NORTHERN AUSTRALIA
CASE STUDY

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BOX 1   NORTHERN AUSTRALIA CASE STUDY - EXECUTIVE SUMMARY

Key findings

This impact study focusses on two projects, however these are just examples of a larger portfolio of work in relation to the Australian Government's northern development agenda. Much of CSIRO's work since 2009 has arisen from CSIRO delivering the Northern Australia Science Review to the Northern Australian Land and Water Taskforce. The FGARA and TraNSIT projects are part of a portfolio of activities by the CSIRO's Agriculture & Food and Land & Water Business Units since 2009. The FGARA and TraNSIT projects have produced the following outputs:

— The FGARA project developed a robust, science based methodology for assessing future land and water developments to help ensure that they are environmentally and economically sustainable.

— The success of FGARA was instrumental in the decision by the Australian Government to allocate $15 million as part of the Northern Australia White Paper to commission CSIRO to do similar assessments in three other catchments across northern Australia.

— The findings of the FGARA project drove a review of the Gulf Water Resources Plan. That review confirmed additional unallocated water resources. The subsequent water tender raised around $10 million in license fees paid to the Queensland Government. A subsequent tender process in late 2017 is expected to raise a similar amount. There is also the potential for significant flow-on benefits if and when that water is used to grow crops and forage.

— The TraNSIT model has been used by both industry and government across the whole of Australia to holistically evaluate the relative merits of proposed investments in new infrastructure and or potential policy changes.

— The TraNSIT model was used to help inform project funding decisions for the $100 million Beef Roads Fund. The use of the model is estimated to have increased the annual benefits of the projects supported by the Fund by $400,000 in 2015/16, $600,000 in 2016/17 and up to $1 million by 2017/18.

— The CSIRO is currently earning fees of around $550,000 a year for the use of TraNSIT by Australian and overseas users.
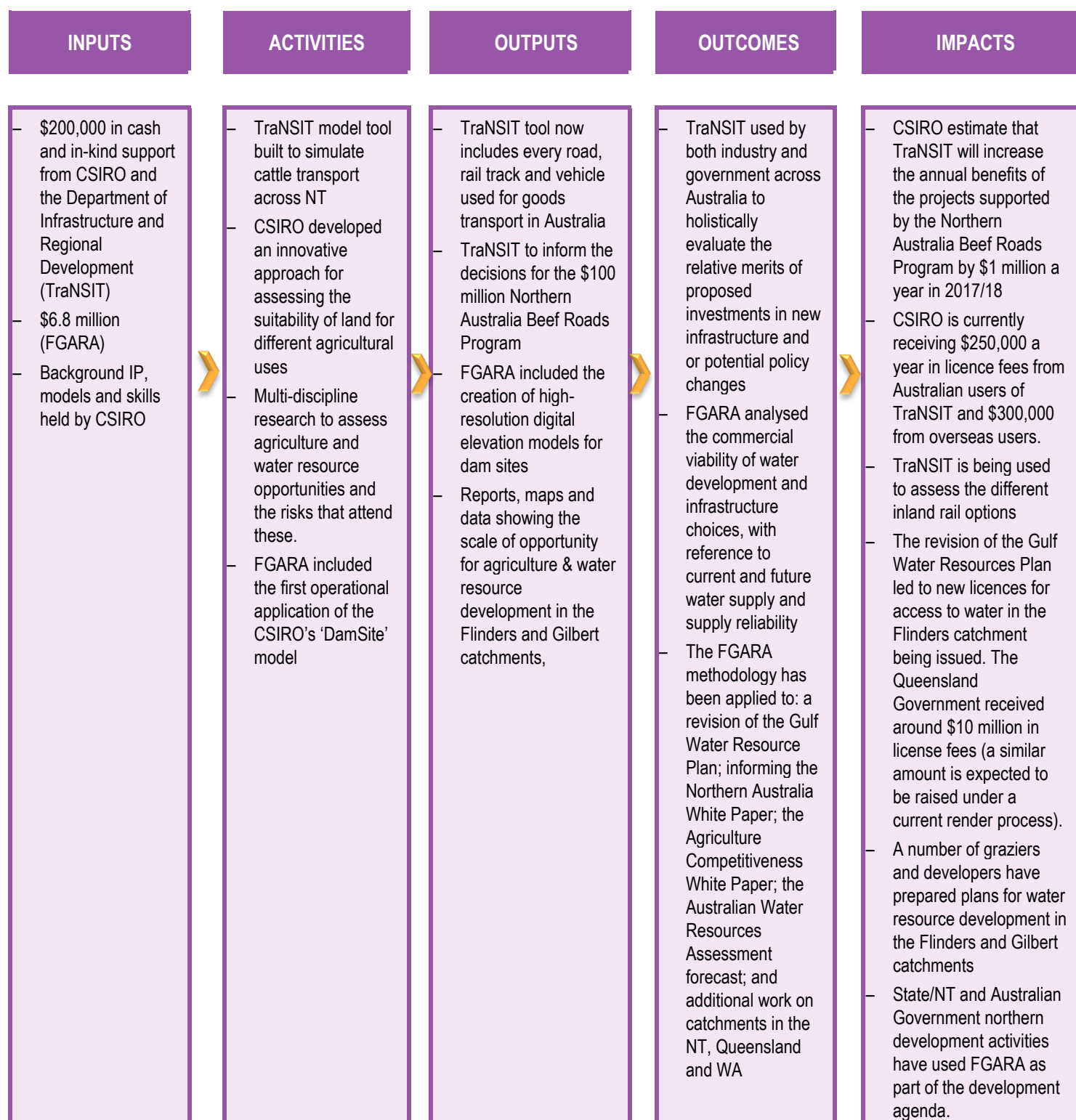
Innovation impact

The methodology developed for the FGARA can be used to much more rapidly and inexpensively assess future land and water developments. It can be tailored to provide information that meets the due diligence requirements of private investors and lenders, by addressing questions of profitability and income reliability of agricultural and other developments.

