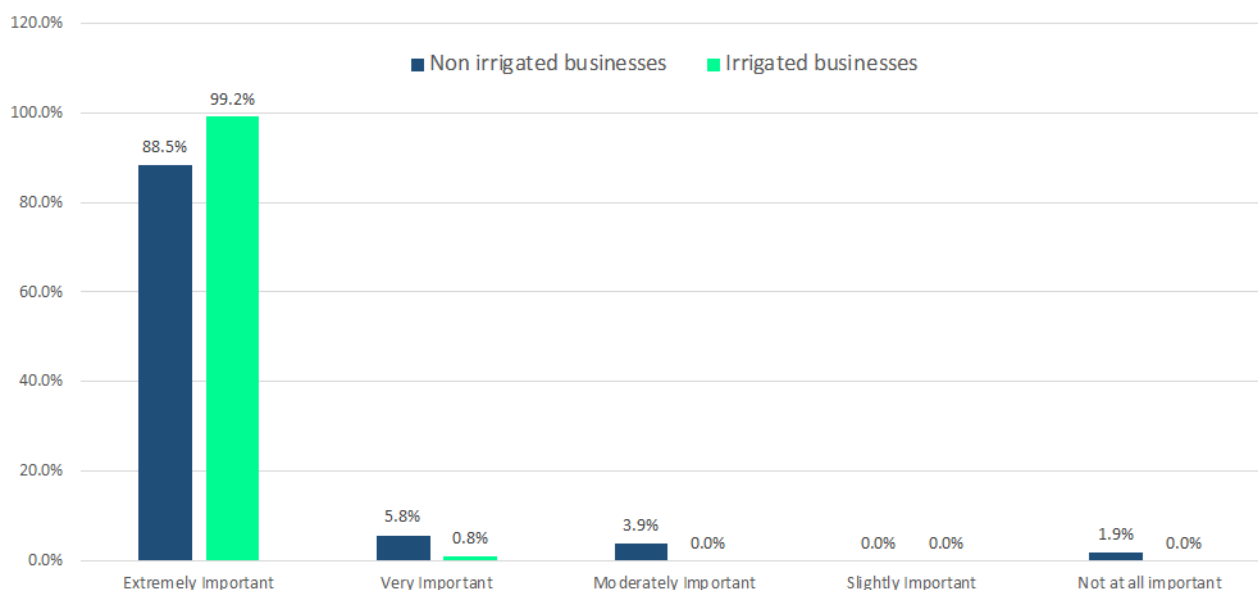
“We are just one business and if we could not continue expanding our business in this region we would look further to other regions with a potential exit from the Bundaberg Region. This would mean we would cease to exist as an employer. I can imagine that we are not the only business in this position.” Grower

“Farming families and staff and the supporting businesses are the backbone of the Bundaberg and Childers communities. Reliable water drives growth and yields which allows us to pay our people well. The growth of our business has allowed us to compete in the employment market with big businesses and we have been able to bring skilled people to the region. The opportunities that have been created from the professional expansion of farming businesses in our region keeps people in the region and supports the growth of the businesses.” Grower

“We won’t be able to grow a profitable crop with a 16% allocation which is the projected figure for the next water year. It is doubtful that we will be able to support the new nut trees with that amount. If we are unable to grow a profitable crop we will not be able to purchase the inputs required for that exercise i.e. fuels, fertilisers, chemicals and materials from local businesses. If we don’t have a viable crop then there is no work for Harvesting Contractors and their staff. No supply of cane to the sugar mill will result in economic impacts for the mill. The biggest impact is that money which is spent on local supply businesses in this area will have reduced income. What those impacts are when applied right across the cane industry is anyone’s guess. Bundaberg Regional Council also relies on Paradise Dam water for domestic water supplies.” Grower

Many non-irrigated businesses in the Bundaberg region also have strong views on the importance of Paradise Dam's water resource to the community (Box 11.)

Figure 15. Importance of the Paradise Dam's water resource to the Bundaberg Community



Source: The importance of the Paradise Dam to your business Survey

Box 11. Comments from non-irrigated businesses on the importance of Paradise Dam's water resource to the Bundaberg community

*"It provides the lifeblood of the farmers & secondary industries that support them. Their prosperity supports employment & provides an income stream enabling the wellbeing of the community & flowing to industries, they can access & support, as a result of this . Overall this prosperity flows to the rest of the community & wider regions ."*Bundaberg business owner.

"Irrigated Agriculture is one of the largest industries of the region, driving a significant amount of purchasing and investment in the region. This contribution and potential for expansion leads to increased needs for support services (private and government alike), which in turn leads to increases in services and confidence across the entire community." Bundaberg business owner." Bundaberg business owner

"Infrastructure, regional development and food production is a mainstay for Bundaberg and by multiplier its contribution to capital cities. Unreliable or at worst case no water a critical times to

support this already in place development totally destructs any future development and makes redundant large parts of development already undertaken.” Bundaberg business owner

“Though we have manufacturing businesses in Bundaberg we are essentially a farming community. Business people in Bundaberg know when farmers are doing it tough because it always impacts on the amount of money spent in the town.” Bundaberg business owner

“Our district is built on agricultural pursuits due the availability of excellent soils, good flat terrain and accessibility to markets. Due to the nature of our local climate, and the fact that many of our local crops are perennial tree crops, or are forward marketed, water surety is essential. Without the level of surety provided by the two major dams, the risk level for longer term investment in crops and infrastructure rises considerably, possibly making current and future projects economically unviable.” Bundaberg business owner

“Our success is directly impacted by the success of the farms we deal with. The workers we provide bring in high proportion of tourism dollars to the region. On any given day we need from 2,000 to 5,000 itinerant workers in this region that produces 25% of Australia's fresh produce. Without an adequate water allocation we will see farms closing, with follow-on effects on all types of small and large businesses in the region.” Bundaberg business owner

“The water security that Bundaberg has enjoyed has provided a steady growth of agricultural businesses and the innumerable other businesses in town that benefit from the Agri sector being secure. So many of the families at Shalom depend on this sector employing and injecting funds into the region. Any decisions that may be taken that will endanger the water security provided by the Paradise Dam may well have very damaging effects to the lives and welfare of Bundaberg families.” Bundaberg business owner

5.6 Planned projects contingent upon Paradise Dam

Survey respondents were asked whether they were aware of any other major projects planned for the Bundaberg region that are contingent upon the capacity of the Paradise Dam. The majority of the feedback related to the ongoing expansion of tree crops and associated investments. Other projects that were referenced included the expansion of the Port of Bundaberg, the Isis Mill railway line from Cordalba to Wallaville and the Almoize Groups investment in the Isis Central Mill valued at \$35 million. A sample of qualitative responses to the question is presented in Box 12.

