

National Environmental Science Programme



Integrated Environmental Assessment to inform sustainable development decisions A preliminary analysis for northern Australia Report

> Mat Hardy, Damien Burrows, Allan Dale, Michael Douglas, Alan Jordan, David Karoly, Kirsten Parris, Rachel Morgain, Sheriden Morris and Brendan Wintle

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Front cover images:

Clockwise from top left: Darwin Harbour from the air (Image: JarrahTree Wikimedia (CC BY 2.5 AU), Pastoral land near Timber Creek, Northern Territory (Image: Jaana Dielenberg); A Top End river (Image: Patch Clapp); Indigenous Rangers planning meeting (Image: Nicolas Rakotopare)

Executive summary

Significant landscapes of northern Australia are experiencing major development investment. Increasing focus on the development of northern Australia is seeing the region experience major investment and development in a landscape that boasts internationally and nationally significant environmental and cultural values. Robust development planning and decision-making processes are needed to meet the needs of investors and the community, and to reduce the risks to both the region's unique values and future economic opportunities.

Integration of environmental, social, cultural and economic dimensions is needed to assist complex decision-making. Development decision-making in northern Australia is often complex and contested, requiring consideration of environmental, social, cultural and economic dimensions. Achieving high-quality investment and development in the north requires planning and decision-making that can account for the complexity and diversity of values of the region, can facilitate acceptable trade-offs, and is based on the best available knowledge. However, development decision-making is often hindered by incomplete and uncertain information. Existing planning and assessment approaches are impeded by the complexity of sustainable development decision-making. Assessment approaches are needed that can address this complexity, integrate the multiple dimensions of sustainable development, and provide useful information to decision-makers.

Integrated environmental assessment (IEA) is a policy-orientated process for combining information from diverse knowledge systems to inform decision-making. This technical report explores Integrated Environmental Assessment (IEA) as an approach with significant potential to improve the delivery of sustainable development in northern Australia. IEA is an interdisciplinary and policy-orientated process for combining information from diverse scientific disciplines and knowledge systems to inform and enhance decision-making. IEA helps close decision-making, data and engagement gaps between higher level legislative requirements and on-ground project assessment and approval. The ability of IEA to synthesise and analyse information from multiple knowledge systems at relevant scales makes it particularly useful for informing development decisions in large, contested areas that contain high biodiversity and cultural values. As one example, products arising from the IEA process could integrate with and inform landscape-scale and regional planning, helping to identify areas where development, cultural and environmental conservation values overlap, compete or complement, and facilitate exploration of scenarios of environmental and development futures.

This report explores an IEA process framework for Australia, and offers a preliminary analysis of using IEA in northern Australia. Drawing on current knowledge and experience in IEA, this technical report explores a broadly applicable IEA process framework for conducting IEA in Australia. The report provides a preliminary analysis of using IEA in northern Australia, stepping through each stage of an example IEA process framework. This is not a report on an actual IEA process, rather a scoping document with the objective of highlighting how the IEA approach could inform and improve sustainable development decisions in Australia.

This technical report provides an overview of the IEA approach, identifies how IEA can complement existing environmental assessment approaches, and highlights the benefits and challenges that adopting an IEA approach can bring. It presents, as an example, a broadly applicable IEA process framework that is relevant and applicable at multiple scales, and could prove particularly valuable for supporting broadscale regional planning and policy decision-making. Utilising the region of northern Australia as context, the report then steps through each stage of the example IEA process framework to illustrate how relevant environmental, social, cultural, and economic data and knowledge can be gathered, synthesised, and analysed as part of the IEA process, and presented to inform and support development decision-making. The report also identifies available data and

information for use in an IEA for northern Australia (in the appended compendium). The report also explores some of the key challenges likely to be faced when implementing IEA.

Our exploration suggests that IEA offers opportunity as a foundational process for assisting sustainable development decision-making. The report suggests there is real value in adopting an IEA approach in northern Australia to assist in the delivery of sustainable development, providing preemptive insights into the key impacts of development decisions through the integration of cultural, social, environmental and economic information that is unavailable via current approaches. The IEA approach offers applicability across Australia, particularly valuable would be IEA's contribution to broad-scale planning approaches such as the bioregional planning recommended by the 2020 Review of the EPBC Act (Samuel 2020a). Our conceptualisation of IEA for this report offers opportunity to get in front of biodiversity loss, Indigenous cultural heritage and development issues and be proactive, reducing the reactive and inefficient application of planning and environmental assessment. IEA could prove an invaluable foundational process that facilitates the gathering, synthesising and analysing of knowledge and information from a wide range of sources - including Indigenous knowledge systems - which can then be drawn from to inform regional and development planning and decision-making at multiple scales.

Implementation of IEA comes with challenges, but solutions are available by drawing on existing practitioner experience. The preliminary analysis and case studies explored in this report suggest that the implementation of IEA is not without challenges. These include challenges in clarifying the IEA's purpose, facilitating genuine stakeholder engagement and participation, and accessing the required data and knowledge. However, insights from IEA practitioners also offer ways to address these challenges, such as grounding the process in the existing policy and regulatory context, working closely with stakeholders and end-users to tailor the process to their needs, and identifying data and knowledge requirements early on and adapting analyses as needed.

