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ECONOMIC IMPACT ASSESSMENT OF THE NATIONAL RADIOACTIVE WASTE MANAGEMENT FACILITY

KIMBA, SOUTH AUSTRALIA

REPORT FOR THE DEPARTMENT OF INDUSTRY, INNOVATION AND SCIENCE

JULY 2018

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EXECUTIVE SUMMARY

The Australian Government is seeking to establish a National Radioactive Waste Management Facility (NRWMF) at a suitable site to dispose of low level waste (LLW) and temporarily store intermediate level Waste (ILW).

Two of the three sites under consideration for the NRWMF are near Kimba. The first of these is 'Napandee' which is 25 kilometres west of Kimba and the second is 'Lyndhurst' which is located 15-20 kilometres north east of Kimba.

This report assesses the economic impacts of the proposed facility on the Kimba region considering both the construction and operational stages of the project in terms of both expenditure and staffing requirements. The modelling inputs are based on the best available information available at the time and are subject to review. For example, the capital expenditure is based on theoretical costs provided by the Department of Industry, Innovation and Science, and are subject to change over time.

Hosting a facility such as the NRWMF does raise concerns over potential detrimental impacts on land prices, agricultural market access and prices as well as tourism impacts. To address these concerns, this report contains a desktop review of the literature on potential adverse impacts in Australia and overseas of hosting a facility such as the NRWMF. This review finds no credible evidence of any adverse impacts and so has been excluded from the modelling.

Economic impacts

Kimba has a population of 1,040 people, although the population is expected to decline over time.[1] The region is heavily concentrated on agricultural production. The labour market is characterised as having relatively high participation rates compared with the broader South Australian region, and relatively low levels of unemployment according to data produced by the Australian Bureau of Statistics (ABS).

The economic impact assessment of the NRWMF is based on an application of a computable general equilibrium (CGE) model which has been customised to include the Kimba region as a distinct operating economy.

The results show that the NRWMF is projected to confer economic benefits to Kimba. These benefits are driven by an increase in demand for goods and services through both the construction and operational phases of the NRWMF, the increase in supply of workers moving to the region during the operational phase as well as a wage premium for all workers at the facility.

The results show that by 2030, when the NRWMF is fully operational, real Gross Regional Product (GRP – which is a measure of the goods and services produced in the region), in Kimba is projected

[1] Source: Department of Planning, Transport and Infrastructure, Government of South Australia, 2016, *Population Projections for South Australian Local Government Areas, 2011-31, February 2016 release*, it is unlikely that the South Australian Government projection includes any potential impacts of the proposed facility.

to be 4.9 per cent higher than reference case levels which equates to a $8.4 million increase in real 2018 dollars, see Table 1. Over the first 33 years of the project,[2] from 2021 to 2054, the net present value (NPV) of the projected increase in real GRP in Kimba is just over $95 million.

Table 1: Projected economy-wide impacts for Kimba under the central case scenario

Variable	Description	Result
Real GRP	2030 - Deviation (%)	4.9
	2030 - $m (real 2018)	8.4
	NPV - $m^	95.2
Real GRI	2030 - Deviation (%)	4.7
	2030 - $m (real 2018)	9.1
	NPV - $m	119.0
Employment	2030 - Deviation (%)	2.5
	2030 - FTE	16.6
Real wages	2030 - Deviation (%)	5.9
Real GRI per Capita	2030 - Kimba (real 2018)	7,658.9

Source: Cadence Economics estimates. ^ NPV is presented in real 2018 dollars, discounted over the period 2021 to 2054 using a 7% real discount rate.

In welfare terms, real GRI is projected 4.7 per cent higher ($9.1 million in real 2018 dollars) in Kimba at 2030. These projected welfare increases are reflective of positive labour market outcomes in terms of employment and real wages.

In terms of labour market outcomes, the NRWMF will employ 45 FTE directly. Of these, 34 FTE are drawn from the local labour market which have been redirected to work in this facility from the existing pool of employed persons in Kimba under conservative assumptions. The additional 11 FTE are relocated to the region to work in the facility.

As shown in Table 15, the projected net additional economy-wide increase in employment in 2030 in Kimba is 16.6 FTE. This is comprised of the additional 11 FTE that relocate to the region to work in the facility as well as 5.6 FTE being the result of positive flow on economic effects of the NRWMF.

The projected increase in economic welfare in 2030 in Kimba, real GRI, is $7,659 per capita in 2030.

Sensitivity analysis

To test the robustness of the results, sensitivity analysis is conducted on: the local content of construction work undertaken; the assumed spend by outside construction workers in the region;

[2] As recognised by Infrastructure Australia, *Assessment Framework. Infrastructure Australia (March 2018). p102* as a result of 'uncertainty of demand modelling over longer time horizons, many jurisdictions suggest 30-year appraisal periods'. The EIA has considered 30 years of full operations for the NRWMF, in addition to a construction and pre-operational phase of 3 years, recognising the uncertainty associated with waste production and demand management activities post 2054.

and the responsiveness of the labour market in the region to the economic stimulus that accompanies the NRWMF through both the construction and operational phases of the facility.

The results show that the estimated impacts are not overly sensitive to assumptions around the local content of construction work undertaken nor the assumed spend by outside construction workers in the region. However, the responsiveness of the labour market did have a material impact on the projected results. For example, the more responsive the labour market is to the employment opportunities resulting from the NRWMF, the higher the economic impacts in the region.

Under the scenario where the labour supply elasticity is doubled, the projected increase in real GRP is 5.3 per cent at 2030 compared with the central case projection of 4.9 per cent. This projected increase in economic activity in 2030 is because when the labour market is more responsive to increases in demand, more resources are drawn into the economy leading to higher levels of production and income (the reverse is also true).

1 INTRODUCTION

The Australian Government is seeking to establish a National Radioactive Waste Management Facility (NRWMF) for LLW disposal and ILW storage.

The LLW materials include health by-products, contaminated soils, operational waste from research reactors and lightly contaminated laboratory items such as paper, plastic and glassware. Examples of ILW include waste from the production of radiopharmaceuticals, waste generated by the reprocessing of spent research reactor fuel and disused radioactive sources from industry and medicine.

Three sites in South Australia are currently under consideration, one near Hawker and two near Kimba. The site at Wallerberdina Station is approximately 30 kilometres north west of Hawker. Of the remaining two sites, the first of these is 'Napandee' which is 25 kilometres west of Kimba and the second is 'Lyndhurst' which is located 15-20 kilometres north east of Kimba.

A key element of the site selection process is to engage with the community on a range of issues, including the potential economic impacts of the NRWMF on the economies in closest proximity to the facility.

Against this background, Cadence Economics has been commissioned by the Department of Industry, Innovation and Science to consider the economic impacts of the proposed NRWMF. This report assessed the economic impacts of the proposed NRWMF on Kimba. The analysis has two elements. First, a quantitative economic assessment of the impacts of the NRWMF on Kimba. Second, an assessment of evidence in relation to the economic impacts of comparable sites, considering any measurable effects on a range of factors such as house prices, agricultural production and tourism.

This report begins with an overview of the economic characteristics of the Kimba region of South Australia in Section 2. An overview of the economic scenarios considered is presented in Section 3. The results of the economic modelling are presented in Section 4. Section 5 considers the evidence of economic impacts of comparable sites and Section 6 outlines the conclusions of the analysis.

2 THE KIMBA REGION

The District of Kimba (Kimba) LGA covers a total area of 5697.1 square kilometres is located west of Whyalla in the northern Eyre Peninsular. The region includes a single major population centre of Kimba, see Figure 1.

Figure 1: District of Kimba Local Government Area

Source: Google Maps

In 2018 the region's population was estimated at 1,040 people, less than 0.1 per cent of the South Australian population. Gross Region Product (GRP) in the region is estimated to be almost $120 million dollars in the same year.

Employment and Industry Structure

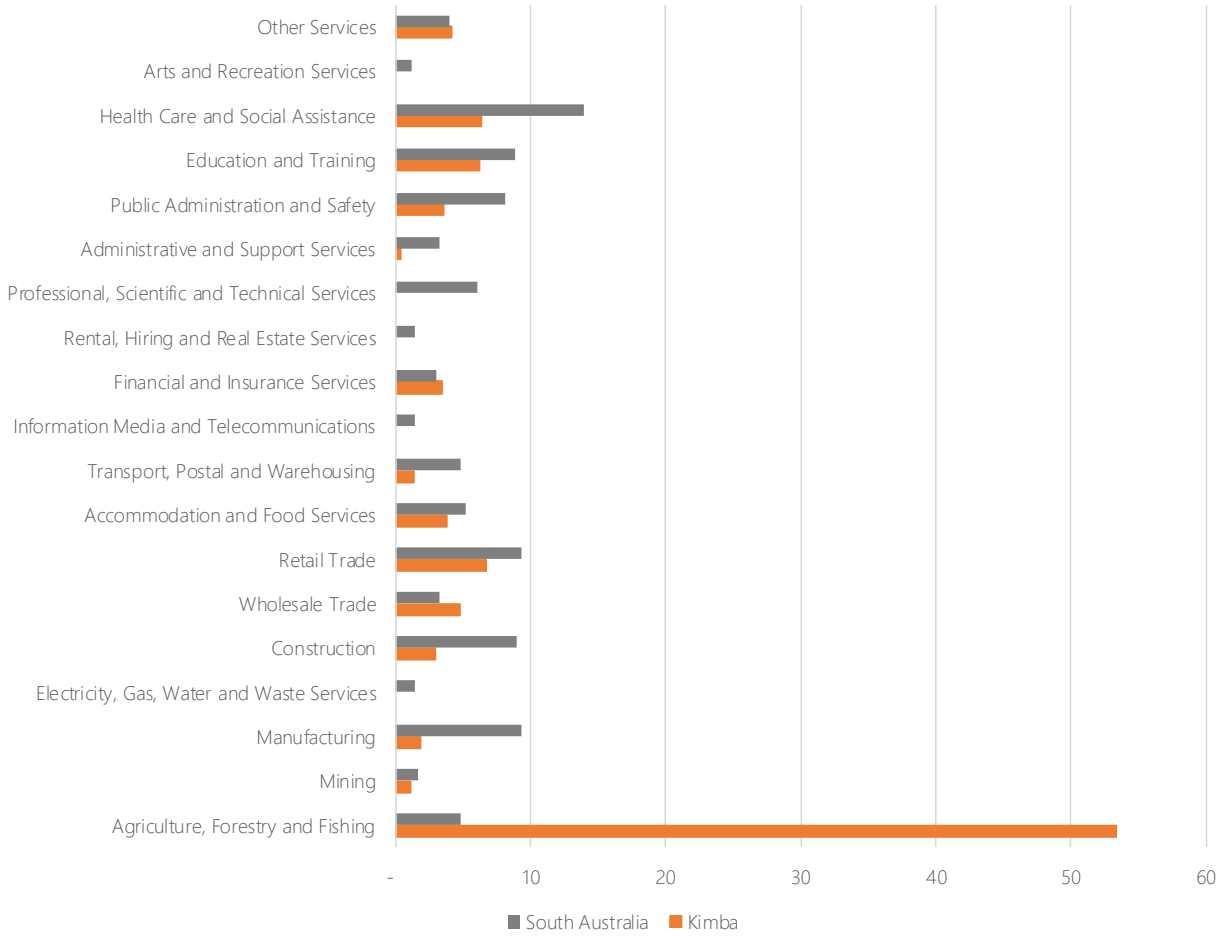
This section outlines the proportion of employment and value added, by 1 digit ANZSIC industry[3] and is based on 2016 Census information. As shown Figure 2, the employment profile in the region is distinct from the broader South Australian economy, with high concentration of employment, 53 per cent, in Agriculture.