Box 12. Comments from businesses on planned projects contingent upon Paradise Dam

“Since 2006 the Horticulture Industry has undergone tremendous growth, contingent on the water security of the region (due to Paradise Dam water). This investment in expanded planting and diversification into some new commodities will continue this trend, IF there is confidence in the region's water supply/security for irrigated production. Additionally, value-add opportunities expand with fresh production. Value-add facilities also require ample water supply.” Grower

“Our port has huge potential and something could happen in the future with the Government nominating the port as a development area. We need to have surety of water for years to come for any future development.” Grower

“The area is clearly experiencing growth in tree crop industries and is fast becoming one of the major growing regions for these crops. Many farms that have had relatively low water use previously have been purchased with the intention of converting them to tree crops. Without reliable and consistent irrigation this will not be able to take place.” Grower

“The extension and growth of operations for local businesses such as Greensill Farming and Macadamia’s Australia who currently have plans for major construction. Along with these businesses, all other businesses in Bundaberg continually perform major projects which need a reliable water supply.” Grower

“The expansion into tree crops in the region has provided a profitable alternative to a declining sugar industry. Without Paradise water this will not be possible and will result in limitation on diversification for existing growers in the region.” Grower

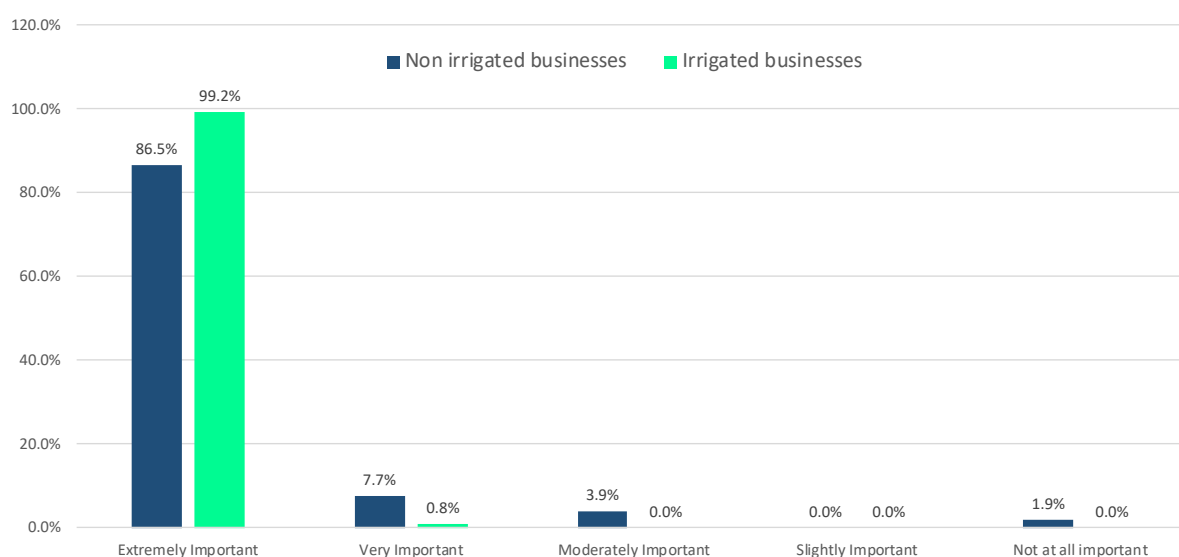
“The processing factory Pacific Gold is set to undergo major expansion to cater for the increase in macadamia nuts. This may not go ahead if interest in macadamia orchards decrease.” Grower

“Critical to our decisions to invest further in the region. We have plans to further expand our plantings and invest in processing and manufacturing facilities for our produce in the future. Without water security, we will be forced to reconsider our options which will include divesting the farms we have purchased and re-deploying our capital elsewhere in other regions and other asset classes. Paradise Dam delivers water security for the region and is critical to the regions success and to our family's investment decisions.” Grower

5.7 Importance of restoring the Paradise Dam's capacity

Survey respondents were asked how important they believed it is to restore the Paradise Dam to its original and intended capacity (Figure 16). Virtually every irrigated business (99.2%) indicated it was extremely important, and 86.5% of non-irrigated businesses indicated it was also extremely important to restore Paradise Dam's capacity. Relevant comments from irrigated businesses are presented in Box 13.

Figure 16. Importance of restoring Paradise Dam's original and intended capacity



Source: The importance of the Paradise Dam to your business Survey

Box 13. Comments from irrigated businesses on the importance of restoring Paradise Dam's original and intended capacity

"The security of guaranteed water would encourage further industry development and strengthen the local economy with far reaching implications. Without water security, these proposed projects will be unlikely to proceed." Grower

"This gives confidence to the investors that are making this region grow. It also gives confidence in QLD as a whole as a safe place to invest. By investors we mean both the people investing in the agriculture directly as well as associated businesses within the town e.g. Motor dealers, tractor dealers, irrigation and ag suppliers." Grower

“Restoration to full capacity gives long term security to the region and may drive investment here for decades to come. A long term fix will give a long term gain.” Grower

“Without water security we risk turning what is a food bowl of Australia into a dust bowl. Why would we look at investing millions of \$ on an unknown return.” Grower

“This is incredibly important, major investments by many companies and individuals have been done on the reliance of Paradise dam. This uncertainty of lack of capacity and reliable water has already reduced the value of all the irrigated land reliant on the Burnett and Kolan irrigation schemes by a massive amount.” Grower

“The dam capacity must be restored if we are to have any confidence in Sunwater's ability to supply our full allocations and to be able to earn from our land to its full potential. We have all invested hugely in infrastructure to apply our water as has Sunwater. Not to restore the capacity would be a travesty & a farcical waste of the billions of dollars of irrigation & water infrastructure invested in between government, industry and landholders in the affected area.” Grower

Comments from non-irrigated businesses are presented in Box 14.

Box 14. Comments from non-irrigated businesses on the importance of restoring Paradise Dam's original and intended capacity

“A guaranteed water supply ensures confidence for investors and provides employment opportunities, that in turn improve financial security for families & improve general wellbeing- physical, mental & social - and allow communities to flourish. Bundaberg business owner

“The past 14 years of growth and diversification are proof enough of what private investment can occur when you provide water security to a region - particularly for irrigated agriculture. Original capacity being restored will retain confidence and value of agricultural land, and the region's economy stays more sustainable.” Bundaberg business owner

“Development and investment was based on what was there you cannot then take away the reason for being and then have any hope of this investment achieving its intent. Then what does this say for any other development opportunities in any region, these will not get any support, particularly from private enterprise, with the belief that the basis for the investment maybe removed or at least diminished.” Bundaberg business owner