Timely to consider further development of a foundational IEA process for Australia, starting with a co-designed pilot project. It is our view that it is timely to further the development of a foundational IEA process for Australia. Within this we suggest the initiation of a suitable co-design process with key stakeholders in the north to identify a suitable IEA framework for addressing the development challenges faced by northern Australia. As part of developing and testing that framework, we suggest it would be useful to develop a co-designed pilot project for a specific region or problem in northern Australia.

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Chapter 1: Introduction

Key messages:

- Sustainable development issues are often multi-dimensional, and often have complex causes and consequences that are not well understood
- Existing environmental assessment and planning frameworks are often hindered by this complexity, insufficient information, and reactive application, and insufficiently address cumulative impacts, risking environmental, social, cultural and economic values
- Addressing the complexity and uncertainty of sustainable development decision-making requires integrated thinking that provides informed insights to decision-makers
- Integrated Environmental Assessment (IEA) is an interdisciplinary and policy-orientated process for combining, interpreting and communicating knowledge from diverse scientific disciplines and knowledge systems to inform decision-making
- IEA could operate as foundational platform that brings together and analyses knowledge and information from a wide range of sources - including Indigenous knowledge systems - to inform existing assessment frameworks and improve development planning and decisionmaking at multiple scales

Over the past few decades sustainable development has become a key consideration in environmental and development decision-making. The World Commission on Environment and Development defined sustainable development as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987), and at its core requires due consideration of three key intertwined dimensions – environment, society, and economy. Sustainable development remains a priority at the international level through the UN's 2030 Agenda for Sustainable Development, with the Sustainable Development Goals (SDGs) the current global initiative aimed at delivering sustainable development, a set of 17 goals and 169 targets adopted by all 193 member states of the United Nations. At a fundamental level, without sustainable development, the ability of ecosystems to supply the goods and services that humans need is severely threatened.

Sustainable development has become central to development decision-making for Australia. As well as Australia committing to the SDGs to 'reduce poverty, promote sustainable development and ensure the peace and prosperity of people across the world' (DFAT 2018), the concept of sustainable development has been embedded in much of Australia's environmental legislation. At the federal level, the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) has an object to 'promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources', and includes a set of principles relating to sustainable development for consideration when making decisions. Sustainable development is also present in State and Territory legislation, for example as objects in the *Environmental Protection Act 1994* (Qld) and the *Environment Protection Act 2019* (NT), and a stated purpose of the *Planning and Development Act 2005* (WA).

A key part of delivering sustainable development is assessing the environmental, social and economic impacts of projects, plans, policies and programs in advance of their implementation. In Australia, a number of frameworks are available to help in this. Environmental Impact Assessment (EIA) is used in each state and territory of Australia to assess the environmental impacts of specific development projects, and also at the federal level under the EPBC Act if the proposed development is likely to have a significant impact on Matters of National Environmental Significance (MNES). Strategic Assessment (SA) under Australia's EPBC Act, as a form of Strategic Environmental Assessment (SEA), is used to evaluate the environmental consequences of policies, plans and programs (Partidário 1996; Sadler & Verheem 1996; Marsden 2013). The EPBC Act also provides for

'bioregional plans' as a landscape-scale assessment framework, though the purpose of bioregional plans is not clearly specified. Nonetheless, bioregional plans show significant potential as a proactive planning tool to guide subsequent planning and development decision processes into the future (Pope & Moore 2013). Four marine bioregional plans have been developed to date, which identify the need to better understand marine conservation values (protected species, protected places and key ecological features), the risks posed by human activities, and the need to monitor and report on ecosystem health. At present no terrestrial bioregional plans have been prepared.

Though EIA and SEA frameworks in particular are well-established and widely used, there are critical impediments to the ability of these tools to deliver sustainable development. Sustainable development decisions and issues are often multi-dimensional, and environmental challenges often have complex causes and consequences, with many interactions between humans and the environment poorly understood. Existing assessment processes are often hindered by insufficient information, impeding their efficiency and effectiveness. Moreover, EIA and SEA frameworks are primarily incremental and reactive tools, assessing development matters as they arise on a case by case basis, and as such are often insufficient for systematically considering and addressing cumulative impacts of development and other regional pressures (e.g. see Grech et al. 2016). In short, existing assessment frameworks are insufficient for addressing cumulative impacts of project-level decision-making at scale (Dales 2011; Pope & Moore 2013).

The recent reviews of Australia's EPBC Act highlight some of these challenges. The audit of the assessment and approvals process under the EPBC Act found that it was neither effective nor efficient, in part due to the complexity of matters under consideration, and challenges in obtaining necessary and accurate information (ANAO 2020). More recently, the independent statutory review of the EPBC Act found similarly that "decision-makers, proponents of development and the community do not have access to the best available data, information and science", leaving "unacceptable information gaps", resulting in sub-optimal and inefficient decision-making (Samuel 2020a). Cumulative impacts upon the environment were found to be not well managed under the current EPBC Act, leading to underestimation of development impacts on species and ecosystems (Samuel 2020a). As recent research from the Cooperative Research Centre for Developing Northern Australia (CRCNA) has found, the uncertainty that arises from development decision-making in this context leaves industries, financiers and communities uncertain and risk-averse about investment and, importantly, places the environmental and cultural values within the landscape at risk (Dale & Marshall 2020; NAJA Business Consulting Services 2020a, 2020b).