This region also has a relatively small construction sector employment with 3 per cent of the workforce compared to 8.9 per cent share state-wide. Importantly, for the NRWMF, there are a small pool of construction workers in the region comprising 16.3 full time equivalent (FTE) workers.

[3] ANZSIC or the Australian and New Zealand Standard Industrial Classification is the industry classification used by the Australian Bureau of Statistics. The 1 Digit ANZSIC categories, including industries like Agriculture, Forestry and Fishing, Mining and Retail Trade.

In addition, the region has several sectors that to not employ workers within the region, including Electricity, Gas, Water and Waste Services, Telecommunications, the Arts and Professional, Scientific and Technical Services.

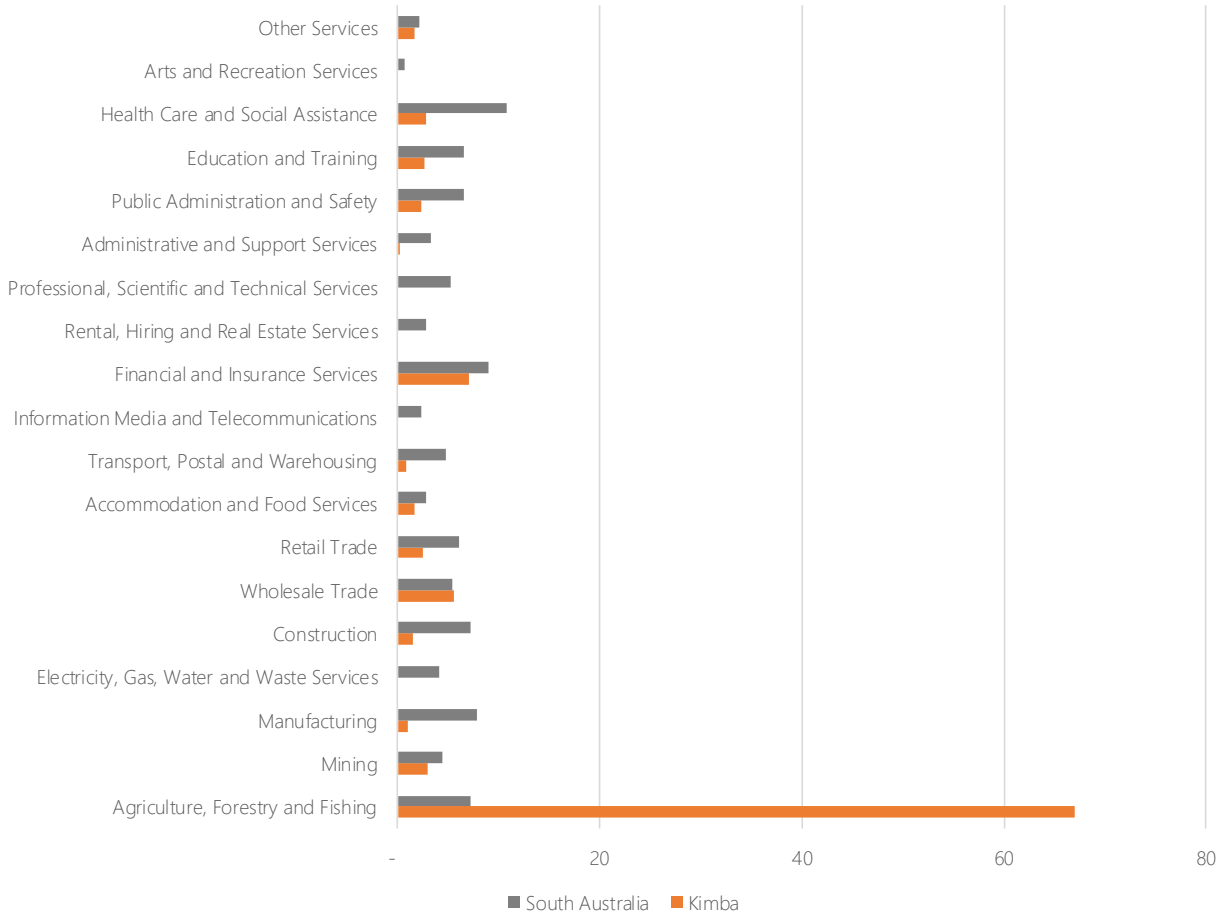
Figure 2: Share of employment by industry sector in selected regions (% of FTEs in 2016)



Source: Cadence Economics estimates based on 2016 Census data

These trends continue when we consider the value added generated by industry within the region. A high proportion of the value added in the region is generated within the Agriculture sector, with 67 per cent of industry value added, see Figure 3.

Figure 3: Share of value added by industry sector in selected regions (% of FTEs in 2016)



Source: Cadence Economics estimates based on 2016 Census data

Occupations

Kimba is characterised as having a relatively high proportion of Managers with almost a 40 per cent share of the workforce (Figure 4). The occupational breakdown is in keeping with the industry structure within the region, with Agriculture employing a high proportion of both Managers and Labourers.

Figure 4: Share of employment by occupation in selected regions (% of FTEs in 2016)

Source: Cadence Economics estimates based on 2016 Census data

Population

This section highlights the age breakdown within the region and the future population dynamics.

In 2018, the age demographic of the Kimba region is generally older when compared to South Australia as shown in Table 2. People in the working age population, contribute a relatively small proportion of the population, 58.8 per cent, compared with 64.0 per cent for South Australia. In addition the region has a higher share of younger persons aged between 0-14 and a significantly higher proportion of older persons 22.5 per cent compared to 18.2 per cent in South Australia.

Table 2: Regional Population profiles (2018)

	0-14	15-64	65+	Total
Population (Persons)				
Kimba	194	611	234	1,040
South Australia	310,195	1,116,565	318,393	1,745,153
Population share (%)				
Kimba	18.7	58.8	22.5	100.0
South Australia	17.8	64.0	18.2	100.0

Source: Cadence Economics estimates from the South Australia Department of Planning, Transport and Infrastructure, *Population Projections for South Australian Local Government Areas, 2011 – 2031*, February 2016

Over the period to 2031 the region is projected to experience a significant shrinking population and working population share (Table 3).

Over the period 2018 to 2031 the total population in Kimba is projected to fall at the annual rate of 0.9 per cent and the working population will also fall at an annual rate of 1.4 per cent. Overall the

share of the working population is projected to fall from 58.8 per cent in 2018 to 55.2 per cent in 2031, significantly lower than the projected South Australian working population share.

Table 3: Kimba Regional Population, 2018 - 2031

	0-14	15-64	65+	Total
Average annual growth rate (2018 – 2031)				
Kimba	-1.6	-1.4	0.7	-0.9
South Australia	0.4	0.5	2.2	0.8
Population share 2031 (%)				
Kimba	17.0	55.2	27.8	100.0
South Australia	17.0	61.2	21.9	100.0

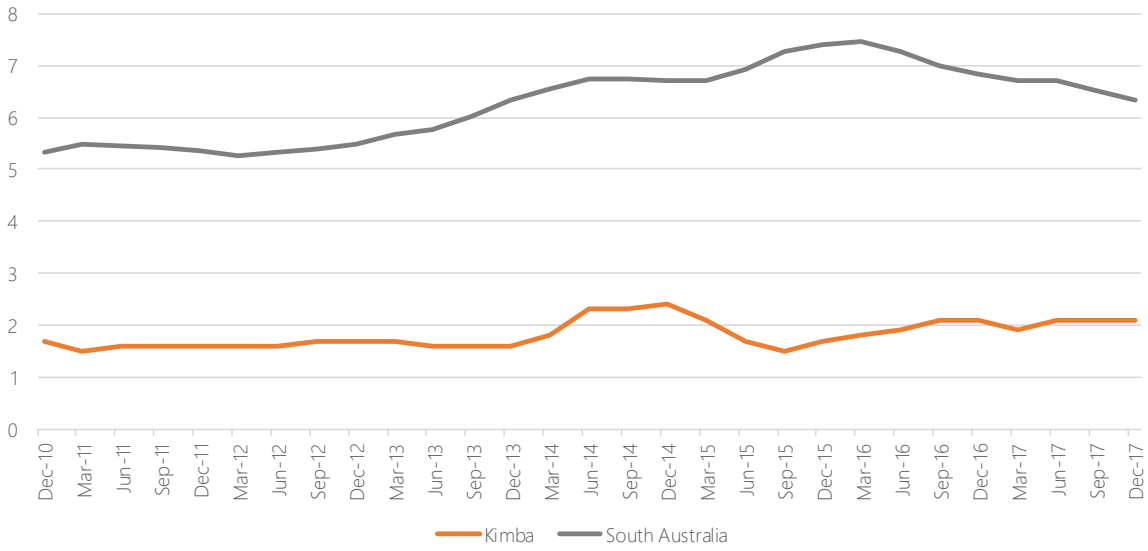
Source: Cadence Economics estimates from the South Australia Department of Planning, Transport and Infrastructure, *Population Projections for South Australian Local Government Areas, 2011 – 2031*, February 2016

Employment trends

In recent history the Kimba area has experienced significantly low levels of unemployment in comparison to South Australia (Figure 5).

Over the period December 2010 to December 2017 the unemployment rate within the Kimba region has averaged 1.8 per cent compared to 6.3 per cent in South Australia. Unemployment in the region has been relatively steady generally uncommon for a small region like Kimba.