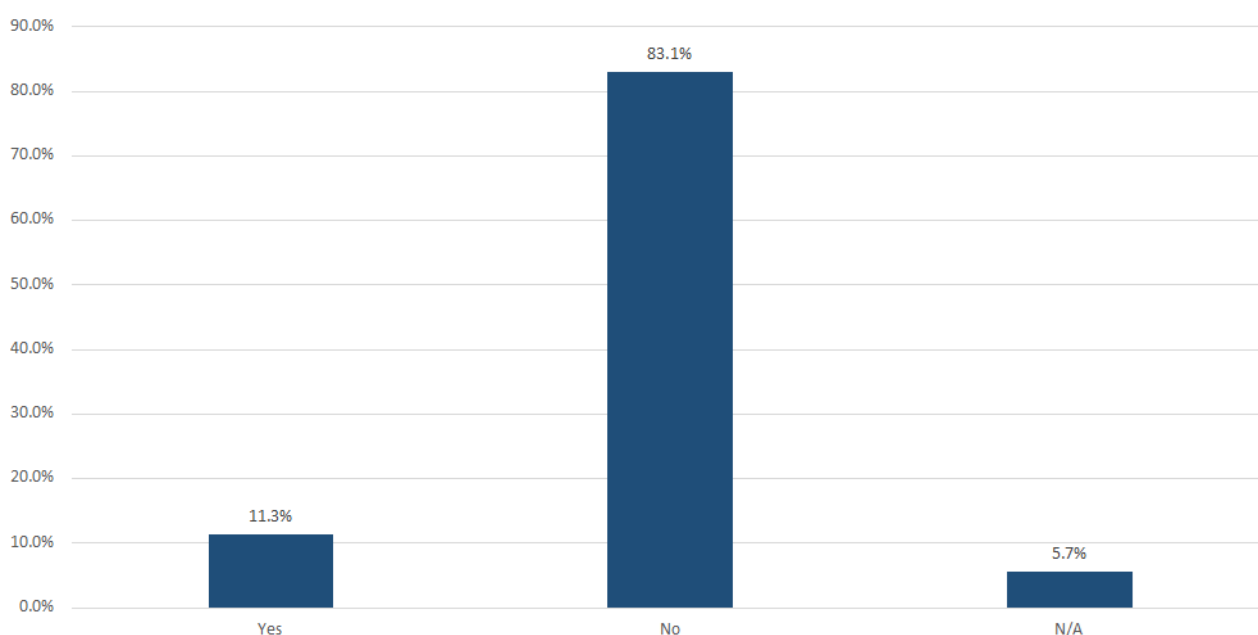
“Reliable and consistent irrigation water supply to meet the demands of growing agricultural enterprises is essential to not only the direct cropping enterprises, but also to the entire town. Bundaberg relies heavily and exclusively on these industries to not only survive, but to continue to grow and expand.” Bundaberg business owner

“While not all the water from Paradise was allocated, the availability of surplus water in the scheme makes new projects requiring water allocations more likely to proceed.” Bundaberg business owner

5.8 Businesses’ ability to mitigate to loss of Paradise Dam’s storage capacity

Survey respondents were asked whether their business was able to mitigate the impact of a permanent reduction in water storage capacity of the Paradise Dam. Only one in ten growers (11.3%) indicated they would be able to mitigate the impact of a permanent reduction in water storage capacity of Paradise Dam. Generally, there are a range of options available to growers as referenced in section 4.9.1 but these are considered insufficient to make up for a reduction in the amount of water that has been or is planned to be accessed from Paradise Dam.

Figure 17. Ability to mitigate the impact of a permanent reduction in water storage capacity of Paradise Dam



Source: *The importance of the Paradise Dam to your business Survey*

Comments from growers able to mitigate the impact are presented in Box 15.

Box 15. Comments from growers able to mitigate the impact

"To a degree. We can source other water, but not necessarily enough." Grower

"We are already looking into the possibility of having to replace all our sprinklers and run with dripper tape on our trees if we are reduced to having to run off a small water allocation. Otherwise we might have to sell up." Grower

"We can purchase more water if it was made available. This however will take away funds that would normally be spent at suppliers in town." Grower

"We have bores on the property and this can be used to top-up river allocations to an extent however not if we have continual low allocations." Grower

Comments from growers unable to mitigate the impact are presented in Box 16.

Box 16. Comment from growers unable to mitigate impact

"We cannot access sufficient water to store in dams, to supply the ongoing demand for water, in the hot summer climate, for our trees on an ongoing basis. We have made significant efforts to maximise our ability to do so, but fall short of our requirements, by a significant margin." Grower

"It will be critical to find the additional water required for our trees as they reach maturity. It will be extremely hard to find water at an affordable price. At present we are limited to dam size by the dept of Natural Resources to 20 megalitres. This is a joke. we will need dams with a total capacity of 200 megalitres. This will never be allowed. Therefore we need Paradise at full capacity. Nothing less will do." Grower

"We don't have any other significant water sources or storage capacity. A permanent reduction at Paradise would result in a permanent reduction in our business." Grower

"Limited underground water might be available but to sink and equip bores is extremely expensive and there is no guarantee that water will be found." Grower

"No. The government in its wisdom has a moratorium on building on farm dams & drilling new bores. Ostensibly, this is to protect overland flows & relieve pressure on underground aquifers, but it also protects the governments water market through Sunwater." Grower

5.9 Alternatives available to Government

Survey respondents were asked whether there were any alternatives available to Government to the restoration of the water resource from the Paradise Dam. Considerable feedback was provided on this issue that can be distilled down to the following options.

- Further investigating and verifying the extent of Paradise Dam's structural issues.
- Remediating the existing Paradise Dam wall.
- Building a new dam, including increasing storage capacity. Further to this, feedback indicated building a dam below the existing wall to reduce cost or building another dam to supplement the Paradise Dam that would continue to operate at 42% capacity.
- Installing flood gates on the existing Paradise Dam wall.
- Providing storage elsewhere in the system. This included building own farm storages, increasing weir and barrage holding capacities, installing bags on walls of weirs, placing gates on Ned Churchward Weir and Ben Anderson barrage.
- Sourcing water from elsewhere in the system including the Kolan.
- Providing compensation to farmers and offering a development fund for installation of improved irrigation equipment and water storages.

The overwhelming feedback though was the need to either rectify the existing wall, or to build a new dam as a priority. Qualitative comments indicated concern about undermining certainty beyond the short term.

6. Estimates of the costs of inaction on Paradise Dam

6.1 Economic model approach

For this project, Adept Economics constructed an economic model for Bundaberg regional irrigated agriculture based on a range of inputs, including:

- production (GVAP, local value), yield, gross margin and agricultural capital stock estimates from a range of sources, including the ABS, ABARES, primary industries departments in Queensland and NSW, industry associations, and academic researchers;
- irrigation water requirements data from CANEGROWERS and academic researchers;
- Announced Allocations data from Sunwater;
- Stakeholder consultation and survey results; and
- land use mapping undertaking by Queensland DNRME.