Addressing the complexity and uncertainty of sustainable development decision-making requires consideration of a plurality of perspectives from a wide range of disciplines and stakeholders, and a mechanism to combine them all and assess current knowledge (Bailey 1997) – integrated thinking that provides informed insights to decision-makers. Realising sustainable development requires inter- and multidisciplinary approaches that give due consideration of multiple dimensions (Bond et al. 2001), environmental, social and economic. This requires a structured process that allows for consideration of environmental issues and their interactions with society and within the economic system. In short, integrated thinking and assessment approaches are needed to help ensure the goal of sustainable development can be delivered.

Integrated Environmental Assessment (IEA) is an interdisciplinary and policy-orientated process for combining, interpreting and communicating knowledge from diverse scientific disciplines and knowledge systems to inform decision-making. IEA as a process offers a participatory, structured framework for organising and analysing available knowledge in its various forms, including expert knowledge, data and cultural perspectives, to inform and support decision-making. The process allows for early identification of knowledge gaps and other barriers in advance of decision-making, which can then be addressed as part of the assessment. Various existing analytical approaches allow for detailed consideration and combination of economic, social and environmental factors within the

IEA process, providing vital insights to decision-makers through targeted outputs. It is through this process that IEA has significant potential to assist in the delivery of sustainable development.

Rather than reactive to development pressures, our conceptualisation of IEA sees it as a foundational platform that brings together and analyse knowledge and information from a wide range of sources - including Indigenous knowledge systems - which can then be drawn from to inform decision making at multiple scales, for example strategic assessments, EIAs, regional planning (e.g. bioregional plans), natural resource management (NRM) plans, Healthy Country Plans etc. We see the IEA process best used pre-emptively, with knowledge-gathering feeding a common knowledge and information base, and synthesis and analysis of this information occurring in advance of planning and decision-making processes. Through this, IEA will greatly improve and enhance existing planning and decision-making processes.

A particularly powerful use for IEA would be for informing regional planning and development approval decision-making. At regional and landscape scales, the information obtained through IEA could help identify areas where development and environmental conservation values overlap, compete or complement, and explore scenarios of environmental and development futures. Applied pre-emptively, it could help identify 'hard lines' and 'no-go zones' to protect important environmental and cultural assets, whilst identifying areas appropriate for development. Utilised to assist regional planning in advance of decision-making, IEA is particularly well-suited for avoiding and mitigating cumulative impacts from multiple development actions across multiple sectors (e.g. Wickham et al. 1999; Whitehead et al. 2017). And at project and local scales, IEA could be used to navigate complex multi-dimensional issues and address problematic information gaps, improving the way development planning and approvals are handled, such as those in large, contested areas containing high biodiversity and cultural values.

Adopting an IEA approach to sustainable development decisions would help build a better understanding of both the economic development priorities and the environmental and cultural values of the landscape, and enable governments, investors and key stakeholders to evaluate development futures at regional and local scales.

Through the process, development options, alternatives and trade-offs could be considered, allowing for the identification of key development sites. This could reduce sovereign risk for investors, and improve the protection and management of the environmental and cultural values of the region. Moreover, industry and agency decision-makers would be better prepared to avoid, mitigate or offset risks to the region's values, following a reliable and defensible approach accepted by all parties.

Drawing on current knowledge and experience in IEA, this report aims to explore at a high level a broadly applicable process framework for conducting integrated environmental assessment in Australia. It then steps through a preliminary analysis of using this IEA process framework in the northern Australia context, to demonstrate the technical side of how to improve development planning and decision-making of northern Australia through the IEA approach. Though the analysis is preliminary, and noting that important detail is missing without a specific real world application to consider, the report identifies key information for analysts and technical practitioners to think about when conducting IEA in northern Australia. In this it identifies key considerations, some example case studies, example analytical techniques, and example data and knowledge that could assist the development of an IEA process in northern Australia. It then explores some of the main challenges and opportunities for advancing IEA in northern Australia. The objective of the report is to identify how IEA could improve existing environmental planning and decision-making processes in Australia, stimulate and guide the uptake of IEA within Australian government agencies (especially Commonwealth, State and Territory governments). Important to note is that this is a scoping document outlining the key steps in conducting an IEA, and not a report on an IEA in itself, nor is it the scoping component that forms the first part of an IEA process.

The intended primary audience for this report is Commonwealth, State and Territory government practitioners working in sustainable development and associated decisions, environmental planning at regional and landscape-scales, environmental regulation, monitoring and reporting; as well as researchers, industry and other practitioners in related fields.

This report is divided into 5 chapters:

- Chapter 1 (this chapter) provides an overview of sustainable development, the key assessment frameworks currently in place to facilitate sustainable development in Australia and the key challenges they face, and outlines the need for integrated thinking in order to deliver sustainable development.
- Chapter 2 provides an overview of IEA, the key stages of an IEA process framework (using the United Nations Environment Program's framework as an example), its relationship to other forms of environmental assessment, some of the tools available to assist in IEA analyses, and some examples of where IEA (or important components thereof) has been applied previously.
- Using the region of northern Australia for context, Chapter 3 steps through a preliminary
 analysis of using IEA in the northern Australia region, following the IEA process framework
 identified in Chapter 2. Though not reporting on an actual application or case study of IEA,
 Chapter 3 aims to illustrate the technical side of how IEA could be used to improve
 development planning and decision-making. Its central focus is on identifying key
 considerations, relevant case studies that exemplify parts of the IEA process, types of
 knowledge synthesis and analysis that could be undertaken as part of an IEA, the types of
 data needed, and the likely challenges and opportunities faced when implementing IEA. The
 report notes in Chapter 3 the types of data that would prove useful in an IEA, and in the
 appended data compendium provides an extended list of some of the datasets that might
 prove useful for conducting an IEA in northern Australia.
- With a view to guiding the implementation of IEA more widely in Australia, Chapter 4 then outlines the key issues and challenges likely to arise when developing and implementing IEA in Australia.
- Chapter 5 then concludes the report and offers some suggested future work for furthering the development of the IEA approach in Australia.