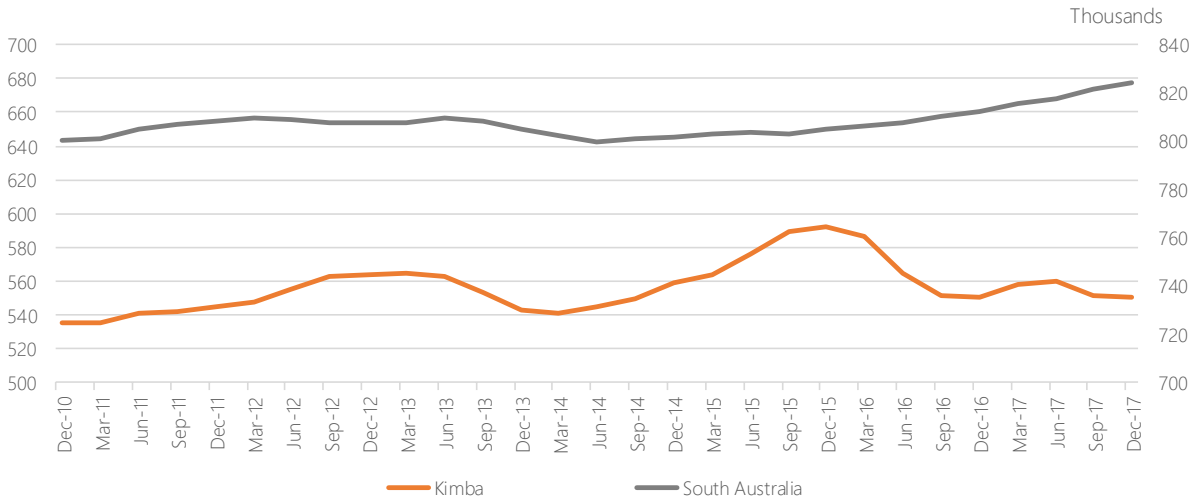
Figure 5: Unemployment, Kimba and South Australia, December 2010 to December 2017



Source: Cadence Economics estimates from the Commonwealth Department of Jobs and Small Business, *LGA Data Tables – Small Area Labour Markets- December quarter 2017*, March 2018

Total employment within the region has an average of 555 people over the period December 2010 to December 2017 (Figure 6). Employment peaked at just over 590 persons in December 2015 and since then has fallen.

Figure 6: Employment, Kimba and South Australia, December 2010 to December 2017



Source: Cadence Economics estimates from the Commonwealth Department of Jobs and Small Business, *LGA Data Tables – Small Area Labour Markets- December quarter 2017*, March 2018

The participation rate, that is the proportion of working age people employed or looking for work, in Kimba is significantly higher compared with South Australia (Table 4). Of those aged 15 and over within the region 67.1 per cent are either employed or looking for work in the workforce, compared to 61.2 per cent for South Australia. In addition, for the working age population 92.7 per cent of Kimba residence are in the workforce compared to 78.6 per cent for South Australia.

Table 4: Kimba Region Participation Rates, 2017

	15+	15-64
Kimba	67.1	92.7
South Australia	61.2	78.6

Source: Cadence Economics estimates from the Commonwealth Department of Jobs and Small Business, *LGA Data Tables – Small Area Labour Markets- December quarter 2017*, March 2018 and South Australia Department of Planning, Transport and Infrastructure, *Population Projections for South Australian Local Government Areas, 2011 – 2031*, February 2016

2.1 Summary

The analysis presented above demonstrates the key economic characteristics of the Kimba regions. The salient features of these economics are:

- Based on the 2016 ABS Census, the population of the Kimba was 1,040 people.
- According to the South Australian Department of Planning, Transport and Infrastructure, the population in Kimba is projected to fall over the period 2018 to 2031 by 0.9 per cent per annum.
- Kimba relies heavily on Agriculture to underpin their economies.
- The unemployment rate in Kimba is relatively low, averaging 1.8 per cent over the period of December 2010 to December 2017.
- Kimba has a relatively small construction sector. Based on the ABS 2016 Census, the construction sector in Kimba employed 16.3 FTEs.

3 NRWMF SCENARIOS

This section of the report includes the detailed analysis used to model the regional economic impacts of the NRWMF to the Kimba LGA. The analysis includes both the construction and operational phase of the project, including:

- Construction phase that is undertaken from 2021 to 2024
- Pre-Operational phase, between 2021 to 2024
- Operational phase, starting in 2025. For the purposes of the modelling, an operational phase of 30 years has been applied.

To model these key inputs into the CGE modelling, we have used several sources, including those in the public domain and a number of assumptions, which are set out below. A *central case scenario* has been assessed along with a range of sensitivity analysis. The sensitivity analysis presented reflects a range of uncertainties around both the final specifications of the project and likely impacts on the Kimba region.

3.1 Construction Phase

As outlined above, Kimba has a relatively small local construction sector comprising of 16.3 FTEs. Even where all these workers are employed to build the NRWMF only a small proportion of activity could be undertaken.

It is not reasonable to expect such a small workforce to have the capacity to construct a relatively large facility in the timeframe required. As such, it is expected that an external workforce during the construction phase of the project will be required.

As a result, to model the regional impacts of the NRWMF construction phase, we have undertaken scenarios analysis with the assumed level of local industry supply and employment engagement.

The scenario analysis was based on:

1. Assessing of the total labour requirement for both the enabling works and construction of the NRWMF facility.
2. An assumed level of construction activity that will be performed by the local workforce and local suppliers.
3. Estimating the number of migrant workers required.
4. Estimating the migrant workforce expenditure while they are within the regions to complete the construction.

The assumptions presented below comprise a central case scenario, while different elements of these assumptions are the subject of sensitivity analysis which is outlined below.

Construction phase spending

The construction phase includes a total of $325 million dollars of expenditure over the period 2021 to 2024, see Table 5. The construction phase includes:

- Enabling works of $75 million, staged over 2021 and 2022 that includes constructing a number of essential infrastructure for the construction and operation of the facility.
- Capital works of $250 million for the NRWMF facility, staged over 2022 to 2024.

Table 5: Construction phase spending under the central case scenario, 2021 - 2024

	2021	2022	2023	2024
Enabling works	37.5	37.5	0	0
NRWMF facility	0	50	125	75
Total Capital Works	37.5	87.5	125	75

Source: Department of Industry Innovation and Science

The construction phase spending used in the analysis is provided by the Department of Industry, Innovation and Science and is estimated using on theoretical construction cost estimates. This is the best available information to date. The final construction spend is subject to further analysis and will be updated as the concept design is progressed.

Labour requirement

The Australian Bureau of Statistics Input-Output table provides a ratio of the labour requirement for $1 million dollars of construction activity. Table 6 provides these ratios for Heavy and Civil Engineering Construction and the Non-Residential Building Construction.

Table 6: Construction employment ratios – Employment (FTE) per $M

Input-Output Industry	Construction phase	Direct Employment Ratio
Heavy and Civil Engineering Construction	Enabling works	1.24
Non-Residential Building Construction	NRWMF facility	1.46

Source: ABS Cat. No. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2012-13

Each construction phase has been assigned an Input-Output industry, for example the Enabling works are classified as Heavy and Civil Engineering Construction, and within this industry each $1 million dollars of expenditure requires 1.24 FTEs.

The enabling works is estimated to employ 46.5 FTE each year, based on expenditure of $37.5 million in 2021 and 2022, see Table 7. The total employment requirement for the project ranges from 46.5 FTE in 2021 to 182.8 FTE in 2023.

Table 7: Direct Construction employment under the central case scenario (FTE)

	2021	2022	2023	2024
Enabling Works	46.5	46.5		
Capital Expenditure		73.1	182.8	109.7
Total	46.5	119.6	182.8	109.7
Average Multiplier	1.24	1.37	1.46	1.46

Source: Cadence Economics Estimates

Local construction activity

As outlined above the labour requirements for the construction phase is significantly higher than the local construction workforce, and moreover is a significant proportion of the local workforce. As a result, we have assumed that $2.5 million per annum of the construction works would be undertaken by local industry participation (this figure is the subject of sensitivity analysis discussed below). The assumed local construction activity used in this analysis is based on the current observed capacity within the Kimba region. The assumption is conservative, as it only allocates about 20 per cent of the local construction workforce to the build and it does not include any measures to enhance local construction participation.

Table 8 outlines the assumed annual local employment in Kimba during the construction phase that ranges from 3.1 FTEs to 3.7 FTEs. While the level of expenditure remains constant each year, of $2.5 million, the average multiplier (as outlined in Table 6) increases over the years, as we shift from enabling works to building the NRWMF facility.

Table 8: Local employment under the central case scenario (FTE)

	2021	2022	2023	2024
Kimba	3.1	3.4	3.7	3.7

Source: Cadence Economics Estimates

Migrant worker requirement

The remainder of the workforce required to build the facility and its enabling works will be sourced from workers who migrate into our modelling regions. Over the period between 43.4 and 179.1 FTE additional workers are required (see Table 9).

Table 9: Migrant worker employment under the central case scenario

	2021	2022	2023	2024
Kimba	43.4	116.2	179.1	106.0

Source: Cadence Economics Estimates

Migrant worker local expenditure

Finally, Table 10 provides the estimated migrant worker spend while in the region. To estimate this expenditure we have assumed a FTE worker is locally based for the whole year and spends $100 per day while in the region. In Kimba migrant workers are estimated to spend $5.6 million in the region by 2023.

This figure is broadly consistent with a 2013 study undertaken by SGS Economics and Planning[4] that considered the level of expenditure by fly-in-fly-out (FIFO) workers for a proposed temporary accommodation village outside Singleton New South Wales. The average daily expenditure figure used in this report was around $120. This assumption is subject to sensitivity analysis outlined below.

Table 10: Migrant worker expenditure under the central case scenario ($ million)

	2021	2022	2023	2024
Kimba	1.6	4.2	6.5	3.9

Source: Cadence Economics Estimates

3.2 Operational Phase

The operational phase of the project, over the first 33 years from 2021 to 2054 and includes two phases:

- A pre-operational phase over the period 2021-2024.
- An operational phase where full operations are undertaken from 2025. For the purposes of the modelling, an operational phase of 30 years has been applied.

To estimate the operational phase activity we have used a number of sources and assumptions that will be outlined in further detail below.

The steps used to estimate the activity are:

1. Allocate the FTE staff into occupational categories.
2. Determine the average wage (including allowances) paid to each FTE.
3. Estimate the annual wages paid.
4. Estimate the annual operational costs.
5. Estimate the project costs.

3.2.1 Operational phase

The Department advises that once the NRWMF is at full operational capacity the facility will employ 45 FTE staff of which 75 per cent (34 FTE) are employed from the local region including appropriate retraining. It is important to note that the 34 staff that are employed from the local region the conservative assumption is made that these employees are all redeployed from the existing workforce. In other words, there is no additional employment associated with these 34 staff.

A description of the roles staff members will play is based on information provided by the Department which were then allocated to an occupational category. These occupational categories

[4] SGS Economic and Planning (2013), Social and Economic Impacts of Proposed Temporary Accommodation in Singleton for FIFO workers, Consulting report prepared for the CFMEU and BFFSA, Access here http://www.sgsep.com.au/assets/downloads/Social-Economic-Impact-Singleton-FIFO-Camp.pdf.

are based on the standard ANZSCO classification, except for the CEO of the facility. For example, the General Manager was classified as a Manager and the Waste Technicians were classified as Technicians and Trade Workers.

A full list of the operational roles, the number of FTEs required, and the occupational role is outlined in Table 11.