The time frame of the model is the 30 years out to 2050, with 2020 as the base year, to reflect the long-lived nature of dams. This is a conservative assumption. For instance, Deloitte Access Economics estimated an average remaining asset life of approximately 50 years for ACCC-regulated valleys with dams.⁵⁷

The model was built in Microsoft Excel, using the @RISK add-in, which enables Monte Carlo simulations to be undertaken. Given the large amount of uncertainty around the impacts of inaction on Paradise Dam, and the uncertainty that already exists in agriculture due to the vagaries of the weather, it was considered important to acknowledge this uncertainty by running Monte Carlo simulations to generate confidence intervals for our estimates. As can be inferred from the assumptions in the next section, as with all models, the economic model developed is a simplification of reality. Adept Economics believes these estimates are indicative of the magnitude of costs that are likely to be incurred.

⁵⁷ Deloitte Access Economics, 2013, *Final report - asset lives for State Water's 2014 pricing proposal*, for the Australian Competition and Consumer Commission.

6.2 Assumptions

6.2.1 General assumptions

General assumptions used in the economic modelling are presented in Table 9.

Table 9. General assumptions in the economic modelling

Parameter	Value
Discount rate (real, i.e. excluding inflation) ^a	4% - 7%
Proportion of water requirements sourced from BIS (rather than from bore water or on-farm storages) per annum ^b	50%
Probability Announced Allocation is lower than requirement ^c	10%
GRP of Bundaberg 2018-19 ^d	\$4,280 million
Average annual earnings (FTE) in agriculture ^e	\$50,000
Unemployed in region ^f	2,800
LTU as % of total unemployed ^g	40%

Notes: a. consistent with 4% discount rate used as lower-bound discount rate by Queensland Department of State Development, Manufacturing, Infrastructure and Planning and 7% rate suggested by Infrastructure Australia. b. Not directly observable, but value chosen by calibrating water taken by the scheme in the model to data on water deliveries to irrigators. c. based on analysis of Announced Allocations data available on the Sunwater website. d. NIEIR data presented on economy.id website. e. based on average earnings figures reported on the Seek hiring website for a farm hand. f. Small Area Labour Market data published by the Australian Government Department of Education, Skills and Employment. g. ABS Labour Force Survey data for Queensland.

6.2.2 Irrigated hectares and water requirements by crop type

The model takes into account changes in crop types which we have seen occurring (and expect to continue in the Bundaberg region (Table 10). Hence, it is important to establish a baseline of hectares by key crop types: sugar cane, macadamias, avocados, and other irrigated crops. The baseline was based on Queensland land use mapping data, with a utilisation rate of two-thirds applied to take into account land being unused or fallow in any one year.⁵⁸ This utilisation rate means the estimated land use for sugar cane is close to harvested hectares estimates reported by CANEGROWERS.⁵⁹

Table 10. Hectares utilised and irrigation water requirements by crop type, Bundaberg

Crop type	ha	Irrigation water required ML/ha
Sugar cane	33,768	6.0
Macadamias	5,360	10.0
Avocados	2,814	6.2
Other	7,973	7.0
Total	49,915	

Source: various sources as discussed in the body of the report. Note that the exact irrigation water requirement will depend on rainfall and, for tree crops such as macadamias, the age profiles of trees in the plantation.

⁵⁸ This can be considered a conservative assumption with respect to hectares cultivated with other crops such as macadamias and avocados which do not have the same requirements for land to remain fallow.

⁵⁹ See figures for Bundaberg and Isis in CANEGROWERS, 2018, *Annual Report 2017-18*, p. 8.

As well as presenting our baseline estimates of hectares by crop type, Table 10 also presents estimated irrigation water requirements taking into account the average effective level of rainfall per annum in the Bundaberg region (around 580mm).⁶⁰

6.2.3 Yields and value of production

The model incorporates the different yields and production values of different crop types. Yields are expressed in tonnes per hectare, and the value of total tonnes of production is estimated by assumptions regarding farm gate values, based on the best available data and estimates of long-run average prices, in real inflation-adjusted terms (Table 11). These are converted to Gross Value of Agricultural Production (GVAP) estimates by adjusting for transport and wholesale margins, based on ABS data. While GVAP represents the value of production, and farmgate value represents revenue of farmers, neither represents profit. In agricultural economics, gross margin estimates are used to represent the profitability of crops, as it measures revenue less variable production costs, excluding fixed costs and depreciation. It is the gross margin figures rather than the GVAP figures which would be relevant in a CBA.

⁶⁰ Schroeder, et al., 2009, p. 16. Note the effective level of rainfall corresponds to the amount of rainfall which enters the soil.

Table 11. Yields and value of production and gross margins

Crop type	Yield tonnes/ha	Farmgate value \$/tonne	Margin to calculate GVAP ⁱ	Gross margin \$/ha
Sugar cane	85.00 ^a	45 ^e	4.50%	1,200 ⁱ
Macadamias	2.72 ^b	5,200 ^f	2%	6,900 ^k
Avocados	8.00 ^c	5,200 ^g	9%	9,400 ^l
Other	50.00 ^d	1,000 ^h	11%	19,000 ^m

Notes: a. Information provided by Bundaberg CANEGROWERS.

b. Macadamia Industry Benchmarking Report, p. 18 (nut in shell figure).

c. Based on Queensland DPI gross margins workbook, year 6.

d. Estimate of yield for tomatoes based on mid-range of NSW Government Industry & Investment Gross Margin Budget for Tomatoes.

e. Based on analysis of gross margins data prepared by Bundaberg CANEGROWERS and on consultations with Bundaberg CANEGROWERS.

f. Approximate 5-year average of nut-in-shell price, which is preferable to historical average as reflects step up in demand internationally, based on Australian Macadamia Society website data.

g. Avocados Australia, 2019, Facts at a Glance 2018/19, p. 3.

h. Assumption based on information on Ausveg website.

i. Margin assumptions based on ratio of GVAP to local value in ABS, 7503.0, Value of Agricultural Commodities Produced, 2017-18.

j. Based on historical gross margin estimates from Bundaberg CANEGROWERS, inflation-adjusted.

k. Queensland Government, 2019, Macadamia Benchmarking Report, p. 22.

l. Based on 1999 Queensland DPI spreadsheet for 5 year old tree, inflation-adjusted.

m. Assumption based on information on Ausveg website.

6.2.4 Capital investment by crop type

Another important element of the economic model is capital investment or capital expenditure (CAPEX) by crop type. Capital investment occurs in the model when additional hectares are added to hectares already under cultivation. CAPEX is relevant to both CBA and economic impact analysis. In a CBA it would be necessary to offset gross margin benefits by required capital investment. In an economic impact analysis, capital investment can have impacts on gross regional product (GRP) and full-time equivalent (FTE) employment. Assumptions regarding capital investment per hectare in Table 12 are based on a range of sources. For simplicity, the CAPEX/ha is assumed not to vary with the previous use of the land.