Chapter 2: Integrated Environmental Assessment

Key messages:

- IEA is an interdisciplinary and policy-orientated process for combining, interpreting and communicating knowledge from diverse disciplines and knowledge systems to inform and support decision-making
- The main task of IEA is to gather and analyse available knowledge to provide useful information to policy and decision-makers for environmental decision-making
- IEA can provide the key to integrating matters of environmental, social, economic and cultural importance in decision making at relevant scales
- IEA can be fully integrated within existing planning and decision-making processes, enabling it to operate as a complementary enhancement that works in conjunction with existing planning and decision-making frameworks
- Existing IEA frameworks are available and the process has been used to help understand complex environmental challenges

What is Integrated Environmental Assessment?

Though the conceptualisation, interpretation and implementation of integrated environmental assessment (IEA) varies considerably, in a general sense IEA describes an interdisciplinary and policyorientated process for combining, interpreting and communicating knowledge from diverse disciplines and knowledge systems to inform and support decision-making. The "integrated" component of IEA refers to the synthesis and analysis of different types of available knowledge and the interdisciplinarity of this process, and "assessment" refers to the focus of the process on assisting policy and decision-making (Parson 1995; Bailey 1997; van Asselt 2000). With a deliberately specific focus on linking science to policy (Jäger et al. 2009), the main task of IEA is to gather and analyse available knowledge to provide useful information to policy and decision-makers for environmental decision-making.

In the main, IEA is implemented as a structured process, aimed at "dealing with complex issues, using knowledge from various scientific disciplines and/or stakeholders, in such a manner that integrated insights are made available to responsible decision-makers" (van Asselt 2000). Importantly, IEA should not be seen as a one-off analysis. It is ideally established as an ongoing process that is updated with new knowledge and information as it is generated or becomes available, providing the evidence base upon which outputs are produced to inform one-off and cumulative decisions. Preferably the process is under the responsibility of one or more independent scientific bodies with a clear mandate (Nooteboom & Wieringa 1999).

Central to the thinking behind IEA is that the integration of different knowledge systems under a single and coordinated analysis framework should provide more complete insights into complex phenomena than the insights derived from disciplinary studies (Bailey 1997; Rotmans & Dowlatabadi 1998; Toth 1998). IEA builds on the knowledge obtained through disciplinary studies and analyses. In this way IEA should be seen not as a replacement for, but as a supplement to and extension of single-discipline and single-sector analysis (Levin et al. 2009). IEA is not just about the collation of large amounts of data and knowledge, but about synthesis and analysis of diverse information to help understand how decisions will impact on ecosystems and their services valued by society. Within the process, care is needed to ensure that all relevant environmental, social, cultural, and economic issues are duly considered. The analytical components of IEAs can vary depending on the purpose at hand, drawing on, for example, modelling, literature reviews and participatory approaches such as expert elicitation workshops and focus groups (Rotmans 1998; Boileau et al. 2019). Most IEAs involve a combination of multiple synthesis and analytical methods (Hisschemöller et al. 2001).

While IEA is intentionally focussed on providing analysis and information to support policy and decision-making, the aim is not in itself to provide answers or solutions (Morgan & Dowlatabadi 1996). Though the process may result in products that assist policy and decision-making for specific purposes, it is important to recognise that IEA should not be seen as a technocratic salve, nor that any output from an IEA should not be seen as an end itself. Instead the aim is to provide insights and information for, but not a complete solution to, environmental decision-making (Haigh 1998). The products of IEA should be designed to integrate with existing planning and decision-making systems, with a view to assist decision-makers in addressing challenging environmental issues (Boileau et al. 2019).

The applications and purposes for IEA can vary considerably. Variations of IEA have been used to assess various issues such as the environmental performance and sustainability of soybean, corn and pig farming in Brazil (Franzese et al. 2013), the management of dryland water resources in Oman (Al-Kalbani et al. 2016); and the impacts of climate and socio-economic change on agriculture, biodiversity, coastal zones and water resources in the UK (Holman et al. 2005a, 2005b).

IEA differs from but has an important and complementary role to play with existing environmental decision frameworks. It should not be seen as a replacement or alternative for SEA and EIA and other types of assessment, or planning, but rather a complementary enhancement that works in conjunction with existing frameworks. A proactive approach to sustainable development decision-making would see IEA used in conjunction with other assessment tools such as EIA and SEA (Nooteboom & Wieringa 1999), helping to get in front of reactive decision-making, landscape planning and policy decisions. For example, in Australia, products arising out of the IEA process could be used to inform strategic assessments, environmental impact assessments, state of the environment reports, bioregional plans and other assessments, and development decisions, particularly when combined with decision-making tools and approaches (e.g. scenario analysis) – see Figure 1. Equally, data and knowledge obtained through existing policy, planning and regulatory processes could be fed into the ongoing IEA process to build understanding of environmental issues and inform subsequent decisions.