Table 11: Characteristics of the NRWMF workforce, 2025 to 2054

Role	FTE	Occupation
CEO NRWMF	1	CEO
General Manager	1	Managers
Administrators	1	Clerical and Administrative Workers
Manager Support Services	1	Managers
Leader QA	1	Professionals
Leader Safeguards	1	Professionals
Leader Safety Case	1	Professionals
Safety Case Team	1	Professionals
Leader Environmental Monitoring	1	Professionals
RPA/WHA	1	Professionals
HPS	1.5	Professionals
Leader Security	1	Professionals
Guard Force	12	Professionals
Leader QC	1	Professionals
Analysts	2	Professionals
Manager Operations	1	Managers
Leader LLSW	1	Professionals
Operations Supervisor	1	Professionals
Leader ILSW	1	Professionals
Waste Technicians	9.5	Technicians and Trades Workers
Manager External Liaison	1	Managers
Leader Community Liaison	0.5	Professionals
Visitor Centre	0.5	Sales Workers
Leader Future Planning	1	Professionals
Leader Logistics	1	Professionals
Total	45	

Source: Cadence Economics Estimates based on information provided by the Department of Industry, Innovation and Science

Average wages

The 2016 Census provides an estimate of the wages paid by occupation. These wages from the 2016 Census were updated to 2018 dollars using the ABS's Wage Price Index. Table 12 outlines the average wages paid by occupation, for example a Professional earns and annual income of $94,938.

Table 12: Average wages ($ million 2018)

Occupation	Average wage
Managers	117,837
Professionals	94,938
Technicians and Trades Workers	74,372
Community and Personal Service Workers	76,868
Clerical and Administrative Workers	71,543
Sales Workers	66,154
Machinery Operators and Drivers	62,678
Labourers	46,831

Source: Cadence Economics Estimates based on Census 2016 and ABS Cat. No. 6345.0- Wage Price Index Australia March 2018.

In addition to the average wages above, given the relative isolation of the facility employees are expected to earn an additional allowance for working in a remote location. The regional allowance payable for working in the facility is $5,541 per annum. This is based on the District Allowance payable under the *Department of Defence Enterprise Agreement 2017-2020*.

In addition, the CEO of the facility is estimated to earn $365,570 per annum, based on the remuneration of several CEOs of a similar sized organisation as sourced from the *Remuneration and Allowances for Holder of Full-time Public Office, Determination 2016/19* Remuneration Tribunal (2016).

In total the project is expected to generate $4.65 million dollars of wages once the facility is fully operational, see Table 13. In addition, the facility is also expected to generate $1.99 million in other inputs costs, such as utilities, facilities management and other consumables.

Once the NRWMF is fully operational it is estimated that the facility will operate at a cost of$6.64 million, as outlined in Table 13.

Table 13: Annual operational costs under the central case scenario

Total Operational Output	$m 2018
Wages	4.65
Other input costs	1.99
Total	6.64

Source: Cadence Economics estimates

To estimate the other operational costs the Department advises that 70 per cent of the operational costs are wages and the remaining 30 per cent are other operational costs.

3.2.2 Pre-operational phase

As outlined above the pre-operational phase will run from 2021 to 2024. Over this phase there are a number of staff that will be located in the region, to undertaking various tasks to provide community liaison, prepare for the operational phase, by hiring and training potential staff and maintain security to the facility. Based on the current advice from the Department the per-operational phase will include:

- Operation of a visitor centre (with 2.5 FTE) and a community liaison officer (1 FTE), over the whole pre-operational phase.
- Guard force (10 FTE), employed over the period 2022 -2024 to coincide with the construction of the facility.
- A manager to prepare for operational readiness, (1 FTE), in 2023 and 2024.
- Section leads to hire operational staff (6 FTEs), in 2024.

Table 14 provides a summary of the employment requirement and the costs for the pre-operational phase. Over the period the number of FTE ranges from 3.5 in 2021 to 20.5 in 2024. The wage cost and the total pre-operational cost peak in 2024 at $2.1 million and $3.1 million respectively.

Table 14: Annual pre-operational employment (FTE) and costs ($m), 2021 to 2024

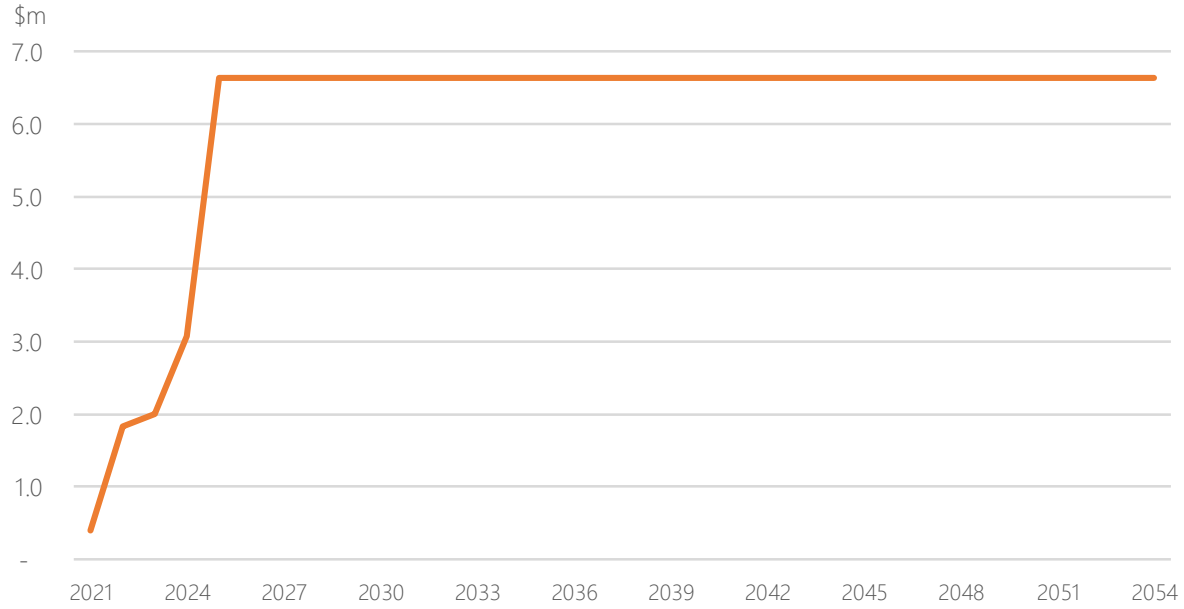
	2021	2022	2023	2024
FTE				
Leader Community Liaison	1	1	1	1
Visitor Centre	2.5	2.5	2.5	2.5
Guard force		10	10	10
Manager – Operational readiness			1	1
Manager – Section leads				6
Pre-operational FTE	3.5	13.5	14.5	20.5
Costs				
Wage Cost ($m 2018)	0.3	1.3	1.4	2.1
Other input costs ($m 2018)	0.1	0.6	0.6	0.9
Total ($m 2018)	0.4	1.8	2.0	3.1

Source: Cadence Economics estimates

Project operational costs

As outlined above the in the operational phase will involve an initial pre-operational phase where the CEO, the General Manager and the Administration staff will be engaged to undertake site preparation and set up. This phase will operate for the first two years. From 2024 the facility will be fully operational and the complete 45 FTE will be onsite. Figure 7 provides a summary of the annual operational costs for the NRWMF facility. During the pre-operational phase, 2021 to 2024, the project is expected to operate at an annual average cost of $1.83 million, during the operational phase the project is modelled to operate at an annual cost of $6.64 million.

Figure 7: Operational costs under the central case scenario (real 2018 $ million)



Source: Cadence Economics estimates

Regional productivity benefits

The pre-operations and the operations of the facility will contribute to increasing productivity within the region, through offering higher wages that those currently offered.

In the Kimba region the current average wage within the region is $56,176 (Cadence Economics estimates, based on the 2016 Census). Compared to the average wage for operational workers of $103,348 once fully operational), an increase of $47,172 for each worker. Across the operational workforce of 45 FTE, the annual increase in wages in the region is $2.1 million for each year of full operations, reflecting an effective increase in labour productivity. During the pre-operational phase labour productivity increases in proportion to the number of staff and the average wages paid.

3.3 Summary of the central case scenario

The economic modelling in the preceding section is based on a set of assumptions in relation to the construction and operational phases of the NRWMF.

For the Kimba region, the central case scenario is based on:

- A construction phase over the period 2021 to 2024 that is based on an aggregate expenditure of $325 million. Of this, $75 million is required in enabling works over the period 2021 and 2022 and $250 million in capital works over the period 2022 to 2024 (the expenditure profiles are summarised in Table 4 above).
- Given the size of the construction sector, it is assumed that $2.5 million worth of construction per annum is undertaken by local construction firms over the period 2021 to 2024. This assumption is based on the size of the construction sector in the Kimba region.

- The remaining construction work is to be undertaken by migrant workers with an assumed expenditure of $100 per day in the region, as shown in Table 9 above.
- During the pre-operational phase, we assume the community liaison officer, the visitor centre staff, and the guard force are sourced locally. The remaining pre-operational staff, the managers and section leads are sourced from outside the region.
- The full operational phase begins in 2025. During this phase, 45 FTE workers are employed at the facility of which 75 per cent are employed from the local region (conservatively assumed to be drawn from the existing workforce). These workers earn a combined salary of $4.7 million when the NRWMF is fully operational (shown in Table 12 above).
- Other input costs are assumed to be around $2 million per annum to support the operation of the NRWMF.
- Labour productivity in the region is estimated to increases by $1.9 million per year once the project is fully operational. The increase in labour force productivity is a reflection of the higher wages offered in the facility to those currently offered in Kimba, as outlined above.

3.4 Sensitivity Analysis

To test the economic impacts of the NRWMF, a range of assumption have been altered in relation to both specification of the project as well as key parameters in the model (in particular, labour supply responses).

Specification of the NRWMF

In relation to the specification of the NRWMF, there is uncertainty around the activity that is likely to be generated during, particularly, the construction phase of the project. This uncertainty relates to both the overall magnitude of the investment required to establish the facility, as well as the ability of local contractors to secure work on the project.

To test the sensitivity of the projected economic impacts of the project a scenario has been undertaken to double the value of construction projects undertaken by local firms from $2.5 million (***central case***) to $5 million each year (***double content***) from 2019 to 2023 (with a commensurate reduction in expenditure from migrant workers). In addition, a scenario where no construction work is undertaken by local firms is also considered (***no content***).

Apart from uncertainty around domestic content of the construction expenditure, there is a level of uncertainty around the magnitude of expenditure for those workers coming to the region to augment the local workforce during the construction phase. The ***central case*** scenario assumed that these workers spend $100 per day. Two alternative scenarios have been undertaken, the first assuming this expenditure is $200 per day (***double expenditure***) and the other assuming zero expenditure (***no spend***).

Labour market assumptions

We also considered the responsiveness of the local labour market to the increase in wages (the labour supply response, or the labour supply elasticity). To test the responsiveness we have incorporated into our modelling three labour market assumptions, as discussed below.

Conceptually, if the economy is operating at full employment and, therefore, no new workers were available to service the increase in expenditure associated either with the construction of the NRWMF or the associated operations, the project would not create a single additional job. That is, workers would be drawn from their existing jobs via the new project offering higher wages. Similarly, if a new project required very specific highly trained and skilled workers not available locally and there were none readily available, the project would not create a single additional local job. In the modelling this scenario is represented by a perfectly inelastic labour supply curve, or a labour supply elasticity of zero (the ***zero elasticity*** scenario considered below).