Table 12. Capital investment required by crop type, Bundaberg

Crop type	CAPEX \$/ha
Sugar cane	9,400 ^a
Macadamias	69,000 ^b
Avocados	62,900 ^c
Other	25,800 ^d

Notes: a. Based on ABARES reported average asset value of \$3.1 million (p. 20) and average farm area of 367 hectares, adjusted for inflation.

b. Calculated as 10x gross margin to reflect a realistic payback period. This estimate is consistent with CAPEX estimates provided by industry participants which ranged up to \$100,000/ha.

c. Qld Department of Agriculture and Fisheries gross margin analysis from 2007, adjusted for inflation.

d. ABARES vegetable farms financial performance survey data for Queensland, available via the ABARES website, adjusted for inflation.

6.2.5 Social costs

In addition to the lost economic value of long-term unemployment, we have estimated a broader range of social costs associated with inaction on Paradise Dam largely based on recent Deloitte Access Economics's estimates of the economic and social costs of the North and Far North Queensland monsoon trough in early 2019.⁶¹ Inaction on Paradise Dam is expected to cause distress among irrigators and to result in a range of social problems and social costs, including mental health problems, alcohol abuse, and family violence. To calculate the number of people potentially affected, we took the 1,360 agricultural businesses in Bundaberg LGA as at 30 June 2018, according to the ABS and multiplied it by 50% to obtain a conservative estimate of the number of people potentially at risk of the above-mentioned social problems. Further assumptions underpinning the estimates in the report are set out in Table 13.

Table 13. Social cost assumptions

Type of cost	Incidence	Average cost per person per annum
Mental health	13.5%	\$38,400
Alcohol misuse	1.1%	\$2,300
Family violence	1.9%	\$27,900

Source: Adept Economics assumptions based on Deloitte Access Economics (2019, p. 29).

6.2.6 Offsetting environmental benefit

Our estimated avoided cost of any environmental externality associated with a reduction in available water at Paradise Dam is based on estimates in the 2016 Alluvium study for the Queensland Government Department of Environment and Heritage Protection which suggest these would only provide a minor offset to the cost of inaction estimates.⁶²

⁶¹ Deloitte Access Economics, 2019, *The social and economic cost of the North and Far North Queensland Monsoon Trough*, report prepared for the Queensland Reconstruction Authority.

⁶² Alluvium, 2016.

Alluvium's 2016 report reported an estimated total cost of achieving target reductions in loads of dissolved nitrogen and sediment going to the Great Barrier Reef from a base year of 2013 to 2025 of only \$13.3 million for the Burnett Mary region, out of a total of \$8.21 billion. The Bundaberg region is right at the southern end of the Great Barrier Reef and makes minimal contribution to environmental damage to the Reef, the vast bulk of which emanates from the Fitzroy and Burdekin regions.

Nonetheless, for completeness we have incorporated an estimate of the environmental externality avoided by assuming the cost per annum of meeting Reef targets implied in the Alluvium report persist until 2050, and scaling the estimate down to reflect the contribution that would have been made by additional water capacity in Paradise Dam.

6.2 Economic modelling scenarios

Based on the desktop analysis and stakeholder consultations, we have formulated scenarios (alternative versions of the future) to simulate in the economic model with a view to quantifying the cost of inaction on Paradise Dam. The two scenarios are:

- **base case scenario:** Paradise Dam level is not lowered (no assumptions are made regarding what CAPEX is required to achieve this); and
- **inaction on Paradise Dam scenario:** whereby growth in hectares cultivated (by different crop types) and CAPEX are affected by the decline in water security, and there are also implications for irrigation water applied and GVAP in years in which Announced Allocations provide insufficient water (and inaction on Paradise Dam means the Announced allocation is lower than in the base case).

The inaction on Paradise Dam scenario is essentially a scenario on the likely development of irrigated agriculture in the affected region out to 2050 if the level of Paradise Dam is permanently lowered by up to 10m.

Lower, medium, and upper-bound values were developed for critical values, specifically:

- percentage growth per annum in hectares by different crop type, noting the switch in land use type from sugar cane to macadamias which has occurred in recent years and would have been expected to continue, along with associated CAPEX;
- growth of GRP of Bundaberg in base case and Paradise Dam-inaction scenarios, and a deviation from the GRP baseline due to inaction on Paradise Dam adversely

affecting the attractiveness of Bundaberg as a place to invest and undermining the viability of existing manufacturing industries (including sugar milling)⁶³; and

- increase in long-term unemployment associated with a reduction in economic opportunities in Bundaberg associated with inaction on Paradise Dam.⁶⁴

In the inaction on Paradise Dam scenario, we are assuming there is no longer any growth in tree crops such as macadamias and avocados, and possibly declines in hectares of tree crops, as such crops require regular watering so they do not perish before they reach their peak years of production in after 5-10 years. Hectares of sugar cane would decline at a faster rate as growers are assumed to take advantage of high prices for water entitlements associated with Paradise Dam inaction (and which were confirmed in stakeholder consultations and by recent auction data). Parameters for the economic modelling scenarios are presented in Table 14.

⁶³ The assumed deviation from the baseline GRP assumption is also informed by potentially fewer professional jobs being available. Stakeholder consultations revealed the switch toward tree crops was attracting a more professional workforce (including e.g. agronomists) to Bundaberg.

⁶⁴ To calculate the economic cost of long-term unemployment we compare expected earnings, taken as the average earnings of agricultural workers in model and subtract the reservation wage/value of leisure, assumed to be 33% of earnings, a standard assumption.

Table 14. Economic modelling scenarios

Parameter	Base case (lower bound)	Base case (central value)	Base case (upper bound)	Dam inaction (lower bound)	Dam inaction (central value)	Dam inaction (upper bound)
Change in ha p.a.						
- Sugar cane	-1.0%	-0.5%	0.0%	-1.5%	-1.0%	-0.5%
- Macadamias	2.0%	4.0%	5.0%	-1.0%	-0.5%	0.0%
- Avocados	2.0%	4.0%	5.0%	-1.0%	-0.5%	0.0%
- Other	2.0%	4.0%	5.0%	0.0%	0.2%	0.5%
GRP growth rate	2.0%	2.5%	3.0%	2.0%	2.5%	3.0%
Deviation from GRP baseline	-	-	-	0.0%	0.5%	0.75%
Increase in long-term unemployed	-	-	-	0.0%	10.0%	15.0%

Source: Adept Economics assumptions based on desktop review and stakeholder consultations.

Short-run economic impacts are incorporated by assuming, in the years when Announced Allocations are insufficient to provide necessary irrigation water, that there is a direct translation of reduced water into tonnes of production, GVAP, and gross margins via the assumptions set out in Table 10 and Table 11. In line with informal advice received by growers from Sunwater representatives, it is assumed that, in the Paradise Dam inaction scenario, in the years when Announced Allocations are insufficient to provide necessary irrigation water, available water would be reduced by 5% of entitlements.