Figure 1. Conceptual relationship between IEA and existing planning, assessment and decision processes, at different scales

Box 1. Using integrated impact assessment to assess diamond mining in Canada's northern territories

Using integrated impact assessment to assess diamond mining in Canada's northern territories

Kwiatkowski and Ooi (2003) outline the process for an integrated assessment of the impacts of a diamond mine in Canada's Northwest Territories. Though there was uncertainty over the mine's environmental impacts, and the level of public concern for the project was high, the diamond mine was seen to be of critical importance to the territorial and federal governments.

Through a Public Panel Review process under the Canadian Environmental Assessment Act, a review panel considering the development application instructed the proponent to determine how to incorporate traditional knowledge into the baseline assessment of the project, the prediction of the impact, their planning and monitoring program, and to include the socioeconomic environment of the region in their environmental impact report. Of particular concern was the project's impact on the indigenous community, including health, demographics, land and resource use, employment, education, and social and cultural patterns.

Following submission of the impact report, the Panel concluded that the environmental effects of the project could be mitigated, and that the project would be beneficial to the North, though they made a number of recommendations on land claims, aboriginal rights, traditional knowledge and monitoring of the environmental and socio-economic programmes – all of which were accepted by the federal government in its approvals for the project. Through the process, the cooperative efforts between government, industry and the community led to the development of a project that coordinated the needs of stakeholders, including the implementation of appropriate mitigation measures.



Overview of the UNEP IEA process framework

One of the most prominent integrated environmental assessment (IEA) process frameworks is the one developed through the United Nations Environment Program (UNEP). Developed using the experience of UNEP's Global Environmental Outlook (GEO) program, this approach to IEA aims to develop and provide systematically collected, analysed and presented information (Jäger et al. 2009) to enhance and improve environmental decision-making. This framework takes an intentionally broad view, defining IEA as "an assessment that includes environmental, social and economic aspects in an analysis of environmental states and trends linked with policy analysis... [covering] a broad spectrum of issues and policies and all aspects of the environment... in an integrated analysis of environmental change and human and societal well-being." (Boileau et al. 2019).

The UNEP IEA process was designed to bring together all relevant stakeholders, organisations and individuals, policy- and decision-makers, and through a common, structured methodology, fosters dialogue between science and policy. It provides opportunity for discussion of possible environmental futures, identification of emerging issues, and analysis of scenarios. Its structure and adaptability suggest that it could prove a particularly useful framework for assessing the environmental, social and economic impacts of project, plans, policies and programs in advance of their implementation. We largely draw from and adapt the UNEP IEA approach in this technical report as an example of an IEA process framework useful in the Australian sustainable development context.

The UNEP IEA process was developed with the Drivers-Pressure-State-Impact-Response (DPSIR) framework in mind, which shows the cause-effect relationships between these five categories, though it is sufficiently flexible to accommodate other analytical frameworks. DPSIR itself is well-established, widely used, adaptable and considered a valuable tool for understanding the relationship between human activity and the state and trends of the environment and human wellbeing (Gari et al. 2015; Patrício et al. 2016), and help direct policy-makers to where actions are needed (Boileau et al. 2019).

The UNEP IEA process framework has 7 main stages, around which key activities and participation can be organised, capacities built, resources and time allocated, and release of outputs scheduled. Each of the stages and the details within the process can be modified and adapted to meet local conditions and requirements, the needs of stakeholders, and the focus of the IEA. Importantly, the UNEP IEA process framework facilitates the ongoing implementation of IEA, whereby the process can be revised and improved through monitoring, evaluation and feedback. The IEA process framework would be stepped through for each iteration of an IEA, though depending on the assessment, only parts of the process may need to be revisited.

Here we outline the key steps in the UNEP IEA process framework, with a graphical representation of the framework provided in **Figure 2**. In Chapter 3 we use a modified version of this UNEP framework as the basis for our preliminary analysis if using IEA in northern Australia.



Figure 3. The IEA process framework from the United Nations Environment Program, indicating key stages, activities and outputs (adapted from Gómez et al. 2009).

Stage 1. Start-up

The first or start-up stage of an IEA is aimed at identifying the need and objectives for the assessment and laying the groundworks for the IEA process. It involves initial discussions between relevant organisations, securing necessary mandates to proceed with the IEA, and identifying the scale and feasibility of the work given available funding and resources. A key part of this stage is identifying who needs to be involved and bringing those agencies into the IEA process, identifying who is best placed to lead it and who will manage it, and securing necessary resources for the process. The lead institution is typically a government organisation (e.g. Department of Environment), with a mandate to prepare an IEA. Different arrangements can be set up should a different type of organisation be better placed to lead the process, for example a university or non-government organisation, provided that the lead organisation can bring legitimacy to the IEA and has the support of decision-makers. Key outputs at this stage are an initial conceptual framework (describing the goals of the IEA, the methodology, the process, any relevant guidance for implementing the IEA, and the resourcing requirements), and any relevant Memoranda of Understanding (MoUs) between parties.