On the other hand, in a world where the economy is operating at below capacity, as evidenced for example by higher unemployment and slower growth, it is more realistic to assume a relatively more 'elastic' labour supply whereby potential workers are encouraged into the workforce, again through increased wages. In terms of specifying the elasticity of labour supply, we follow the lead of the Australian Treasury and use a labour supply elasticity assumption of 0.15 under the ***central case*** scenario, which indicates a relatively 'inelastic' response from workers. This means workers are slow to respond to changes in wages because (it is assumed that) the economy is close to full employment or the project under consideration requires highly skilled workers.

To further test the responsiveness of the impacts to labour market assumption, under the ***double elasticity*** scenario a labour supply elasticity of 0.3 is assumed, which is relatively more 'elastic' and means that workers respond more readily to marginal changes in the wage rate.

4 ECONOMY-WIDE MODELLING

The economy-wide impacts of the NRWMF on Kimba have been estimated using our in-house CGE model CEGEM (the Cadence Economics General Equilibrium Model). CEGEM is a large scale, dynamic, multi-region, multi-commodity CGE model of the world economy. A description of the model is presented in Box 1.

CEGEM is of a genre of economic models that are used extensively by the Australian Government to assess the economy-wide impacts of major policy changes and economic developments. For example, the Commonwealth Treasury undertook a series of assessments of the economic impacts of climate change response policies using CGE models over the previous decade. The Productivity Commission has also used CGE modelling to consider the impact of economic reforms.

CGE modelling is the preferred technique to assess the impacts of large projects, such as the NRWMF project, as they are based on a more detailed representation of the economy, including the complex interactions between different sectors of the economy. For the Australian economy, the modelling captures:

- Direct increases in demand associated with the proposed facility (short term construction activity) as well as the assumed increases expenditure attributable to the NRWMF project.
- Indirect increases in demand, or flow-on effects associated with increased economic activity relating to both the construction and operational phase of the NRWMF.
- Labour market displacement caused by the direct increase in demand from an expansion in demand from the NRWMF on other sectors of the economy bidding up wages and 'crowding out' other sectors of the economy.

A key feature of the NRWMF in the context of the economic modelling is that the facility does not generate an economic return once operational. In other words, the NRWMF is a not for profit entity that does not generate any ongoing returns to the capital that is invested in the region.

CEGEM has detailed sectoral and regional representation of the economy. This means the model is based on a customised representation of the full range of sectors of the Australian economy allowing us to consider varying economic impacts across the construction and operational phases of the project. In addition, the model has been customised to represent both the Flinders Ranges LGA and Kimba LGA regions of South Australia.

CEGEM is dynamic and is solved on a year-by-year basis over a prescribed period of time. This will allow us to consider the forward looking nature of investments in the NRWMF as well as test a range of different scenarios related to the project. In practical terms, the modelling is based on defining a counterfactual, or baseline scenario, which is then compared with a scenario under which the NRWMF goes ahead. The difference between the two scenarios provides us with a measure of the economic net benefits of the project.

Box 1: An overview of the CEGEM model

CEGEM is a multi-commodity, multi-region, dynamic model of the world economy. Like all economic models, CEGEM is a based on a range of assumptions, parameters and data that constitute an approximation to the working structure of an economy. Its construction has drawn on the key features of other economic models such as the global economic framework underpinning models such as GTAP and GTEM, with state and regional modelling frameworks such as Monash-MMRF and TERM.

Labour, capital, land and a natural resource comprise the four factors of production. On a year-by-year basis, capital and labour are mobile between sectors, while land is mobile across agriculture. The natural resource is specific to mining and is not mobile. A representative household in each region owns all factors of production. This representative household receives all factor payments, tax revenue and interregional transfers. The household also determines the allocation of income between household consumption, government consumption and savings.

Capital in each region of the model accumulates by investment less depreciation in each period. Capital is mobile internationally in CEGEM where global investment equals global savings. Global savings are made available to invest across regions. Rates of return can differ to reflect region specific differences in risk premiums.

The model assumes labour markets operate in a model where employment and wages adjust in each year so that, for example, in the case of an increase in the demand for labour, the real wage rate increases in proportion to the increase in employment from its base case forecast level.

CEGEM determines regional supplies and demands of commodities through optimising behaviour of agents in perfectly competitive markets using constant returns to scale technologies. Under these assumptions, prices are set to cover costs and firms earn zero pure profits, with all returns paid to primary factors. This implies that changes in output prices are determined by changes in input prices of materials and primary factors.

The outputs of the modelling can be used for a variety of purposes. For example, the model provides an assessment of the economic impacts of the NRWMF at both the macroeconomic and sectoral levels. At the macroeconomic level, key variables such as the impact on economic growth (gross regional product), employment, exports and investment will be produced along with the impact on economic welfare.

The ultimate aim of an economic impact study based on applied CGE modelling is to estimate the net benefit of the proposed NRWMF on economic activity and the living standard of residents of Kimba.

The welfare measure in CEGEM is the ideal basis on which to conduct cost benefit analysis. The welfare measure used in this analysis is gross regional income (GRI). As a measure of income, Pant et al (2000) shows how the change in real GRI is a good approximation to the ***equivalent variation*** welfare measure in global CGE models, such as CEGEM. This measure is widely used by practitioners and can also be decomposed into various components to assist in the analysis of results. Real GRI is computationally more convenient than (say) an equivalent variation, and a more familiar concept to explain to decision makers (Layman, 2004).

4.1 Economy-wide impacts

The projected economic impacts estimated using our CGE model, of the NRWMF for Kimba are summarised in Table 15. The results reported include real GRP (economic output), real GRI (economic welfare), employment and real wages. The projected change in real GRI per capita is also included. The results are reported as either percentage of dollar value changes in 2030 (a year in which the NRWMF is fully operational) or as a net present value (NPV) of the differences in real GRP and real GRI over the period 2021 to 2054 (these figures are discounted using a 7 per cent real discount rate).

The CGE modelling results show that the NRWMF is projected to confer economic benefits to Kimba by all metrics reported in Table 15. These benefits are driven by an increase in demand for goods and services through both the construction and operational phases of the NRWMF, the increase in supply of workers moving to the region during the operational phase as well as a wage premium for all workers at the facility.

The results show that by 2030, when the NRWMF is fully operational, real GRP in Kimba is projected to be 4.9 per cent higher than reference case levels which equates to a $8.4 million increase in real 2018 dollars.

Over the first 33 years of the project, the NPV of the projected increase in real GRP in Kimba is just over $95 million.

Table 15: Projected economy-wide impacts for Kimba under the central case scenario

Variable	Description	Result
Real GRP	2030 - Deviation (%)	4.9
	2030 - $m (real 2018)	8.4
	NPV - $m^	95.2
Real GRI	2030 - Deviation (%)	4.7
	2030 - $m (real 2018)	9.1
	NPV - $m	119.0
Employment	2030 - Deviation (%)	2.5
	2030 – FTE	16.6
Real wages	2030 - Deviation (%)	5.9
Real GRI per Capita	2030 - Kimba (real 2018)	7,658.9

Source: Cadence Economics estimates. ^ NPV is presented in real 2018 dollars, discounted over the period 2021 to 2054 using a 7% real discount rate.

In welfare terms, real GRI is projected 4.7 per cent higher ($9.1 million in real 2018 dollars) in Kimba at 2030. These projected welfare increases are reflective of positive labour market outcomes in terms of employment and real wages.

In terms of labour market outcomes, the NRWMF will employ 45 FTE directly. Of these, 34 FTE are drawn from the local labour market which have been redirected to work in this facility from the

existing pool of employed persons in Kimba under conservative assumptions. The additional 11 FTE are relocated to the region to work in the facility.

As shown in Table 15, the projected net additional economy-wide increase in employment in 2030 in Kimba is 16.6 FTE. This is comprised of the additional 11 FTE that relocate to the region to work in the facility as well as 5.6 FTE being the result of positive flow on economic effects of the NRWMF.

The projected increase in economic welfare in 2030 in Kimba, real GRI, is $7,659 per capita in 2030.

4.2 Local construction content sensitivity analysis

As discussed in the previous section, there is uncertainty around the construction spending that might take place under the NRWMF. The construction phase of the NRWMF occurs over the period 2021 to 2024.

The ***central case*** scenario adopts relatively conservative assumptions about the dollar value of construction work undertaken by local firms ($2.5 million in Kimba per annum).

The projected economic impacts of the NRWMF under an assumption of doubling of the construction expenditure (***double content***) as well as assuming this expenditure is zero (***no content***) is presented in Table 16.

The results show that the doubling of this assumption has a slight negative impact on the projected results at 2030 (albeit at the second decimal place). This slight projected reduction in economic activity in 2030 is because over the construction period, construction resources in the region are reallocated to the NRWMF. This displaces other investments that would have occurred in the region, a phenomenon known as 'crowding out'.

While ordinarily, replacing one form of investment with another would not be expected to adversely affect the economy, it does in this case because the NRWMF does not go on to generate any economic return once it's fully operational as it is a not for profit entity. As such, the projected losses in 2030 are a direct result of crowding out other profit generating investments over the period 2021 to 2024.

That said, the economic gains from increased local content in construction do provide a greater positive, short-term benefit to the economy. This is reflected in the projected NPV of the real GRP and GRI being higher under the double content relative to the central case scenario. The increase in these variables reflect greater increases in these variables over the construction phase of the NRWMF.

Under the no content scenario, the projected impacts on the economy are roughly the same in 2030, albeit slight higher (at the second decimal point) but in NPV terms are slightly lower.

Table 16: Local content over the construction phase sensitivity analysis

Variable	Description	Central case	No content	Double content
Real GRP	2030 - Deviation (%)	4.9	5.0	4.9
	2030 - $m (real 2018)	8.4	8.4	8.3
	NPV - $m^	95.2	93.5	95.8
Real GRI	2030 - Deviation (%)	4.7	4.7	4.6
	2030 - $m (real 2018)	9.1	9.2	8.9
	NPV - $m	119.0	115.6	119.7
Employment	2030 - Deviation (%)	2.5	2.5	2.5
	2030 - FTE	16.6	16.6	16.5
Wages	2030 - Deviation (%)	5.9	6.0	5.7
Real GRI per Capita	2030 - Kimba (real 2018)	7,659	7,682	7,443

Source: Cadence Economics estimates. ^ NPV is presented in real 2018 dollars, discounted over the period 2021 to 2054 using a 7% real discount rate.

4.3 Construction worker spend assumptions

Apart from uncertainty around domestic content of the construction expenditure, there is a level of uncertainty around the magnitude of expenditure for those workers coming to the region to augment the local workforce during the construction phase.

The ***central case*** scenario assumed that these workers spend $100 per day. Two alternative scenarios have been undertaken, the first assuming this expenditure is $200 per day (***double expenditure***) and the other assuming zero expenditure (***no spend***).