6.3 Estimates of the costs of inaction on Paradise Dam

6.3.1 Central estimates

Using the regional economic model outlined above, and the assumptions and scenarios defined, we have estimated the potential cost of inaction on Paradise Dam as being in the order of \$2.4 billion in present value (PV) terms over the next thirty years (2020-21 to 2049-50), relative to the counterfactual in which Paradise Dam is assumed to be maintained in its originally intended capacity (Table 15).

Table 15. PV of estimated total costs of inaction on Paradise Dam over 30 years, excluding short-run impacts

Cost item	\$ million @4% real discount rate	\$ million @7% real discount rate
Gross margin forgone due to lower investment and irrigated agricultural production	2,769.3	1,632.9
CAPEX reduction	-861.0	-570.7
Lower productivity across economy as a result of lower regional investment	378.0	288.1
Social costs (i.e. long-term unemployment, mental health, alcohol abuse, family violence)	142.8	102.5
Offsetting environmental benefit from reduced dissolved nitrogen and sediment	-2.7	-1.6
Total	2,426.3	1,451.2

Source: Adept Economics estimates, 2020.

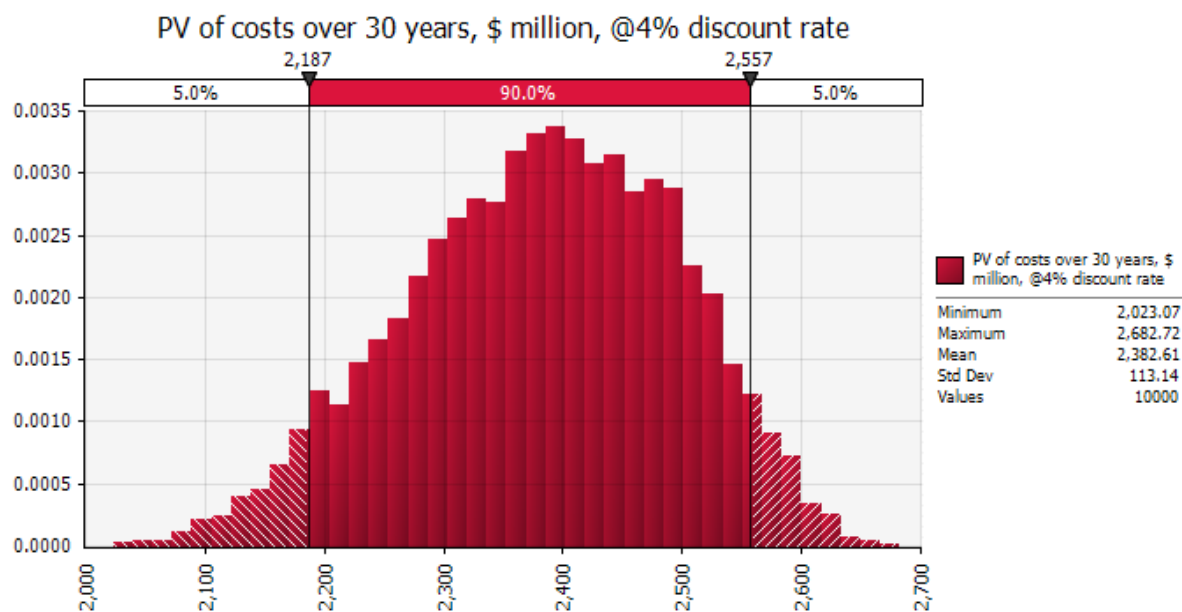
This economic cost estimate would need to be compared with the estimated cost of repairing Paradise Dam, or of undertaking alternative measures which guarantee the same degree of water security. Incidentally, the full cost estimate suggests a value of each ML of capacity

slated to be lost in Paradise Dam of \$13,900/ML to \$14,000/ML. In terms of the total value of production lost, that amounts to a much larger number of \$48,100/ML, as approximately \$8.4 billion of production could be lost over the thirty years to 2050 if there is inaction on Paradise Dam.⁶⁵

6.3.2 Sensitivity analysis using @RISK Monte Carlo simulations

Taking into account the risk Announced Allocations due to Paradise Dam inaction would be less than necessary to provide irrigation water, and to account for other uncertainties in the model, we have run Monte Carlo simulations in @RISK, using 10,000 iterations. The Monte Carlo simulations demonstrate a wide range of potential outcomes, with a potential economic cost over 30 years of over \$2½ billion (Figure 18). The 90% confidence interval for the economic cost runs from \$2.187 billion to \$2.557 billion, using a 4% real discount rate.

Figure 18. PV of total cost of Paradise Dam inaction, probability density function, @RISK Monte Carlo simulation



Source: Adept Economics estimates using the @RISK add-in to Excel.

It should be noted that we have focussed on impacts in the Bundaberg LGA region. Based on consultations with WBBROC, Paradise Dam has the potential to facilitate development in

⁶⁵ All the figures quoted in the paragraph are calculated using a 4% real discount rate.

the neighbouring North Burnett LGA, which would augment our estimate of the costs of inaction.

7. Conclusions

This study has revealed potentially large costs to the Bundaberg community of a permanent reduction in Paradise Dam's water storage capacity. There are also implications for the state economy, given Bundaberg's substantial contribution to Queensland agricultural activity in total. In making its final decision on Paradise Dam, the Queensland Government needs to take full account of these economic and social costs. The Government is rightly concerned about the costs of any mitigation measures relating to Paradise Dam, but it needs to consider the full magnitude of the avoided costs which would result from such mitigation measures.

Finally, while difficult to quantify, the Queensland Government should note that it sends a negative signal to investors, both domestic and foreign, when governments unexpectedly reverse previous policy and infrastructure commitments. Previous Queensland Governments saw Paradise Dam as an essential part of the economic development of the Bundaberg region, and based on our stakeholder consultations and survey results, that view is widely shared in the Bundaberg community.

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Appendices

Appendix A: Organisations and individuals consulted

- Australian Macadamia Society
- Bundaberg Fruit & Vegetable Growers
- Bundaberg Regional Council
- Bundaberg Regional Council – Cultural Development
- Bundaberg Tourism
- Burnett Mary Regional Group
- CANEGROWERS ISIS
- DNRME
- Geoff Chivers
- Greensill Farming
- IMPACT
- J&R McCracken
- Marland Law
- McDonald Murphy
- Queensland Farmers Federation
- Red Rock Macadamias
- Sunfam
- Ulton
- Vanderfield

Appendix B: Issues discussed in stakeholder consultations

The following interview questions were asked as part of the interviews.