The TraNSIT model can be used to holistically evaluate the relative merits of proposed investments in new infrastructure and or potential policy changes.

This case study uses the evaluation framework outlined in the CSIRO Impact Evaluation Guide. The results of applying that framework to the Northern Australia case study are summarised in Figure 1.1.

FIGURE 1.1 NORTHERN AUSTRALIA CASE STUDY – IMPACT FRAMEWORK DIAGRAM

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACTS
– $200,000 in cash and in-kind support from CSIRO and the Department of Infrastructure and Regional Development (TraNSIT) – $6.8 million (FGARA) – Background IP, models and skills held by CSIRO	– TraNSIT model tool built to simulate cattle transport across NT – CSIRO developed an innovative approach for assessing the suitability of land for different agricultural uses – Multi-discipline research to assess agriculture and water resource opportunities and the risks that attend these. – FGARA included the first operational application of the CSIRO's 'DamSite' model	– TraNSIT tool now includes every road, rail track and vehicle used for goods transport in Australia – TraNSIT to inform the decisions for the $100 million Northern Australia Beef Roads Program – FGARA included the creation of high-resolution digital elevation models for dam sites – Reports, maps and data showing the scale of opportunity for agriculture & water resource development in the Flinders and Gilbert catchments,	– TraNSIT used by both industry and government across Australia to holistically evaluate the relative merits of proposed investments in new infrastructure and or potential policy changes – FGARA analysed the commercial viability of water development and infrastructure choices, with reference to current and future water supply and supply reliability – The FGARA methodology has been applied to: a revision of the Gulf Water Resource Plan; informing the Northern Australia White Paper; the Agriculture Competitiveness White Paper; the Australian Water Resources Assessment forecast; and additional work on catchments in the NT, Queensland and WA	– CSIRO estimate that TraNSIT will increase the annual benefits of the projects supported by the Northern Australia Beef Roads Program by $1 million a year in 2017/18 – CSIRO is currently receiving $250,000 a year in licence fees from Australian users of TraNSIT and $300,000 from overseas users. – TraNSIT is being used to assess the different inland rail options – The revision of the Gulf Water Resources Plan led to new licences for access to water in the Flinders catchment being issued. The Queensland Government received around $10 million in license fees (a similar amount is expected to be raised under a current render process). – A number of graziers and developers have prepared plans for water resource development in the Flinders and Gilbert catchments – State/NT and Australian Government northern development activities have used FGARA as part of the development agenda.

SOURCE: ACIL ALLEN

1.1 Purpose and audience for case study

This case study describes the economic, environmental and social benefits arising from two of the CSIRO's research projects designed to support the development of northern Australia.

This evaluation has been undertaken to assess (and demonstrate to a range of stakeholders) the positive impacts arising from a small sub-set of the work that CSIRO has undertaken in relation to northern Australia agricultural and water resource development. These two projects have been undertaken under the auspices of the Agriculture & Food and Land & Water Business Units.

This case study can be read as a standalone report or aggregated with other case studies to substantiate the impact and value of the Agriculture & Food and Land & Water Business Units' activities as a whole, relative to the funds invested in these activities. The information in this case study is provided for accountability, communication and continual improvement purposes. Audiences for this report may include State and Federal Members of Parliament, Government Departments, CSIRO and the general public.

1.2 Background

CSIRO, as Australia's national research agency, has supported the development of northern Australia for many decades. CSIRO's agricultural research commenced in northern Australia in the 1930s with the aim of supporting the development of the beef cattle industry. That research has produced many important outcomes. For example, it has:

— identified a number of agricultural and pastoral opportunities across northern Australia

— led to the introduction of tick-resistant cattle

— led to the introduction of dung beetles

— led to the introduction of a number of tropical legumes as pasture plants

— developed cotton varieties that are insect-resistant and adapted to growing in the tropics

— mapped much of northern Australia's soil and landscapes

— developed cropping systems adapted to northern Australia

— worked closely with industry to breed and introduce new sugar cane varieties as well as bringing genetic material from China into Australian varieties.

CSIRO's research in support of the development of northern Australia continues to this day. It has expanded to include research to support the minerals and energy, tourism, wildlife, Indigenous knowledge, defence and fisheries industries as well as the emerging carbon economy. It has worked by directly supporting these sectors, as well as providing science that underpins the establishment and growth of industries and communities in the north more generally. CSIRO has around 200 current or recent projects with direct relevance to northern Australia. CSIRO's projects includes initiatives to improve northern Australia's hard and soft infrastructure, economic value chains, Indigenous knowledge and land management, Indigenous economic development, public health, land and water management and understanding of northern Australia's environment.

For the purposes of this case study we have focussed on two projects, namely:

— The development of the Transport Network Strategic Investment Tool or TraNSIT.

— The Flinders and Gilbert Agricultural Resource Assessment (FGARA) which evaluated the feasibility, economic viability and sustainability of agricultural development in the Flinders and Gilbert catchments in the Gulf country of North Queensland.

1.2.1 Transport Network Strategic Investment Tool (TraNSIT)

Northern Australia is the source of about 80% of the country's live cattle exports. The large areas of grazing land that enable these cattle to be raised also mean that transport distances between production, processing and markets are long, often over 1000 kilometres. These long distances mean that the transport costs for cattle can account for up to 40 per cent of the market price. Hence any improvement in transport efficiency could have a significant positive impact on productivity and profits in the sector.

1.2.2 Flinders and Gilbert Agricultural Resource Assessment (FGARA)

FGARA is one of many CSIRO agricultural and water resource assessment projects that build on the Northern Australia Sustainable Yields project (NASY),the Mosaic Agriculture Project, the Northern Rivers and Dams Project and the Food and Fibre Supply Chain Project (all led by CSIRO).