Stage 2. Institutional set-up

The institutional set-up stage focuses on identifying institutions that need to be involved in the IEA, defining their roles, and the key activities and instruments required to ensure coordination between appropriate institutions throughout the IEA process. A technical team is set-up to collate, analyse and interpret data and knowledge, undertake the specialised analysis, provide peer review, and engage the wider expert community. Collaborating institutions are then identified, including those who will have a primary role in the IEA process (e.g. coordination, data collection and analysis, communication of results), and those with secondary responsibilities such as providing input but without responsibility for process coordination or assessment products. Other key stakeholders who need to be engaged are also identified in this stage, for example those: whose interests are affected by environmental issues, whose decisions have environmental effects, who have required information, resources or expertise, trusted relationships with other key stakeholders, or those who control key parts of the decision-making process (e.g. funding). In this stage the basis for the IEA impact strategy is also developed. This requires ensuring that the issues of importance to key decision-makers and those in influential positions are addressed in the IEA.

Stage 3. Scoping and design

The scoping and design stage is central to the success and value of the IEA. The process can determine the success or failure of an IEA, and greatly influence the decision environment in which resulting policies and plans are considered (Levin et al. 2009). It is in this stage that the spatial and temporal boundaries of the IEA are defined, as well as the themes and sectors to examine (see Figure 4). The methodology for the assessment is also identified, clarified and can be co-designed with relevant participants and stakeholders – for example the use of the DPSIR framework which shows relationships between human activity and the state and trends of the environment, and human well-being – to ensure there is common understanding of the connections among the different components of the IEA. The nature and structure of any relevant reports or products coming out of the IEA are also considered in this stage, ensuring that they align with the priority environmental issues identified in the previous stages. Alongside, the target audience(s) for the findings and the main elements for the communications and outreach strategy are identified in this stage, selecting appropriate communication channels and outreach methods for key audiences. The IEA impact strategy is also further defined and formalised in this stage, including the identification of what changes are to be influenced by the IEA, who to engage, what knowledge is to be gathered through the process, and how to reach and engage key actors.

Defin - the sco	ning S	Scope and Scale esents the dimensions used to define	the boundaries of the problem and the scale the level of analysis
		The Scope	The Scale
Ε		Boundaries	Levels of analyses
oble ons		Geographic	Global/Regional/National/Local
e Pr	nensi	Temporal	Long-term/Mid-term/Short-term
۲	Dim	Political/Administrative	Super-national division/Country/State/Province/District/Community

Figure 4. Defining the scope and scale of the IEA. From Boileau et al (2019).

Stage 4. Planning

The aim of the planning stage is to bring together the key elements and content identified in the previous stages into a clear and workable plan. This stage should ensure that the IEA process is shared with all participants and that all involved understand the IEA methodology. A timetable and well-defined results should be identified for each part of the IEA, along with resourcing requirements – human, financial, infrastructure etc. – and how to address any problematic shortfalls. The planning should consider and make use of relevant initiatives already in progress, as well drawing from previous iterations and implementations of IEA. The planning stage should ensure that adequate communications mechanisms are established with stakeholders. During the planning stage, the impact strategy should be reviewed and adjusted as necessary, ensuring that the measures of impact are appropriate and clear. The communication and outreach strategy should be revised and finalised in this stage of the IEA, where target groups, content, channels and products are clearly identified. A key step in this stage is establishing a monitoring and evaluation strategy for the IEA process. This may, for example, involve setting up regular check-points in the timeline to assess progress and manage emerging issues.

Stage 5. Implementation

The implementation stage is the largest of the IEA process, and consists of several main components: the identification of the environmental issues and priorities to assess; the identification of appropriate indicators; the gathering of available data, information and knowledge; data analysis and review; integrated analysis; and writing and publication of results.

Identification of environmental, social, economic and cultural issues and priorities

This part of the implementation stage is focussed on identifying the environmental, social, economic, and cultural issues to be considered in the IEA. The aim is to move from the categories of problems identified in the conceptual framework to the identification of specific issues for assessment. Often the issues can be identified using expert and stakeholder participation, along with a criteria-based prioritisation process to create a short, manageable list of clearly formulated issues, with a clear link to the IEA's conceptual framework, and strong connection to stakeholders' concerns about the environment.

Identification of indicators

This part of the process is focussed on identifying a list of environmental, economic and social indicators for use in the IEA. Indicators are essential to the IEA, used to describe and track the changes of interest. The number and type of indicators to be used in the IEA will vary depending on

the objectives set for the IEA. They can be drawn directly from the priority environmental issues identified above, with a focus on ensuring the indicators are based on criteria that meets the needs of science, feasibility, policy and data availability.

Information gathering

It is not usual for the technical teams in an IEA to gather primary data, instead often at least part of it must be obtained from other sources. Therefore the first step is to identify any relevant and available data, and data sources. The next step is to gather and collate relevant knowledge and information. The data then needs to be organised and verified – checking sources of the information to ensure the data is reliable. The data and information then needs to be transformed, combined and prepared in different ways according to the components of the DPSIR framework. Any substantial knowledge and data gaps can be identified in this part of the process, and critical knowledge gaps filled by exploring available data repositories, engaging primary researchers, or drawing from other information sources (e.g. expert elicitation, substitute data).