- Please indicate what type of business you are, your postcode, how many full-time equivalent employees your business has and the turnover range of your business for 2018-19.
- Please provide a brief overview of your business (e.g. years in operation, whether it is a family owned business and the goods and services it provides, etc.)
- How much water is your business licensed to take each year (Nominal Allocation in megalitres) from the Bundaberg Irrigation Scheme? How does this work?
- How is this water used by your business?
- Has your business ever failed to use its full licensed nominal allocation of water from the Bundaberg Irrigation Scheme?
- How important do you consider the Paradise Dam's water resource is for your business?
- Has your business made investments since the Paradise Dam was built in 2005 contingent upon the availability of its water supply?
- How important do you consider the Paradise Dam's water resource is for the Bundaberg community?
- Are you aware of any other major projects planned for the Bundaberg region that are contingent upon the capacity of the Paradise Dam?
- How important do you believe it is to restore the Paradise Dam to its original and intended capacity?
- What do you anticipate will be the resulting impact on your business if the Paradise Dam is not restored to its original capacity?
- Is your business able to mitigate the impact of a permanent reduction in water storage capacity of the Paradise Dam?
- Are there any alternatives available to Government to the restoration of the water resource from the Paradise Dam?
- Can you please describe in words what the water resource from the Paradise Dam means to your business and the region.

Appendix C: Crops grown in Bundaberg-North Burnett

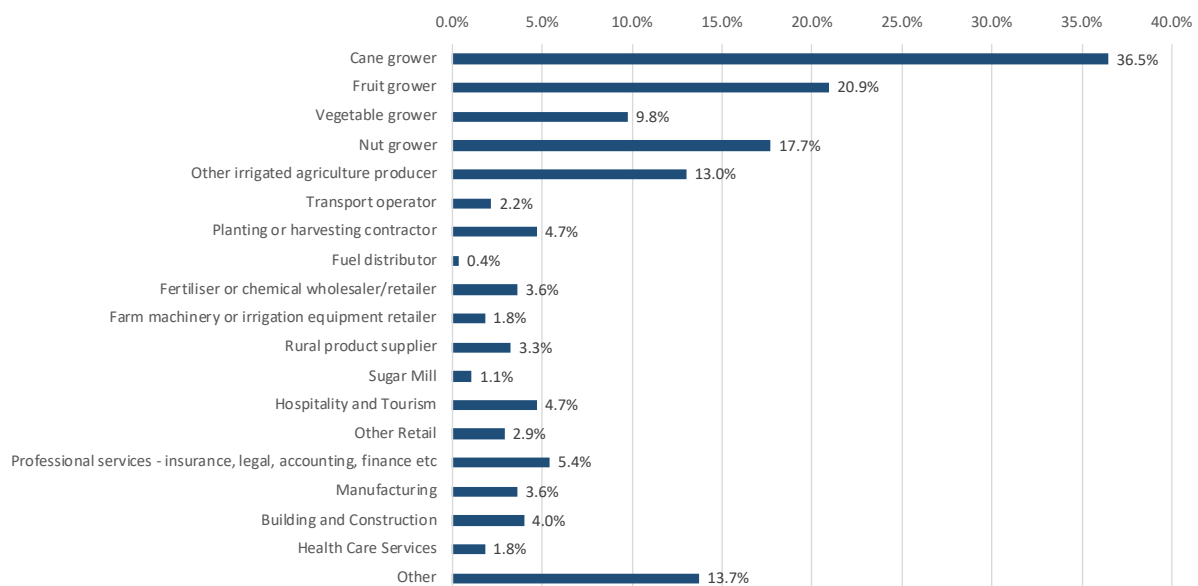
- Avocado
- Banana
- Beans
- Blackberry
- Blueberry
- Broccolini
- Button Squash
- Capsicum
- Chilli
- Citrus (Lemon, Orange)
- Cucumber
- Custard Apple
- Cut flowers
- Dragon Fruit
- Eggplant
- Figs
- garlic
- Ginger
- Herbs
- Honey Dew Melon
- Limes (Tahitian)
- Lettuce (loose variety)
- Lychee
- Macadamia
- Mandarins (Imperial)
- Mango
- Medicinal Hemp
- Passionfruit
- Pineapple
- Popcorn
- Potatoes
- Pumpkins
- Raspberry
- Rockmelons
- Snow Peas
- soybeans
- Strawberries
- Sugarcane
- Sweet Corn
- Sweet Potato
- Tomato
- Tumeric
- Watermelon
- Vanilla
- Zucchinni

Appendix D. Survey demographics

The survey was run over the period 14 January – 31 January 2020, with 283 responses received. The survey was distributed by Bundaberg Fruit and Vegetable Growers, the Bundaberg Chamber of Commerce, Bundaberg CANEGROWERS and CANEGROWERS Isis to their respective memberships. The survey provided both quantitative and qualitative questions and 1,318 individuals comments were received in relation to the Paradise Dam.

Canegrowers (36.5%), Fruit growers (20.9%), vegetable growers (9.8%), nut growers (17.7%) and other irrigated agriculture producers (13.0%) represented the largest categories of businesses completing the survey. The largest segment of non-irrigated business completing the survey was professional services-insurance, legal, accounting and finance (5.4%).

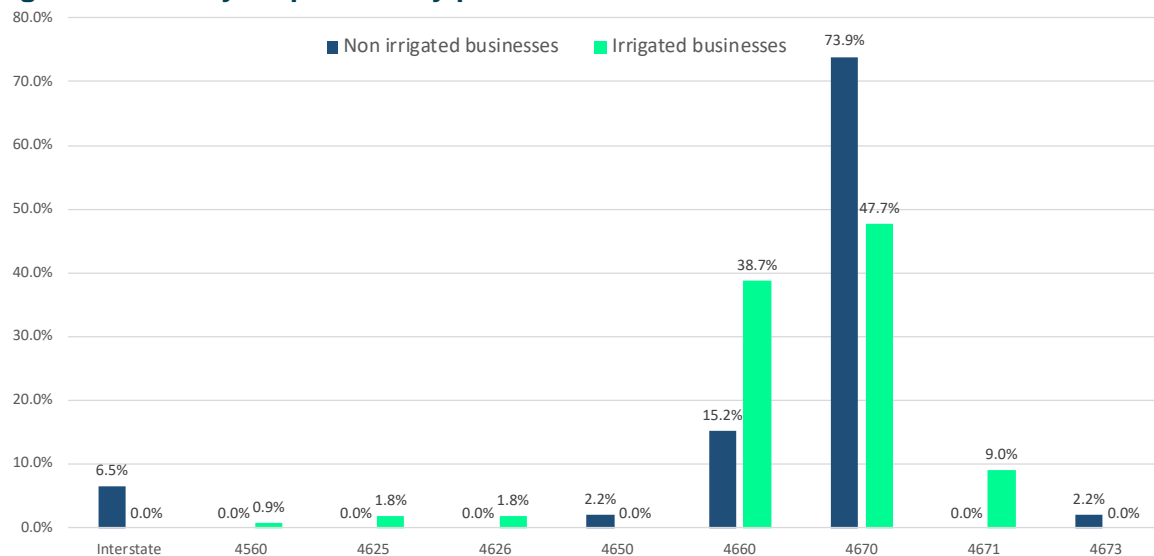
Figure 19. Survey respondent by type of business



Source: The importance of the Paradise Dam to your business Survey

The majority of irrigated business respondents came from the 4660, 4670 and 4671 postcodes and the majority of non-irrigated businesses responses came from Bundaberg (4670).