Millions of hectares of soil across northern Australia are potentially suitable for irrigated agriculture. However, the use of land in this way is dependent upon the users being confident that they will have reliable access to sufficient water. It is also important to ensure that diverting water for use in irrigated agriculture does not create any adverse environmental consequences downstream. In late

2011 the Queensland Premier and the Commonwealth Minister for Regional Development announced the North Queensland Irrigated Agriculture Strategy (NQIAS) to investigate the challenges and opportunities facing northern communities and primary producers.

CSIRO led one component of the NQIAS, namely the Flinders and Gilbert Agricultural Resource Assessment (FGARA). CSIRO was supported by the Queensland Government and a number of subcontracted organisations who brought specific expertise to the project. The Assessment sought to:

— identify and evaluate water capture and storage options

— identify and test the commercial viability of irrigated agricultural opportunities

— assess potential environmental, social and economic impacts and risks.

The FGARA project provided a comprehensive and integrated evaluation of the feasibility, economic viability and sustainability of agricultural and water resources development in these two catchments in north Queensland and has helped inform deliberations and decision making about sustainable regional development. Following directly from FGARA the Australian Government has invested a further $15 million in the Northern Australia Water Resource Assessment (NAWRA).

1.3 Impact Pathway

1.3.1 Project Inputs

TraNSIT

The total cost of the TraNSIT project was $200,000 in cash and in-kind contributions in 2014/15. CSIRO contributed a quarter of the total cost of the project ($50,000) as in-kind support. The other contributor to the project was the Department of Infrastructure and Regional Development, which contributed $150,000 in cash.

FGARA

The total cost of the Flinders and Gilbert Agricultural Resource Assessment (FGARA) project was $6.8 million. The Australian Government funded $6 million while CSIRO contributed $800,000, principally for airborne geophysics. While the Queensland Government announced a budget of $3 million for its component of the NQIAS, none of this was used to support FGARA (see **Table 1.1**).

TABLE 1.1 SUPPORT FOR FGARA

Contributor / type of support		2011/2012	2012/2013	Total
Cash				
CSIRO		$400,000	$400,000	$800,000
Commonwealth Government		$3,000,000	$3,000,000	$6,000,000
	Total	**$3,400,000**	**$3,400,000**	**$6.8 million**

1.3.2 Project activities

TraNSIT

In order to examine the transport challenge facing the live cattle export sector, CSIRO needed to evaluate the entire cattle transport system across northern Australia. To do this, CSIRO researchers simulated more than 1.5 million vehicle movements between 50,000 enterprises over five years using some 88,000 point to point travel routes. The resulting information was then modelled via a tool CSIRO developed known as the Transport Network Strategic Investment Tool (TraNSIT).

Since its original application to the beef industry, the TraNSIT tool has now been developed to the point where it now includes 98 per cent of agriculture transport (road and rail) across Australia.

FGARA

Over 100 researchers contributed to this project, designed to provide a comprehensive and integrated evaluation of the feasibility, economic viability and sustainability of agricultural development in the Flinders and Gilbert catchments in north Queensland.

The key to FGARA was that it integrated information from a wide range of disciplines. FGARA included distinct activities relating to:

— Climate

— River modelling

— Flood mapping

— Geophysical assessment

— Land suitability

— Groundwater

— Surface water storage

— Agriculture productivity

— Dry-season pools

— Aquatic and riparian ecology

— Indigenous water values

— Socio-economics

Many of these activities either developed new techniques (e.g. dry season pools or surface water storage) or applied cutting edge techniques on a larger scale than had previously been attempted (e.g. using Digital Soils Mapping to determine land suitability). The information products from FGARA ranged from highly technical activity reports down to integrated catchment reports, summaries and factsheets. FGARA's value came from its ability to deliver information which could be used by end-users with a range of perspectives – all backed by the rigorous science which is expected of CSIRO.

The key to the new approach was CSIRO's ability to take information that was not confined to a particular discipline or sector and, often using non-traditional approaches, analyse it in ways that gave investors or government a greater feel for the scale of the opportunity. For example, non-traditional approaches were used to develop information about soils and landscape using a range of existing data-sets. This enabled CSIRO to prepare maps of the suitability of land for different agricultural uses for over 155,000 km^2 of the catchments within a year at a relatively modest cost. In the past, preparing such maps would have taken several years at much greater cost.

Another innovation was to use satellite data to estimate water quality. The satellite data provides information about water turbidity and depth which helps to estimate the potential impact of agricultural development on the river systems and pools. Those estimates can then be verified through on the ground testing and measurements.

1.3.3 Project outputs

TraNSIT

While CSIRO initially developed TraNSIT to examine live cattle logistics in northern Australia, it has now been extended and can be used to analyse both small and large scale investments in the agriculture supply chain covering almost all Australian agricultural logistics.

CSIRO applied TraNSIT to inform the Federal Government's $100 million Northern Australia Beef Roads Program and maximise transport cost savings in beef supply chains across the north. CSIRO are currently applying TraNSIT to broader Australia-wide agriculture transport, comprising more than 25 commodities, as part of the Government's Agricultural Competitiveness White Paper.

TraNSIT works by analysing every possible combination of transport routes and modes (road and rail) and determining those that optimise vehicle movements between enterprises in the agriculture supply chain. The tool incorporates factors such as road/rail condition, temporary closures and diversions and the availability of supporting facilities such as truck stops and holding yards. It can be used to manage logistics costs for individual enterprises or whole industries.

The tool currently accommodates 142 million tonnes of agricultural transport and over 5 million vehicle movements and 15,000 rail trips per year. This includes the transportation of cattle as well as grains, dairy, poultry, rice, cotton, pigs, sugar, sheep, buffalo, horticulture crops and stock feed. It accommodates about 98% of the national agricultural transport task. The tool considers transport from farms to storage, feedlots, processing, export ports, as well as domestic supply chains to distribution centres and retailers.