The projected economic impacts of the NRWMF under an assumption of doubling of the construction expenditure (***double content***) as well as assuming this expenditure is zero (***no content***) are presented in Table 17.

The results show that the doubling of the expenditure assumption has a negative impact on the projected results at 2030. For example, under the double content scenario the projected increase in real GRP is 4.8 per cent at 2030 compared with the central case projection of 4.9 per cent. Similar to the previous sensitivity analysis, this projected reduction in economic activity in 2030 is because over the construction period, construction resources in the region are reallocated to the NRWMF displacing other investments that would have occurred in the region.

That said, the economic gains from increased local content in construction do provide a greater positive, short-term benefit to the economy reflected in NPV terms as the projected gains to the region are slightly higher under the double spend scenario compared with the reference case.

Under the no content scenario, the projected impacts on the economy are roughly the same in 2030, albeit slight higher (at the second decimal point) but in NPV terms are slightly lower.

Table 17: Outside worker spending over the construction phase sensitivity analysis

Variable	Description	Central case	No spend	Double spend
Real GRP	2030 - Deviation (%)	4.9	4.9	4.8
	2030 - $m (real 2018)	8.4	8.4	8.2
	NPV - $m^	95.2	92.8	95.6
Real GRI	2030 - Deviation (%)	4.7	4.8	4.3
	2030 - $m (real 2018)	9.1	9.3	8.4
	NPV - $m	119.0	115.7	115.8
Employment	2030 - Deviation (%)	2.5	2.5	2.5
	2030 - FTE	16.6	16.7	16.3
Wages	2030 - Deviation (%)	5.9	6.1	5.4
Real GRI per Capita	2030 - Kimba (real 2018)	7,659	7,829	6,934

Source: Cadence Economics estimates. ^ NPV is presented in real 2018 dollars, discounted over the period 2021 to 2054 using a 7% real discount rate.

4.4 Labour market sensitivity analysis

The sensitivity of the results to changes in labour market assumptions, as described in the previous section, are summarised in Table 18. These scenarios are each based on the ***central case*** assumptions (that is based on a labour supply elasticity of 0.15), but consider a labour supply elasticity of zero (***zero elasticity***) and of 0.30 (***double elasticity***).

The zero labour market response assumes that, with the exception of those workers relocating to the region, no additional employment is created by the NRWMF. Under the central case and high scenario, the labour market responses are assumed to increase (more jobs are created).

The results show that the economic impacts are higher the more responsive the labour market is to the employment opportunities resulting from the NRWMF. Under the double elasticity scenario the projected increase in real GRP is 8.9 per cent at 2030 compared with the central case projection of 8.2 per cent. This projected increase in economic activity in 2030 is because when the labour market is more responsive to increases in demand, more resources are drawn into the economy leading to higher levels of production and income.

In welfare terms, real GRI is projected to be 5.3 per cent higher ($9.0 million in real 2018 dollars) in Kimba at 2030 under the double elasticity scenario. These projected welfare increases are reflective of positive labour market outcomes in terms of employment. The projected increase in employment in 2030 in Kimba under the double elasticity scenario is around 21 FTE compared with 17 FTE under the central case scenario.

Under the zero elasticity scenario, the projected impacts on the economy are lower compared with the central case due to the lack of available labour to meet the increased demand associated with the NRWMF. The exception to this result is real wage growth that is projected to be higher under the zero elasticity scenario compared with the central case which is a direct result of a constrained supply response assumed in the labour market.

Table 18: Projected economy-wide impacts, by Labour Supply Response, by Modelling Region

Variable	Description	Zero elasticity	Central case	Double elasticity
Real GRP	2030 - Deviation (%)	4.5	4.9	5.3
	2030 - $m (real 2018)	7.6	8.4	9.0
	NPV - $m^	85.6	95.2	103.1
Real GRI	2030 - Deviation (%)	4.4	4.7	4.9
	2030 - $m (real 2018)	8.6	9.1	9.6
	NPV - $m	111.5	119.0	125.1
Employment	2030 - Deviation (%)	1.6	2.5	3.2
	2030 - FTE	10.7	16.6	21.4
Wages	2030 - Deviation (%)	6.6	5.9	5.4
Real GRI per Capita	2030 - Kimba (real 2018)	7,119	7,659	8,101

Source: Cadence Economics estimates. ^ NPV is presented in real 2018 dollars, discounted over the period 2021 to 2054 using a 7% real discount rate.

4.5 Summary

Under central case assumptions, the NRWMF is projected to confer economic benefits to Kimba in terms of economic output, welfare, employment and real wages.

The results show that by 2030, when the NRWMF is fully operational, real GRP in Kimba is projected to be 4.9 per cent higher than reference case levels which equates to a $8.4 million increase in real 2018 dollars. Over the first 33 years of the project, the NPV of the projected increase in real GRP in Kimba is just over $95 million. In welfare terms, real GRI is projected to be 4.7 per cent higher ($9.1 million in real 2018 dollars) in Kimba at 2030.

In terms of labour market outcomes, the NRWMF will employ 45 FTE directly. Of these, 34 FTE are drawn from the local labour market which have been redirected to work in this facility from the existing pool of employed persons in Kimba under conservative assumptions. The additional 11 FTE are relocated to the region to work in the facility.

The projected net additional economy-wide increase in employment in 2030 in Kimba is 16.6 FTE. This is comprised of the additional 11 FTE that relocate to the region to work in the facility as well as 5.6 FTE being the result of positive flow on economic effects of the NRWMF.

The results of the analysis are robust in relation to the sensitivity analysis undertake. The changes in aggregate results are not significant when uncertainties around the construction phase are considered, including:

- Construction expenditure in the region is either doubled from $2.5 million to $5 million per annum, or assumed to be zero;
- Expenditure from outside workers is either doubled from $100 per day to $200 per day, or assumed to be zero.

The results show that the economic impacts are higher the more responsive the labour market is to the employment opportunities resulting from the NRWMF. Under the double elasticity scenario:

- The projected increase in real GRP is 5.3 per cent at 2030 compared with the central case projection of 4.9 per cent.
- The projected increase in employment in 2030 in the Kimba under the double elasticity scenario is around 21.4 FTE compared with 16.6 FTE under the central case scenario.

Under the no zero elasticity scenario, the projected impacts on the economy are lower compared with the central case due to the lack of available labour to meet the increased demand associated with the NRWMF.

5 EVIDENCE OF ECONOMIC IMPACTS OF COMPARABLE SITES

This section considers the evidence around the impacts of co-location of radioactive waste facilities similar to the NRWMF from other jurisdictions.

At the outset, a literature review was undertaken with the aim of documenting the existence of any statistical studies that demonstrated either the benefits or adverse impacts of hosting a facility similar to the NRWMF on key economic areas such as:

- Housing;
- Agricultural production; and
- Tourism.

Our review of the literature revealed no studies of this nature. This is despite facilities that are similar in terms of function having been established in many places across the world. While this is not an indication that such impacts don't exist, the lack of analysis is somewhat surprising given the proximity of these facilities to population centres much larger than that being considered for the NRWMF and of the concerns raised by residents throughout the approvals processes.

5.1 Overview of an environmental impact assessment

A useful starting point for considering the broader implications of hosting a facility such as the NRWMF is the environmental impacts assessment (EIA) process that is routinely undertaken in Australia (and in some overseas counties) when large-scale projects are reviewed for approval. An EIA is a process that considers the costs and benefits of a particular project and, to the extent possible, quantifies these in what is called a cost benefit analysis (CBA).

A CBA has many dimensions, for example it can be viewed from a global, Australia-wide, State-wide or local perspective. In this case, assessing the costs and benefits of the NRWMF on the local community is most relevant. While different governments have different guidelines for assessing the costs and benefits of major projects, a well developed framework has been developed by the New South Wales (NSW) government in the context of its deliberations of developing coal mines.

These guidelines, produced by the NSW Department of Planning and the Environment[5], detail a systematic approach to assessing the costs and benefits of coal developments and were developed through an extensive consultation process. Included in this framework is a local effects analysis (LEA)

[5] NSW Department of Planning and Environment (2015), 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals, Accessed http://www.planning.nsw.gov.au/~/media/Files/DPE/Guidelines/guidelines-for-the-economic-assessment-of-mining-and-coal-seam-gas-proposals-2015-12.ashx

that measures the net benefits or costs to a local region that is expected from a particular investment. The characteristics of this assessment are applicable to the consideration of the NRWMF.

The economic analysis used for the LEA is organised into three parts:

- the ***direct impacts*** of the development which consider the economic value generated by a particular development accruing to the region in question. In this case, as the NRWMF is a non-profit government entity, the only likely direct benefits are those associated with any community contribution made by the facility.
- The ***indirect impacts*** are benefits to workers (through additional employment and any wage premiums), benefits to suppliers (through increased demand resulting from the project) and any benefits to landholders (through the sale of land).
- The ***indirect costs*** relating to any net environmental, social and transport-related costs borne by the local community as well as any net public infrastructure costs.

Both the direct and indirect impacts of the NRWMF have been considered in some detail in the previous section. It is the indirect costs that contain the areas of most community concern. There are a range of these costs that are routinely assessed in Australia in the context of large-scale investments. These include impacts on:

- Noise and vibration
- Air quality
- Greenhouse gas emissions
- Visual amenity
- Transport impacts including travel time costs
- Net public infrastructure costs
- Surface water impacts and other water impacts
- Residual value of land
- Subsidence
- Biodiversity impact
- Loss of surplus to other industries (including tourism and agriculture)
- Impacts on housing markets
- Aboriginal cultural heritage and historical heritage.

As shown, a standard EIA in Australia considers a wide range of potential impacts on the local economy. Many of these are the subject of a technical review by experts in the field. For example, acoustic experts are routinely brought in to establish the impacts of noise in relation to a particular project.

However, in relation to the potential adverse impacts of a particular project on other industries such as tourism and agriculture, or housing markets, can be difficult to assess.

5.2 A current EIS

As an example of a radioactive waste storage facility currently under consideration, Canada Nuclear Laboratories (CNL) is proposing to develop a facility to handle both LLW and some ILW at Renfrew County Ontario. The closest town to this proposed development is called Deep River which is about 12 kilometres from the facility and has 4,200 residents. The initial EIA for the project was released in March 2017[6] and was conducted under the Canadian Environmental Assessment Act which has similar features to the EIA framework for Australia described above.

The socio-economic assessment undertaken in this EIA considered a similar range of positive economic benefits associated with the construction phase of the project (which was expected to involve an average of 40 FTE, peaking a 60 FTE) over three years and the ongoing employment of 40 FTE in the facility itself.

The key issue in relation to impacts on housing markets addressed in the EIA did not relate to potential loss of property value caused by proximity to the facility. This was because of the relatively long distance between the facility and the nearest township. The concern was more related to the increase in demand from both temporary and permanent employees increasing property prices. In this regard, the Study concluded that the local areas had capacity to accommodate the additional, temporary workers that would be required under the construction phase of the project as well as the ongoing requirements.

The assessment did not find that the project would have a detrimental effect on the regions productive base, particularly tourism as this was not a key driver of economic development in the region.