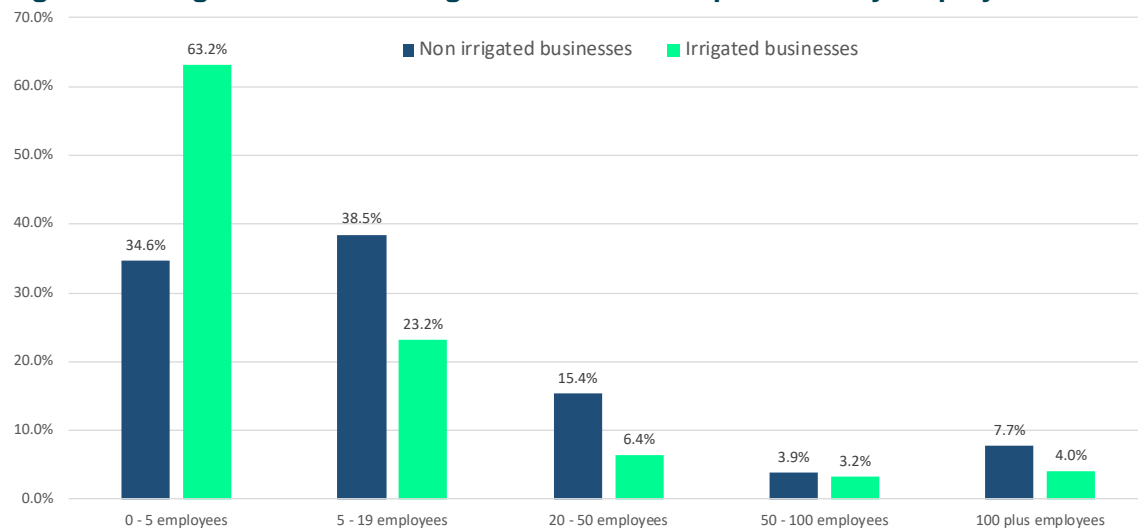
Figure 20. Survey respondent by postcode



Source: The importance of the Paradise Dam to your business Survey

Nearly two in three responses for irrigated businesses came from a grower employing less than 5 employees. For the non-irrigated businesses nearly two in five responses came from a business employing between 5 to 19 employees. 86% of irrigated business and 73% of non-irrigated businesses are defined as being a small business.

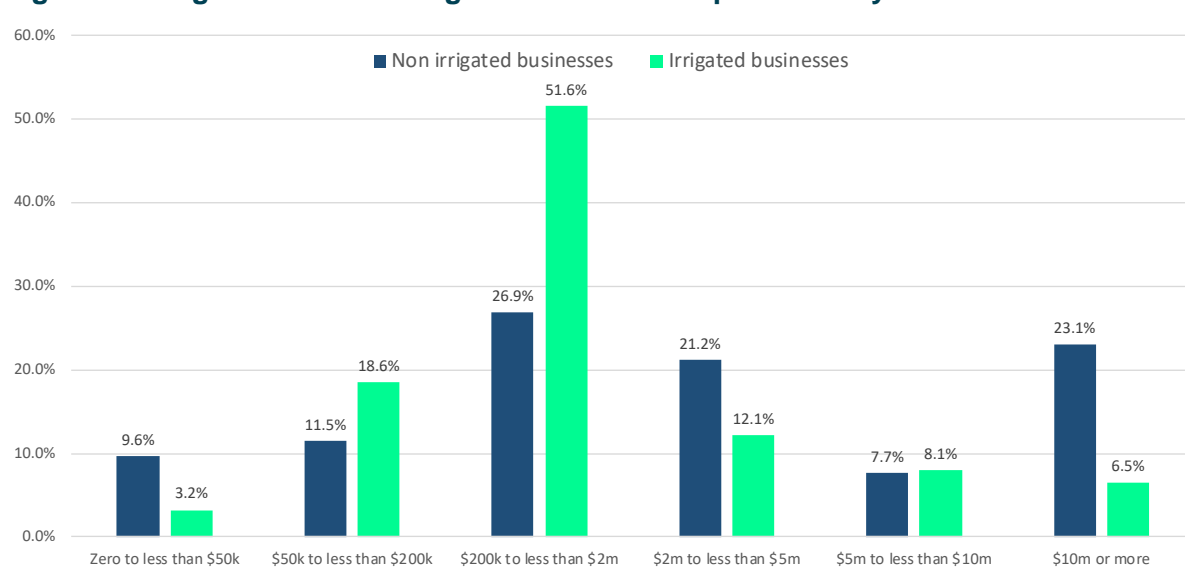
Figure 21. Irrigated and Non-irrigated Business respondents by employment size



Source: The importance of the Paradise Dam to your business Survey

Over half (51.6%) of irrigated businesses had a turnover between \$200,000 and \$2 million. The distribution of non-irrigated business turnover was more even but the largest proportion of businesses also fell in the \$200,000 and \$2 million range.

Figure 22. Irrigated and Non-irrigated Business respondents by turnover size



Source: The importance of the Paradise Dam to your business Survey

About the authors

Gene Tunny is the Founder and Director of Adept Economics, a Brisbane-based consultancy which specialises in economic modelling and cost-benefit analysis. He is a former Australian Treasury official with experience in domestic and international issues.

In recent years, Gene has been a course leader and expert presenter for several short courses delivered by University of Queensland's International Development unit. These courses have covered topics such as best practice policy development, industry policy and trade policy (e.g. tariff policies), cost benefit analysis, taxation, natural resource economics for officials from Indonesia's Ministries of Finance (Kemenkeu) and National Development Planning (Bappenas).

Gene has a first-class honours degree in economics from the University of Queensland and was a University Medallist. He has also lectured in UQ's School of Economics, most recently as course leader for ECON2040 Macroeconomic Policy.

Gene appears frequently in state and national media (e.g. the Courier-Mail, The Australian, and on 612 ABC Brisbane) commenting on economic issues.

Nick Behrens is a Senior Associate of Adept Economics and the Director of QEAS. Across his professional career Nick has realised many outstanding outcomes to complex challenges for the business community. He possesses significant experience in gathering and presenting information, and leveraging that information to achieve results across a range of economic areas including taxation, regulatory environment, workers compensation, employment legislation, and infrastructure and planning issues.

Nick's representations are based on extensive research and his preferred approach to advocacy has always been to achieve results rather than headlines, by working with stakeholders behind the scenes to secure positive outcomes.

He places much emphasis on having a thorough and convincing set of arguments that are readily understood and in turn lead to real world solutions.