FIGURE 1.2   ILLUSTRATIVE EXAMPLE OF HOW TRANSIT MODELS THE DENSITY OF TRANSPORT MOVEMENT
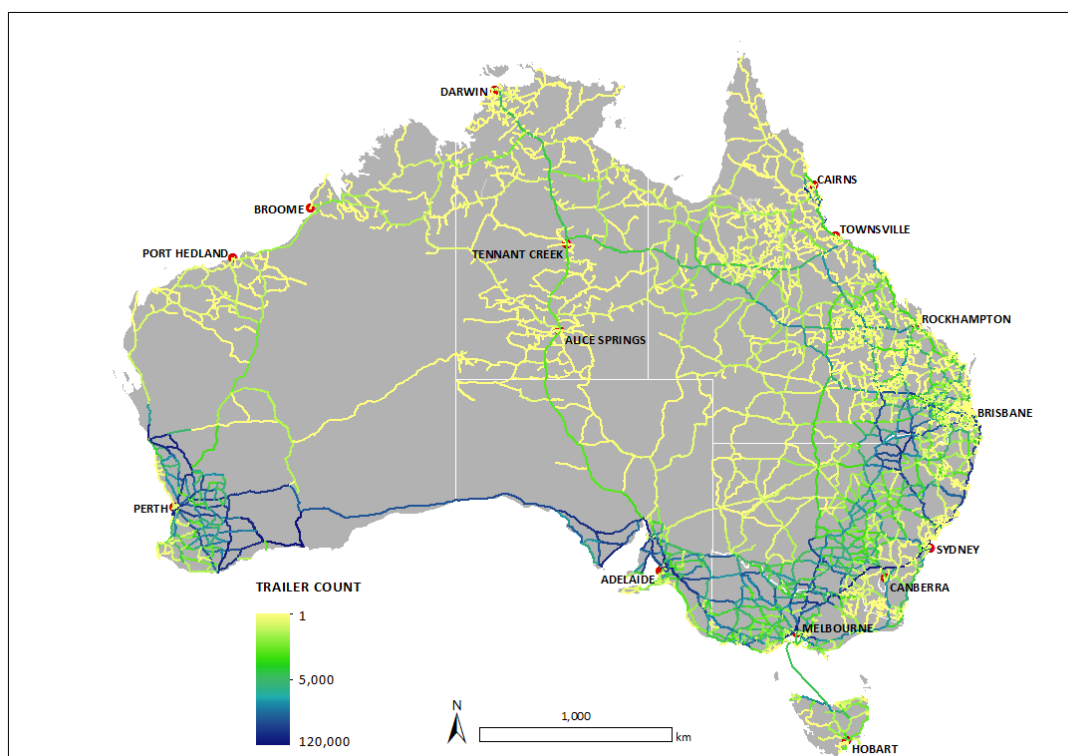
FGARA

The work done for the FGARA differs from previous assessments of agricultural developments or resources in two main ways:

— Whereas previous assessments focused on a single development activity or asset – without analysing the interactions between them – FGARA considered the opportunities presented by the simultaneous pursuit of multiple development activities and assets and any risks associated with these. The Assessment used a whole-of-region (rather than an asset-by-asset) approach to consider the implications of proposed developments.

— The novel methods developed for the Assessment provide a blueprint for rapidly assessing future land and water developments in northern Australia.

FGARA also saw the first operational application of the 'DamSite' model, developed by CSIRO researchers, which enables researchers to automatically identify potential dam locations. DamSite involves the use of high-resolution digital elevation models and sophisticated algorithms to look for potential dam sites. It enables pre-feasibility estimates of dam cost and a number of metrics related to water storage, water yield and cost per ML at the dam wall, even in areas with little pre-existing data.[1]

Importantly, the process developed as a result of the FGARA project is designed to build a knowledge base to inform future development decisions. It does not recommend one development over another. Rather it seeks to inform deliberations and decision making regarding sustainable regional development. The results of the FGARA project provided decision makers with increased confidence that it was possible to quickly and accurately assess the impacts of regional development proposals. This contributed to the Commonwealth Government's decision to establish the $5 billion Northern Australia Infrastructure Fund (NAIF).[2]

The demonstrated success of FGARA also underpinned the decision by the government to allocate $15 million as part of the Agricultural Competitiveness White paper (but linked to the Northern Australia White Paper) to replicate the work done by CSIRO in the Flinders and Gilbert catchments in three study areas across northern Australia. Andrew Dickson from the Office of Northern Australia noted that:

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[1] Water for a healthy country flagship review report 2009 to 2013, CSIRO, 2013.
[2] The Northern Australia Infrastructure Facility (NAIF) may approve loans totalling up to $5 billion by end June 2021. NAIF loans are intended to encourage and complement private sector investment in economic infrastructure that benefits northern Australia, such as airports, communications, energy, ports, rail and water.

> The methodology developed by CSIRO for the FGARA set a new benchmark for comprehensive water and agriculture resource assessments (the gold standard). The approach includes a comprehensive package of foundational science, supporting wide stakeholder involvement which leads to good support for the findings.[3]

FGARA was also significant because it analysed the commercial viability of water development and infrastructure choices, with reference to current and future water supply and supply reliability. Where other water resource assessments primarily aimed to inform government decision-making and provide information to agriculturalists, the FGARA provided information that can be tailored to meet the due diligence requirements of private investors and lenders, by addressing questions of profitability and income reliability of agricultural and other developments.

Publications

The FGARA project produced a series of reports and datasets, which included:

— Two detailed reports covering the Flinders and Gilbert catchments respectively, providing comprehensive analysis of the feasibility, economic viability and sustainability of agricultural development in each catchment.

— Summary reports, FAQs and factsheets covering FGARA project management and key findings,

— 17 technical reports covering methodology and research findings for issues such as: river system, streamflow and surface-groundwater modelling; climate data and hydrological and agricultural scenario modelling; dam and sediment modelling; flood and floodplain mapping and modelling; Indigenous water values, rights and interests; irrigation costs and benefits; socio-economic impact evaluations; land suitability assessments and agricultural production.