Data analysis and review

The analysis of the compiled data and information sets the stage for the detailed integrated assessment. The underlying conceptual framework identified earlier in the process will drive the analysis – for example the DPSIR approach. processing, analysis and writing: sets the stage for the detailed integrated assessment. Analytical framework of the IEA is based on the DPSIR method.

Integrated analysis

The steps involved in the integrated analysis will be guided by the analytical framework (or selection of analytical frameworks) that is chosen, and the objectives and scope of the IEA. Using the DPSIR approach and logic as an example, the first step would be to identify key driving forces, a high-level analysis of socio-economic and institutional conditions that lead to direct pressures on the environment, for example demographic trends or consumption patterns that influence human activities and pressure on the environment, and the institutional framework that governs sustainable development. The key human pressures on the environment would then be identified, those human activities with a direct influence on the environment, for example the conversion of landscapes from natural to cultural or productive uses. The next step would be to assess the states and trends of the environment. This involves identifying the actual condition and trends in the environment, resulting from the driving forces and pressures, involves identification of key indicators and relevant data sources. This information can then be used to analyse the impacts of environmental change, identifying the changes in socio-economic or ecological conditions that are significantly influenced by changes in the state of the environment. From that the policy responses are assessed, specifically a retrospective analysis aimed at identifying the key public or private sector policy drivers that have contributed to the environmental change. And depending on the scope and objectives of the IEA, the next step would be to explore policy options and scenarios. This step builds on the state of the environment and policy analysis to explore possible future scenarios, and provides insights into long-term planning and the impacts of different policy alternatives.

Write-up, review and publication of results

The final step in the implementation stage is to write up the results of the IEA, ensure the results undergo external, independent peer-review, and publish the results (Boileau et al. 2019). The structure of the write-up (e.g. a report) should reflect the need to assist in decision-making processes, and be discussed with stakeholders. For example, decision-makers may or may not wish to have recommendations included in the write-up, this should be specified in the mandate for the IEA.

Stage 6. Communication of results and outreach

Communication is an ongoing activity that should happen throughout and runs parallel to the IEA process. Final products of the assessment are important for conveying key findings, but there are also many opportunities along the way to communicate thoughts and findings of the IEA between experts, policy-makers and other stakeholders. The main product of an IEA is usually a comprehensive report with state of the environment, policy analysis and scenario components, though there may be other forms of communication products that are suitable for end-users and should be co-design considering stakeholder needs. Increasingly outputs from IEA are provided online for end-users and stakeholders, such as through interactive maps, or databases with tools for exploring results of the analyses. The main focus of the communications should be on making sure that key messages are understandable, that the information is relevant and tailored to the target audiences, and that the delivery of the information is through appropriate channels. Involvement of communications experts is often worthwhile to ensure effective communication of the IEA results.

Stage 7. Monitoring, evaluation and learning

Importantly, IEA is a process and should not be seen as a one-off effort. The first iteration of the IEA should be seen as the first step in an ongoing system that produces information relevant to the environment and sustainable development decision-making at regular intervals. This continuity will allow for improved analysis and understanding of the impacts of actions taken, and the links between drivers, pressures, states of the environment and impacts on the environment and human well-being. Therefore it is important to monitor progress at each stage of the IEA, to evaluate the impact of the IEA, and review the experience to learn from and refine the IEA process itself.

Box 2. An integrated approach to investigating alternative fisheries management strategies.

An integrated approach to investigating alternative fisheries management strategies

Fulton et al (2014) used integrated analysis techniques to investigate alternative management strategies for a complex multi-sector, multi-species fishery in southeastern Australia. Australia's Southern and Eastern Scalefish and Shark Fishery (SESSF), which spans from sub-tropical to cool temperate locations and involves a multitude of fishing methods and fleets, was under economic and ecological stress in the early 2000s. Through a stakeholder-driven process, the study looked to evaluate alternative management strategies and improve the ecological, social and economic performance of the fishery.

Using the Atlantis integrated modelling framework, Fulton et al explored 4 alternative management strategies, including one based on the status quo ("2003 status quo"), one with extra controls on the most important species ("enhanced quota"), one taking a balanced approach to management, including the use of quotas, spatial management, removal of fishing method restrictions, and monitoring and enforcement ("integrated management"), and the fourth focussed on quotas, constraints on fishing effort, licence buybacks and detailed spatial management ("conservation-dominated").

The results showed that while no single strategy performed best on all measures, overall the "integrated management" approach had the fewest shortcomings, and consistently performed well amongst a wide range of objectives. The study also showed the importance of considering a system level approach at the outset, and trade-offs between system components. For example, actions aimed at supporting the protection of deep water stocks ended up undermining shelf species.

Through their study, Fulton et al argue that focussing on individual management measures in these types of systems will be inadequate to meet environmental, social and ecological objectives. Integrated solutions will likely outperform single focus measures. Though the measures to be adopted in integrated solutions will vary, successful system-level management is possible that brings together options proposed by all parties with a stake in fisheries management.



Box 3. Combining economic, hydrological and ecological data and models to explore the potential impacts of development in the Daly River

Combining economic, hydrological, and ecological data and models to explore the potential impacts of development in the Daly River catchment

Stoeckl et al (2013) combined data and information from multiple independent projects to explore the potential impacts of development on Indigenous and non-Indigenous residents of the Daly River catchment, Northern Territory.