5.3 Australia's existing facility

Currently, a relatively large proportion of Australia's radioactive waste is stored at the Lucas Heights in NSW. This facility has stored Australia's radioactive waste for 60 years. In addition to storing radioactive waste, a nuclear reactor is on this sight that uses low enriched uranium fuel in the areas of medicine, research scientific industrial and other production uses.

Engadine is a suburb in southern Sydney, located 31 kilometres from the central business district (CBD). Like some facilities overseas, the Lucas Heights Campus where radioactive waste is currently stored is located in the immediate vicinity (in this case, around 1 kilometre) of existing housing.

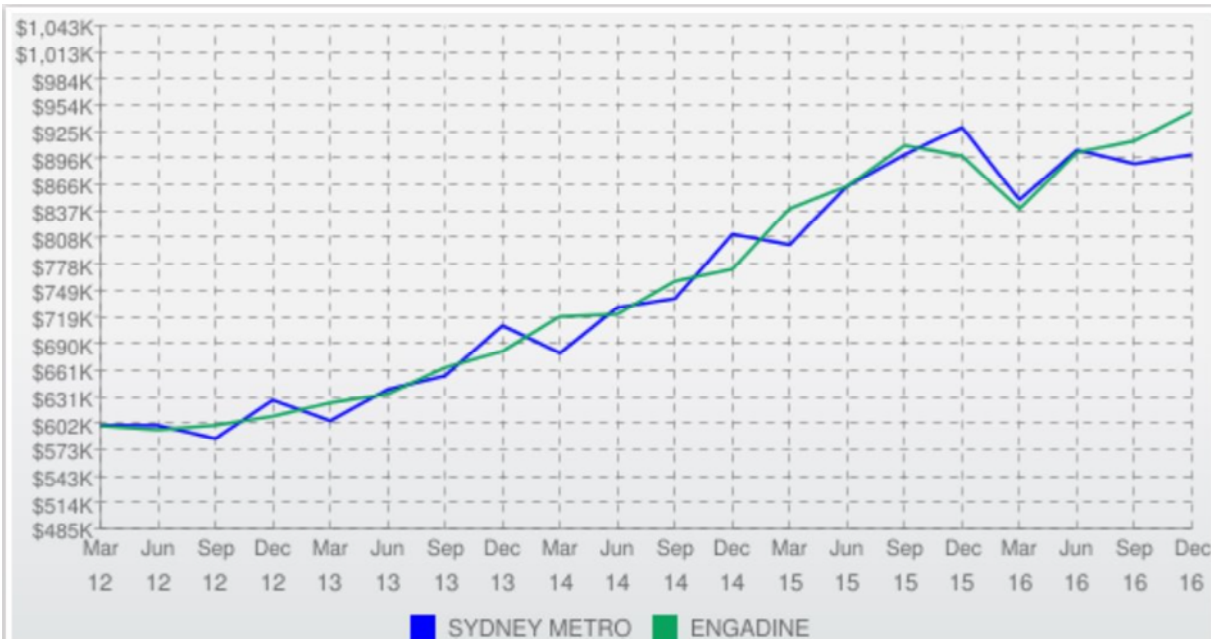
While there are not likely to be concerns in relation to agricultural production or tourism impacts in relation to the Lucas Heights facility, being closely co-located with a residential area raises issues around the potential impact of the facility on real estate values. Figure 8 below contains a

[6] Golder Associates (2017), 'Environmental Impact Statement of the Near Surface Disposal Facility: Deep River, Renfrew County, Ontario', Accessed at http://www.ceaa-acee.gc.ca/050/documents/p80122/118380E.pdf.

comparison of the quarterly median house price across the Sydney metropolitan and Engadine, the suburb closest to the Lucas Heights facility.

This data shows there has been virtually no difference in terms of house price growth in Engadine relative to the Sydney metropolitan area over the last five years. In addition, the median house prices in Engadine are roughly the same as the average across the Sydney metropolitan area. This analysis does not show what house prices in Engadine would be if the Lucas Heights facility did not exist (i.e. if there is any adverse effects on the level of house prices in Engadine associated with the presence of the facility). The data does show that despite the presence of the facility, house price growth in the Engadine area mirrors that of the broader Sydney metropolitan area.

Figure 8: Quarterly median house prices over the last five years



Source: Data from https://propertydata.realestateview.com.au/propertydata/median-prices/nsw/

5.4 Other radioactive waste facilities

While there is little information in the public domain in relation to any study that quantifies the adverse economic impacts of the presence of a nuclear waste facility, there are a number of facilities currently operating across the world. Table 19 presents a summary of nuclear waste facilities operating in developed countries. These facilities have a broadly similar purpose to the NRWMF in that they all process low and intermediate level waste (although some, like Belgoprocess, handle higher grades of radioactive waste).

A number of these facilities are located within 5 kilometres of relatively large population centres. These include Port Hope in Canada and Belgoprocess in Belgium. In the case of Port Hope in Canada, the location of the facility has largely been determined by the nature of the plant. This plant was established to clean up contaminated soil in the region.

The other facilities have been established in either sparsely populated regions, such as Centre de L'Aube in France, El Cabril in Spain and the Low Level Waste Repository in the UK. Other facilities have been established some distance from relatively large population centres, including Douneray in the UK, the Federal Waste Disposal Facility in the US and the Transport Cask Storage Facility in Germany.

Table 19: Summary of other radioactive waste facilities

Facility	Country	Purpose	Proximity to residents
Port Hope	Canada	Stores low level radioactive waste from contaminated soil from various sites around the region stored in an above ground containment mound.	Around 100 kilometres east of Toronto, Port Hope had a population in 2016 of 12,587 people. The waste management facility is around 5 kilometres from the city centre.
Belgoprocess	Belgium	Treatment and conditioning of all types of radioactive waste.	Located in the Belgian province of Antwerp, the facility is around 3 kilometres to Dessel which had an estimated population in 2018 of 9,540 people.
Centre de L'Aube	France	Receives low and intermediate level and short lived radioactive waste.	Located in the Soulaines-Dhuys region which is a relatively sparsely populated region of 417 people, around 250 kilometres from Paris.
El Cabril	Spain	Disposal facility for very low, low level waste and intermediate level waste.	Located 23 kilometres from the town of La Cardenchosa which has a population of 134 in 2017.
Low Level Waste Repository	United Kingdom	Manages low level radioactive waste.	Located in parish of Drigg and Carlton on the West Cumbria coast. Located within 4 kilometres of Seascale which had a population of 1,711 in 2016.
Dounreay	United Kingdom	Disposal of low level radioactive waste.	Located on the north coast of Caithness in Scotland, around 15 kilometres from Thurso which had a population of 7,610 people in 2016.
Federal Waste Disposal Facility	United States	Disposal of low level radioactive waste.	Located in Andrews, Texas closest to Eunice with an estimated population of 1,000 in 2016.
Transport Cask Storage Facility	Germany	Temporary storage for radioactive waste.	Located 23 kilometres from Ahaus which had an estimated population in 2016 of 39,314.

Source: Cadence Economics estimates from the South Australia Department of Planning, Transport and Infrastructure, *Population Projections for South Australian Local Government Areas, 2011 – 2031*, February 2016

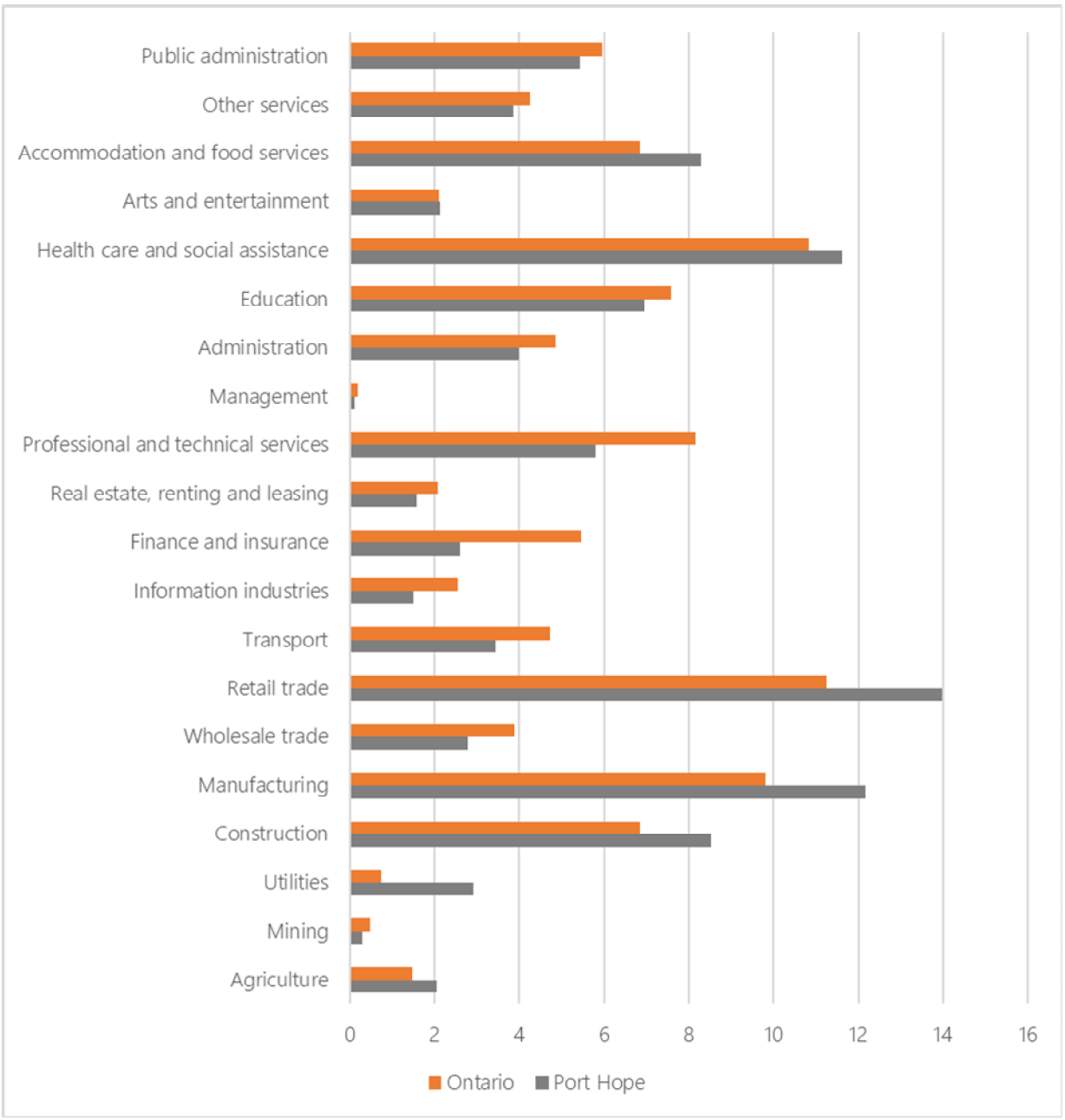
Port Hope

The Port Hope facility stores low level waste from contaminated soil in above ground containment mound and is located around 100 kilometres east of Toronto in Canada. As discussed above, the facility is in close proximity, around 5 kilometres, to a population base of just under 12,600 people (according to the 2016 Census).