— More than 20 scientific journal papers and numerous conference papers.

— A number of datasets accessible through CSIRO's Data Access Portal, for example, covering soil properties and modelled irrigation land uses (i.e. crop and irrigation combinations), with more detailed information on location-specific soil sample results available upon request.

Patents

There are no patents associated with TraNSIT or FGARA.

Awards

CSIRO has received, and been nominated for, a number of awards for its water resources assessment work. While none of these were specifically for the FGARA project, the awards recognise the level of expertise that CSIRO has built in this field over the last decade and innovative processes it has developed.

The FGARA project was nominated for both a Eureka Award and the CSIRO "Impact from Science" award but was unsuccessful with both.

Innovation / commercialisation

TraNSIT

CSIRO has applied TraNSIT to inform the Federal Government's $100 million Northern Australia Beef Roads Programme and maximise transport cost savings in beef supply chains across the north. TraNSIT is also being applied to broader Australia-wide agriculture transport, comprising more than 25 commodities, as part of the Government's Agricultural Competitiveness White Paper. The tool currently can be applied to over 140 million tonnes of agricultural transport and over 5 million vehicle movements and 15,000 rail trips per year.

CSIRO was able to leverage its brand and reputation to gain access to commercial data that would normally be tightly held by commercial firms. For example, information such as livestock movements and grain handling data.

CSIRO provides access to the model on a fee for service basis. For example, the TraNSIT model was used to help inform project funding decisions for the $100 million Beef Roads Fund. The benefits from the use of model began to flow in 2014/15. In that year they were around $70,000. CSIRO estimate that the benefits from the use of the model increased to $400,000 by 2015/16, $600,000 by 2016/17 and up to $1 million by end of 2017. CSIRO assumes that those benefits would flow for the life of the road infrastructure, normally around 50 years.

The TraNSIT model is currently being used to assess the different options for the inland rail proposal. The model is also being used to inform NAIF decisions on which projects will receive funding. The TraNSIT model is also popular in several overseas countries,

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[3] Personal communication with Andrew Dickson, Director, Office of Northern Australia, September 2017.

including Laos, Vietnam and Indonesia. The total fees for service for the use of TraNSIT in Australia has been about $250,000 per year across multiple projects, not including funding to further develop the model (e.g. Agricultural Competitiveness White Paper). For international work, the current project income is about $300,000 per year to about 2021. Fees for the use of the model in Australia are more variable than fees for use overseas but are expected to increase in 2018/2019.

CSIRO has developed a web based version of TraNSIT. It is developing a multi-user licence agreement for the model. CSIRO is currently seeking to arrange funding from state and federal jurisdictions to fund the development of the web based version. This should start later in 2017. Those who contribute to the development of the web version will also receive a license to use it.

FGARA

The novel assessment techniques developed and applied for the FGARA project have since been applied to a broad range of other assessments, including:

— A revision of the Gulf Water Resource Plan
— Informing the Northern Australia White Paper
— The Australian Water Resources Assessment (AWRA) forecast
— Additional work commissioned by the government for catchments in the Northern Territory, Queensland and Western Australia (NAWRA, $15M).

1.3.4   Project Outcomes

TraNSIT

CSIRO has developed a transport modelling tool that can be used by both industry and government across the whole of Australia to holistically evaluate the relative merits of proposed investments in new infrastructure and or potential policy changes.

FGARA

CSIRO has developed and applied a novel approach to land and water assessments that is considerably quicker and cheaper than previous approaches.

1.3.5   Adoption

TraNSIT

This innovative transport modelling tool is being used by both industry and government across Australia to inform significant decisions about infrastructure investment. For example, all proposals for funding under the $100 million Beef Roads Fund are required to be assessed by the CSIRO before a decision was made on whether to provide funding or not. TraNSIT was also used to examine how best to move cattle in a manner that takes account of cattle tick zones across northern Australia.

FGARA

CSIRO has developed and applied a novel approach to land and water assessments that is both considerably quicker and cheaper than previous approaches as well as allowing integration across different disciplines and sectors. That approach has since been applied in other catchments. For example, to determine the Murray-Darling Sustainable Diversion Limit. The results of that analysis have been adopted by the Murray Darling Basin Authority (MDBA).

Key findings of FGARA included that farm dams could support between 10,000 and 20,000 ha of irrigation in 70-80 per cent of years in the Flinders catchments, and that large dams could support 20,000 to 30,000 ha of irrigation in 85 per cent of years in the Gilbert catchment. The FGARA findings have created growing interest in increasing the area of irrigated agriculture in the catchments.[4]

Several stakeholders commented that the scientific rigour that CSIRO was able to demonstrate in the FGARA project was a crucial factor in the decision to bring forward the revision of the Gulf Water Resource Plan. One stakeholder commented that:

> There is no doubt that the FGARA supported Queensland's decision to review and update water resource planning in the gulf region, helping to improving planning and avoid poor spending decisions.[5]

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[4] Around 1,000 ha of land in the catchment was irrigated in 2014.
[5] Personal communication with Andrew Dickson, Director, Office of Northern Australia, September 2017.

The revision of the water resource plans for the Flinders and Gilbert catchments identified an additional 159 gigalitres (GL) and 452GL of water as available for release from those two catchments respectively.[6] In theory this would be enough water to irrigate some 60,000 ha.

The success of the FGARA project also underpinned the decision to allocate $15 million (as part of the White Paper) to enable CSIRO to apply the methodology developed for FGARA to three other study areas in northern Australia. Importantly, Queensland's support for the FGARA methodology was an important element in getting agreement for the funding.

The availability of the data sets assembled for FGARA will be very valuable as proposals for water and agricultural developments begin to emerge. Those data sets will enable proponent's claims to be tested. As another stakeholder commented:

> *FGARA provides the Department with strong insights into the potential for sustainable agriculture and the sustainable benefits of development.[7]*

FGARA can also provide the information needed to underpin changes to many of the restrictive statutory rules currently in place in the region, which limit the areas in which intensive agriculture is allowed to take place. Changes to these regulations could help to open up greater finance and lending opportunities for agricultural developers in the region. For example, the findings were used to justify granting a land clearing permit for 58,000 ha and providing a water allocation for a property in the catchment. FGARA also provided information on what could potentially be grown on the property. The owner of the property has been in contact with CSIRO to discuss getting CSIRO's help to get the project going.

1.3.6 Impacts

TraNSIT

The TraNSIT model to inform decisions about grants from the $100 million Beef Roads Fund has reportedly increased decision makers' confidence in the merits of proposals that are selected for funding. Improved and better informed decision making has in turn helped increase the likelihood of project success and hence improved the flow of benefits from the projects supported by the Fund. The benefits from the use of model began to flow in 2014/15. In that year they were around $70,000. CSIRO estimate that the annual benefits increased to $400,000 in 2015/16, $600,000 by 2016/17 and could reach $1 million by 2017/18. CSIRO have estimated that the cumulative benefits might continue to increase by around $600,000 a year. ACIL Allen has assumed a more conservative increase of $300,000 a year. We have also conservatively assumed that there will be no benefits attributable to CSIRO after 2026/27 as an alternative model could emerge at that time in the counterfactual.

The TraNSIT model was able to show that trucks transporting cattle from tick prone zones will take longer journeys to stay within that zone to avoid the stoppage time associated with tick treatment. The model predicted that if biosecurity policies didn't apply to cattle being transported to abattoirs then trucks would take more direct routes which, based on transport movements between 2008 and 2013, could save up to $2.3 million a year in transport costs from South East Queensland. These savings began in 2016 and ACIL Allen assumes that they will continue to accrue until 2026/27.

Given that transport costs are a significant proportion of the final market price of cattle, even a modest reduction in transport costs could have a significant impact. The average transport costs of transporting cattle from property to abattoir (including a stop to a feedlot or saleyard) is around $60 per head or about 7% of the market price. In 2016 around 8 million cattle were slaughtered.[8] This suggests that the annual total cost of road transport is around $480 million. If TraNSIT was able to reduce the cost of transport by an average of one per cent this would imply an annual saving of $4.8 million. ACIL Allen assumes that this saving will continue to accrue until 2026/27.

The TraNSIT model is now being applied across the entire agricultural sector. ACIL Allen therefore expects that the above estimate of the potential benefits resulting from the use of the model is likely to be conservative. The Northern Territory Cattlemen's Association commented that:

> *TraNSIT has done a great job in objectively determining the return on investment on road projects.[9]*

CSIRO is currently earning around $550,000 a year as fees for service for applying the model to a range of projects.

Better informed investments in transport infrastructure due to TraNSIT also deliver social and environmental benefits. For example, the reduction in travel times reduces the risk of accidents due to driver fatigue and reduces the stress placed on the cattle being

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[6] In theory this would be enough water to irrigate some 60,000 ha.
[7] Personal communication with Drue Edwards, Water Division, Department of Agriculture and Water Resources, October 2017.
[8] Australia's beef industry – Fast Facts 2016, MLA, https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/fast-facts--maps/mla_beef_fast-facts-2016.pdf, accessed 24 August 2017.
[9] Personal communication with Northern Territory Cattlemen's Association, September 2017.

transported. Similarly, the reduction in fuel consumed when transporting agricultural goods also leads to reduced greenhouse gas emissions. ACIL Allen has not sought to value these benefits.

FGARA

Better understanding of future water supply scenarios reduces the likelihood that water managers will invest in agricultural or water projects that will become loss-making or unviable in the future as a result of changes in climate or water supply patterns. At the same time, better information on future water supply risk can help investors avoid higher risk investments, and free up capital for investments in agricultural regions that are more water secure.

Cropping suitability maps and seasonal water flow forecasts from water resource assessments allow farmers to optimise cropping choices and manage crop production uncertainty more effectively than previously. This can reduce risk of misallocation of farming land to sub-optimal uses and risk of loss from water supply stress.

There are also environmental benefits associated with water resource assessments. For example, they can demonstrate the local ecosystem's ability to absorb greater levels of water extraction, while at the same time setting upper limits on sustainable levels of water extraction. Having access to better information on thresholds for sustainable water extraction increases water manager's confidence that the allowed water extraction will have limited impact on the river system.

CSIRO's integrated water resource assessments can help mitigate shocks from natural disasters, water supply and climate variability and longer-term water supply and climate change. Social benefits may flow as a result of potential reductions in losses and greater resilience for communities that are directly dependent upon local water supplies, such as agricultural communities and rural indigenous communities.

The FGARA project is the culmination of many years of research by CSIRO into water resource assessments. ACIL Allen has previously estimated the impact and value of water resource assessments in other regions (such as the Murray Darling Basin) and found them to be substantial. ACIL Allen expects that FGARA will also generate similar positive benefits.

As a result of the revisions to the Gulf Water Resources Plan the Queensland Government in 2015 called for tenders for 265 GL of unallocated water in Gulf catchments for use in irrigated agriculture. The outcome of the tender was that water licences for 92,500ML were issued to successful tenderers. Tenderers paid between $45.5 and $125 per ML for their licences. The average cost paid by tenderers was just over $103 per ML. In total the tender raised just over $10 million for the Queensland Government. A subsequent tender process announced in August 2017 has the potential to raise a similar amount.

It is interesting to note that the average price paid for water in the previous tender in the Flinders catchment was below $38 per ML. It is possible that the increased confidence in the availability of water in the catchment as a result of the FGARA project contributed to this increase in the amount that users were prepared to pay for a water licence.