Figure 9 shows the proportion of employees across various industries in Port Hope as well as the broader province of Ontario. While this is a snapshot of employment in the region taken from the 2016 Canadian Census, a number of factors are interesting to note in relation to the key areas of concern, particularly agriculture and tourism in the Port Hope region.

First, the relatively high proportion of employees in Utilities in Port Hope relative to Ontario is directly linked to the employment at the facility.

Figure 9: Share of employment by industry sector (% of employees), 2016



Source: Cadence Economics estimates, from Canadian Census 2016

Second, the Port Hope region also have a relatively higher proportion of employment in Agriculture compared with Ontario. While this is not definitive evidence that the facility does not affect agricultural production in the region, it might be expected that if there were serious adverse consequences on agricultural production caused by the facility that the relative proportion of employees in agriculture in Port Hope would be lower than Ontario.

Third, there are two key sectors in relation to tourism under the industry classification presented in the Census data: Accommodation and food services and Retail trade. For both of these sectors, the proportion of employees in Port Hope are higher than for Ontario more broadly. Again, while this

analysis is not definitive, if the facility was having adverse impacts on tourism it would be reasonable to expect the proportion of employment in these industries to be lower than in Ontario.

Centre de L'Aube

The Aube region in France is host to the Centre de L'Aube, a similar facility to the one being proposed here. The Centre de L'Aube site was selected in June 1986, was commissioned in December 1991 and received it first waste in January 1992.

While data is limited, there is no evidence that the facility has impacted the regions population, agricultural output, land values or tourism.

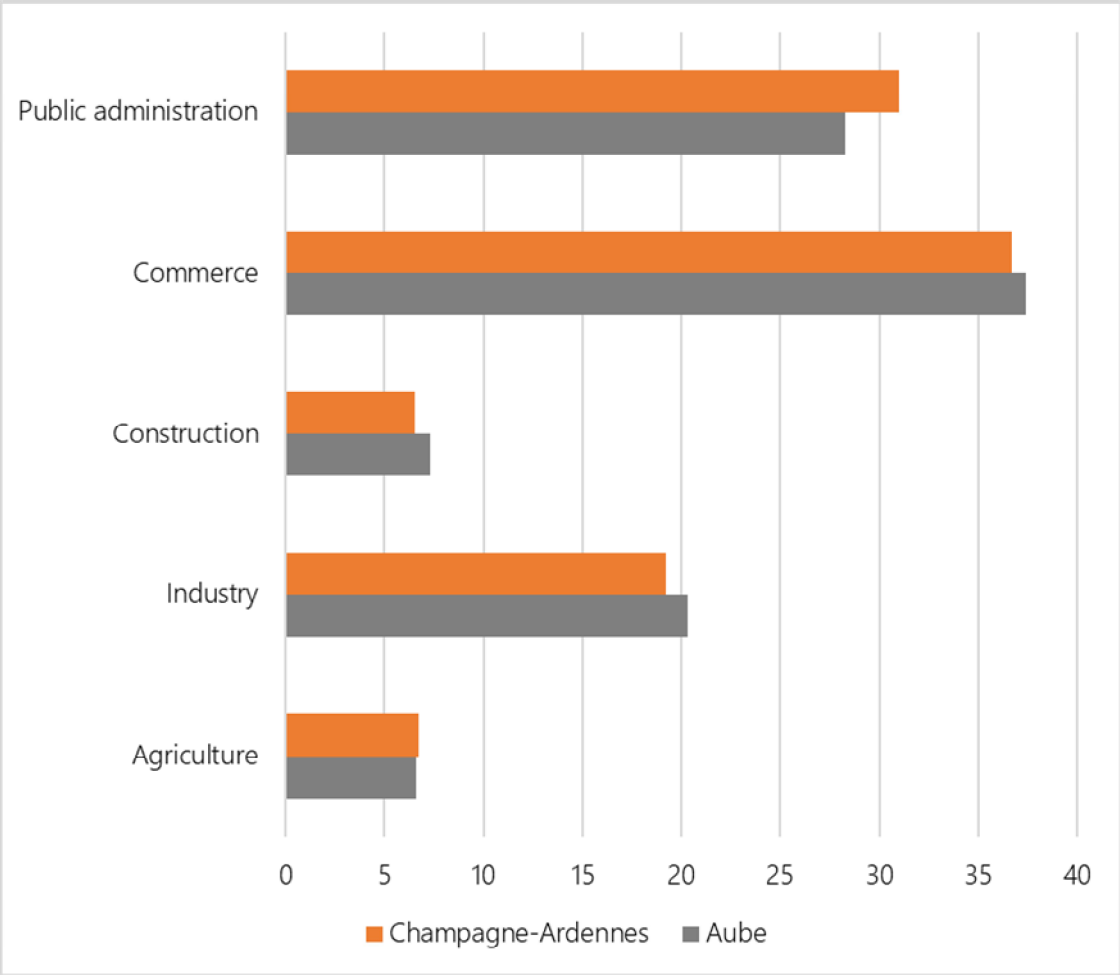
Based on information as outlined in the *ANDRA and its Disposal Facilities: General Presentation*, suggests:

- Population in the canton de Soulaines-Dhuys, the town where the facility is located, has slightly increased since the site was commissioned.
- Tourism in the Aube region has also experienced significant growth, an annual average of 7.4% over the period 2005 to 2013.
- Cabbage production in the Aube region has remained stable, in a general declining market for cabbage.
- In the Champagne region next door, production volumes have grown since the facility has been operational.
- In addition, within the Champagne region, over the period 1991 to 2009 the average price per hectare has increased by more than three times.

While the data for the Aube region of France is older, derived from the 2011 French Census, Figure 10 shows that the proportion of employment across five key sectors. Importantly, in the context of the Aube region, wine production (Agriculture) is critical. In 2011, this region was the second largest producer of champagne as well as being a major producer of potatoes, cereals and beet.

The employment data shows no discernible difference in the share of employment in Agriculture in Aube compared with the broader Champagne-Ardennes region. While this is not definitive evidence that the facility does not affect agricultural production in Aube, it might be expected that if there were serious adverse consequences that the relative proportion of employees in agriculture in Aube would be lower than the Champagne-Ardennes region.

Figure 10: Share of employment by industry sector (% of employees), 2011



Source: Cadence Economics estimates, from French Census 2011

5.5 Summary

A review of the literature did not reveal any studies quantifying either the benefits or adverse impacts of hosting a facility similar to the NRWMF on key economic areas such as housing, agricultural production or tourism.

Each of these factors would be considered in the course of a broader EIA that formally assesses the likely costs and benefits of the NRWMF.

An EIA produced in Canada for a radioactive waste storage facility currently under consideration to be operated by Canada Nuclear Laboratories (CNL) in Renfrew County Ontario focussed primarily on a range of positive economic benefits associated with the construction phase of the project and the ongoing employment.

In this EIA, the concerns raised in relation to housing were around the ability of the region to deal with the increase in demand from both temporary and permanent employees increasing property prices. The assessment did not find that the project would have a detrimental effect on the regions

productive base, particularly tourism as this was not a key driver of economic development in the region.

In relation to existing facilities, a relatively large proportion of Australia's radioactive waste is stored at the Lucas Heights in NSW. Lucas Heights is a suburb in southern Sydney, located 31 kilometres from the CBD. Like some facilities overseas, the Lucas Heights Campus where radioactive waste is currently stored is located in the immediate vicinity (in this case, around 1 kilometre) of existing housing.

A comparison of the quarterly median house price across the Sydney metropolitan and Lucas Heights, which is effectively the suburb of Engadine, shows there has been virtually no difference in terms of house price growth in Engadine relative to the Sydney metropolitan area over the last five years. This analysis does not show what house prices in Engadine would be if the Lucas Heights facility did not exist (i.e. if there is any adverse effects on the level of house prices in Engadine associated with the presence of the facility). The data does show that despite the presence of the facility, house price growth in the Engadine area mirrors that of the broader Sydney metropolitan area.

Looking overseas, 8 radioactive waste facilities were considered across a range of developed countries. A number of these facilities are located within 5 kilometres of relatively large population centres including Port Hope in Canada and Belgoprocess in Belgium. The other facilities have been established in either sparsely populated regions, such as Centre de L'Aube in France, El Cabril in Spain and the Low Level Waste Repository in the UK. Other facilities have been established some distance from relatively large population centres, including Douneray in the UK, the Federal Waste Disposal Facility in the US and the Transport Cask Storage Facility in Germany.

Looking at employment data from Port Hope, a facility that is around 5 kilometres from to a population base of just under 12,600 people, the area has a relatively high proportion of employment in agriculture and tourism related sectors. While this is not definitive evidence that the facility does not affect these activities, it might be expected that that the relative proportion of employees would be lower if there were serious adverse consequences on these activities caused by the facility.

Similarly for the Centre de L'Aube in France, the employment data shows no discernible difference in the share of employment in Agriculture in Aube compared with the broader Champagne-Ardennes region which might be expected if there were adverse impacts of the facility on agricultural production.

6 CONCLUSIONS

This report assessed the economic impacts of the proposed facility on the Kimba region. The analysis includes two elements. First, a quantitative economic assessment of the impacts of the NRWMF on Kimba. Second, as assessment of evidence in relation to the economic impacts of comparable sites.

Hosting a facility such as the NRWMF does raise concerns over potential detrimental impacts on land prices, agricultural market access and prices as well as tourism impacts. To address these concerns, this report contains a desktop review of the literature on potential adverse impacts in Australia and overseas of hosting a facility such as the NRWMF. This review finds no credible evidence of any adverse impacts and so has been excluded from the modelling.

The quantitative assessment of the economic impacts of the NRWMF was based on a ***central case scenario***. Sensitivity analysis was also conducted to reflect a range of uncertainties around both the final specifications of the project and likely impacts on Kimba.

Under central case assumptions, the NRWMF was projected to confer economic benefits to Kimba in terms of economic output, welfare, employment and real wages.

The results show that by 2030, when the NRWMF is fully operational, real GRP in Kimba is projected to be 4.9 per cent higher than reference case levels which equates to a $8.4 million increase in real 2018 dollars. Over the first 33 year of the project, from 2021 to 2054, the NPV of the projected increase in real GRP in Kimba is just over $95 million. In welfare terms, real GRI is projected 4.7 per cent higher ($9.1 million in real 2018 dollars) in Kimba at 2030. The net modelled increase in employment in 2030 in Kimba is 16.6 FTE.

The economic analysis includes a number of sensitivities to test the underlying assumptions used in the analysis. The results of the analysis are robust in relation to the sensitivity analysis undertaken. The changes in aggregate results are not significant when uncertainties around the construction phase are considered.

The results show that the economic impacts are higher the more responsive the labour market is to the employment opportunities resulting from the NRWMF.