The issuing of these water licences opens the door to an as yet undetermined, but potentially substantial, increase in agricultural production from the catchments. There are to date no actual agricultural projects that have come to fruition as a result the FGARA project. However, the potential benefits could be considerable. Based on an assumption of around 60,000 ha of irrigated cropping and 25,000 ha of dryland cropping in the Gulf Rivers Agricultural Development Zone (GRADZ), the value of potential production has been estimated to be around $192 million (this was made up of: cotton $104 million; rice $33 million; and other crops $55 million).[10] ACIL Allen has not included any of these potential benefits in our analysis.

The improved understanding about the sustainable level of water use in the catchment provided by FGARA also has social and environmental benefits. The ability to have greater confidence in the water supply is likely to encourage agricultural development in the region. This will create employment and more resilient farming communities. Sustainably managing the water flows in the Gilbert and Fitzroy Rivers as part of new agricultural developments will also help to protect the important fish and prawn breeding grounds in the Gulf. ACIL Allen has not sought to value any of the above social or environmental benefits.

Incorporating Indigenous water values in the FGARA project was an important and innovative approach that enabled CSIRO and partners to build strong working relationships with Indigenous Traditional Owners. For example, the FGARA work is helping to inform a CSIRO project with the Indigenous Ewamian people in the Gilbert river region. The work CSIRO is doing with them will explicitly link the scientific advice drawn from FGARA with the development aspirations of the Indigenous group's ecotourism and pastoral assets.

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[10] Personal communication with Queensland Department of Agriculture and Fisheries, September 2017.

1.4 Clarifying the Impacts

1.4.1 Counterfactual

TraNSIT

A great deal of the data that CSIRO was able to obtain from firms to incorporate into the model was highly commercially sensitive. Given this, it is unlikely that any other organisation would be able to access that data. Hence it is unlikely that a model with a similar degree of coverage and detail could have been created by another organisation. In addition, five years of industry (farming, processing, transport operators, etc.) expert knowledge across over 80 agencies, associations and companies was used to parameterise and calibrate TraNSIT. It would take a long time for another organisation to duplicate that knowledge base and create the widespread industry confidence that the CSIRO currently holds. We therefore estimate that it would be extremely unlikely that anybody could duplicate the TraNSIT model before 2026, and possibly much longer.

FGARA

In the absence of CSIRO, water management and investment decisions would still have been made. In coming to these decisions the various governments involved could have sought advice from other researchers in either universities or the private sector, most likely through an open tender process. However, such a process would not have provided access to the diverse and multidisciplinary range of resources and capabilities that exist within CSIRO. The advantage CSIRO had was that it was able to, on request, mobilise a large research staff from multiple disciplines to work on the issues. It is unlikely that a highly focused research effort like that delivered by CSIRO could have been mounted through government tendering a range of projects to other researchers.

High level stakeholders from both government and industry noted that CSIRO's involvement in the FGARA project was important in ensuring that the project was given access to the data needed to undertake the research.

It is clear that CSIRO's innovative approach to water resource and land use assessments has significantly increased the speed with which they can be conducted and reduced their cost. In the absence of FGARA it is likely that the review of the Gulf Water Resources Plan would not have occurred for between six and ten years. Hence, ACIL Allen has assumed that in the absence of CSIRO the benefits of FGARA would have been delayed by at least ten years.

1.4.2 Attribution

TraNSIT

There were a large number of groups that contributed to the development of TraNSIT. The data used in the model for northern Australia beef was provided by a range of state government agencies and industry groups. Freight operators and related associations also provided expertise to validate and calibrate TraNSIT. ACIL Allen believes it is highly unlikely another organisation could have gained access to this data and the other support provided to develop the TraNSIT model. We therefore propose to attribute 100 per cent of any benefits flowing from the project to CSIRO.

FGARA

CSIRO led the FGARA project and in doing so let a number of sub-contracts for particular expertise (e.g. James Cook University, Griffith University). Outside the broader NQIAS activities the Queensland Government contributed significantly to the river modelling calibration and the land suitability assessment. CSIRO is probably the only organisation in Australia (perhaps globally) that could assemble a multi-disciplinary team of the nature described above and address it to a complex issue like water resource development. ACIL Allen proposes that 80 per cent of any benefits ultimately identified should be attributed to CSIRO.

1.5 Evaluating the Impacts

1.5.1 Cost-Benefit Analysis

Costs

Based on the cost data presented in **Table 1.1**, the present value of program costs is $10.12 million in 2017 dollars under a 7 per cent real discount rate.

Benefits

Quantified benefits arising from the TraNSIT and FGARA projects in each year between 2014/15 and 2026/27, as described previously in Section 1.3.6, are shown in **Table 1.2**.

TABLE 1.2   PROGRAM BENEFITS, 2014/15 TO 2026/27 ($M)

	2014 /15	2015 /16	2016 /17	2017 /18	2018 /19	2019 /20	2020 /21	2021 /22	2022 /23	2023 /24	2024 /25	2025 /26	2026/ 27
TraNSIT													
Increased benefits from Northern Australia Beef Roads program	0.07	0.40	0.60	1.00	1.30	1.60	1.90	2.20	2.50	2.80	3.10	3.40	3.70
Reduction in cost of transporting cattle near tick-prone zones in SE Queensland	0.00	0.00	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Reduction in other costs of transporting cattle	0.00	0.00	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
Model use fees	0.00	0.00	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
FGARA													
Tenders received from extra water allocations auctioned for Gulf catchments	0	0	10	0	0	0	0	0	0	0	0	0	0
Total benefits	**0.07**	**0.40**	**18.25**	**8.65**	**8.95**	**9.25**	**9.55**	**9.85**	**10.15**	**10.45**	**10.75**	**11.05**	**11.35**

SOURCE: ACIL ALLEN CONSULTING ANALYSIS

The annual project benefits are also shown in **Figure 1.3**.

FIGURE 1.3   PROGRAM BENEFITS, 2014/15 TO 2026/27 ($M)
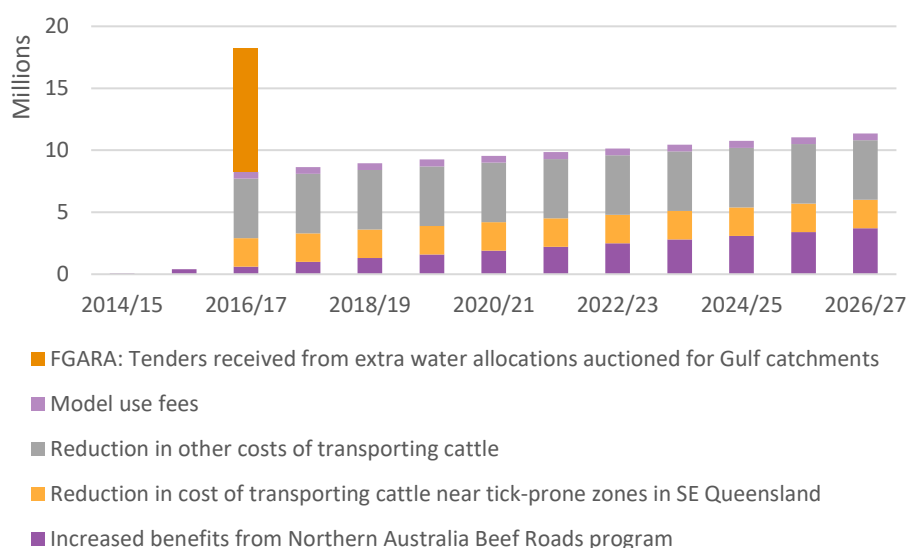
SOURCE: ACIL ALLEN CONSULTING

The present value of the two projects' estimated benefits is calculated to be just under $94 million in 2017 dollars under a 7 per cent real discount rate. This does not take into account any revenue that might be obtained by the current water licence round.

Assessment of benefits against costs

The net benefits or net present value (NPV) of the program is estimated to be $83.9 million in 2017 dollars under a 7 per cent real discount rate. The benefit-cost ratio (BCR) of the program is estimated at around 9.3. To the extent that additional revenue is obtained from the current water licence round (or any additional future rounds) that will lead to a higher net benefit and BCR.

Sensitivity analysis

To test the robustness of the CBA results, ACIL Allen undertook sensitivity analysis in relation to the following key assumptions:

— Annual increased benefits from Northern Australia Beef Roads program, 2018/19 to 2026/27
— Annual reduction in cost of transporting cattle near tick-prone zones in SE Queensland
— Annual reduction in other costs of transporting cattle
— Annual TraNSIT model use fees.

The results of the sensitivity analysis are shown in **Table 1.3**. In each instance, the BCR is 7.25 or higher.

TABLE 1.3   RESULTS OF SENSITIVITY ANALYSIS

Assumption	Assumed value			BCR		
	Central	Low	High	Central	Low	High
Annual increased benefits from Northern Australia Beef Roads program, 2018/19 to 2026/27	$0.3m	$0.1m	$0.5m	9.29	8.70	9.88
Annual reduction in cost of transporting cattle near tick-prone zones in SE Queensland	$2.3m	$1.5m	$3.1m	9.29	8.61	9.97
Annual reduction in other costs of transporting cattle	$4.8m	$2.4m	$7.2m	9.29	7.25	11.33
Annual TraNSIT model use fees	$0.55m	$0.35m	$0.75m	9.29	9.12	9.46

SOURCE: ACIL ALLEN CONSULTING

The sensitivity of the BCR to the choice of discount rate has also been tested. The BCR of the program is 11.89 and 7.37 under a 4 per cent and a 10 per cent real discount rate respectively. The corresponding NPV figures are $94.36 million and $74.91 million in 2017 dollars respectively.

1.5.2   Potential future impacts

TraNSIT

The TraNSIT tool has been extended well beyond its initial design and there is considerable scope to extend its use across the Australian agricultural sector. The model is also being applied in Indonesia, Laos and Vietnam. The rise in the fees paid to use the model over time suggest that it is regarded as a valuable planning tool.

FGARA

The fact that the approach to land and water assessments developed through FGARA is considerably quicker and cheaper than previous approaches suggests that it will continue to be a sought after planning tool. The comments by stakeholders support this view.

1.5.3   CSIRO's role as an Innovation Catalyst

TraNSIT

The TraNSIT model can be used to holistically evaluate the relative merits of proposed investments in new infrastructure and or potential policy changes. Past approaches only examined the impact of individual proposed transport projects in isolation.

FGARA

The methodology developed for the FGARA can assess future land and water developments more rapidly and inexpensively.

1.5.4 Distribution effects on users

The use of the approaches developed for FGARA and TraNSIT will inform decision making and reduce the risk of making costly planning or development mistakes.

FGARA provides information that can be tailored to meet the due diligence requirements of private investors and lenders, by addressing questions of profitability and income reliability of agricultural and other developments.

1.5.5 Externalities or other flow-on effects on non-users

TraNSIT

Improving transport infrastructure planning and develop outcomes will help to reduce travel times and the risk of driver fatigue induced accidents. There will also be benefits to animal welfare as a result of reduced travel times. Improved transport infrastructure can also increase the employment and income security of people in the agricultural sector. For example, through access to year round transport options.

FGARA

There are environmental benefits associated with more robust water resource assessments. For example, they can demonstrate the local ecosystem's ability to absorb greater levels of water extraction, and set upper limits on sustainable levels of water extraction for new agricultural development. This has important benefits to the river system and its ecology. Furthermore there are important downstream commercial impacts to consider. For example, better managing the water flows in the Gilbert and Fitzroy Rivers can help to protect important fish and prawn breeding grounds in the Gulf.