Through an integrated model that combined economic, hydrological and ecological data and models, Stoeckl et al assessed the impact of six different types of economic development on water resources, aquatic habitat resources, and the incomes of Indigenous and non-Indigenous people. The six development scenarios explored three different types of economic growth, each with two different levels of assumed water use. This information was then combined with estimates of the value of aquatic resources consumed by local Indigenous people to estimate the potential net impact of development.

The analysis showed that Indigenous people have more to lose from development of the Daly River catchment than non-Indigenous people, whilst also having significantly less to gain. At best the analysis suggested that the impacts from development on Indigenous people would be relatively benign; while at worst, it may have a detrimental impact on their well-being by degrading aquatic ecosystems.

The study suggests that different types of economic development will impact upon different societal groups in different ways. The authors argue that a key part of fixing this issue will require impact assessment processes that properly assess the impacts of development, including the ecological and social feedbacks arising from development.



Box 4. Integrated environmental assessment to explore water resource management in Oman

Integrated environmental assessment to explore water resource management in Oman

Al-Kabani and colleagues (2016) describe an application of the Drivers-Pressure-State-Impact-Response (DPSIR) framework to examine the social and ecological aspects of mountain water resources in the Al Jabal Al Akhdar (Green Mountain) region in northern Oman. This arid mountain region is experiencing rapid development and a deterioration of water resources. Using the DPSIR framework, and a mix of water quality and quantity data, a survey of stakeholder groups, and secondary data sources, Al-Kabani and colleagues aimed to explore the causal relationships between the different components of the system, and identify water management priorities for the region.

They found that the water resources in the area were becoming increasingly affected by population growth and rapid socio-economic development, particularly through the more immediate drivers of water extraction for agricultural use, the expansion of the local tourism industry, and domestic water consumption. Together these drivers were creating greater demand for water, and in combination with a decrease in the rainfall for the region from exogenous climate pressures, this was leading to an intensification of water abstraction and subsequent overconsumption of available water resources. These pressures were leading to degradation of water quantity and quality, resulting in increased demand for bottled water, decreased agricultural productivity, and considerable losses in agricultural income. In response, the government of Oman has pursued activities to decrease pressures by increasing the supply of water (wells, dams, piping of desalinated water), the efficiency of the water resources network (lining and covering channels), and reducing consumption by encouraging changes in community behaviour.

Through their study, Al-Kabani and colleagues highlight the close inter-linkages between agriculture, the tourism industry and water resources in the Al Jabal Al Akhdar region. Their analysis suggests that current attempts to manage the situation – e.g. the piping of desalinated water – do not address the driving forces identified in the study, and that this agro-pastoral system – and the closely linked tourism industry – remains under threat. Alongside recommending an increasing focus on water efficiency measures, they argue that a sustainable solution requires recognition and a reassessment of the trade-off between economic development and the sustainability of the agricultural water supply.



Figure 7. DPSIR framework scheme for water resources in the Al Jabal Al Akhdar region of Oman, from Al Kabani et al (2016).

Chapter 3: Preliminary analysis of Integrated Environmental Assessment in northern Australia

Key messages:

- Increasing focus on developing northern Australia is seeing the region experience significant opportunities for investment and development, however current approaches to development planning and decision-making are proving insufficient for achieving sustainable development.
- IEA could assist in the delivery of proactive planning and robust decision-making processes that can consider and account for the significant environmental, social, cultural and economic values of the region in an integrated way, using the best available information.
- Our preliminary analysis suggests there are opportunities and challenges for implementing the IEA approach in the region (e.g. identifying a common set of priority environmental and development issues, and aligning IEA with existing decision-making processes, to serve multiple purposes).
- Previous applications of IEA and IEA-related studies in the region help to clarify the challenges likely to be faced by practitioners and offer guidance for future implementations
- The governance and institutional frameworks for planning and development assessment and approval vary in their capacity across northern Australia, meaning the adoption of IEA approaches will need to be tailored to each jurisdictional context.

Background

With a view to assist in the implementation and operationalisation of IEA in Australia, in this chapter we aim to anchor the ideas behind IEA in the northern Australia development context, and provide for a practitioner audience a more detailed view of how to improve development planning and decision-making using the IEA approach. Through a preliminary analysis of using IEA in this context, we seek to identify key information that would be useful for technical practitioners to consider when setting up an IEA process to improve development planning and decision-making in northern Australia.

For clarity, we envisage here IEA for northern Australia as a foundational process that facilitates the gathering and analysing of knowledge and information from a wide range of sources - including Indigenous knowledge systems - which can then be drawn from to inform decision making at multiple levels, for example in strategic assessments, environmental impact assessments, regional planning, natural resource management (NRM) plans, Healthy Country Plans etc. A graphical representation of this conceptualisation is provided in **Figure 1**.

Using the UNEP IEA process to guide the preliminary analysis, we step through each stage and step of an IEA process, identifying for technical practitioners the key considerations for setting up an IEA process in northern Australia, examples of existing plans or case studies that demonstrate good practice of IEA (or parts thereof), examples of the types of analyses that can be pursued, examples of existing datasets that relate to each step, and some of the key challenges and opportunities likely to be faced. Though the UNEP IEA process has guided the structure of this chapter, we have shifted some steps within and between stages to better fit our conceptualisation of a suitable IEA process for this context. As such we provide a short overview at the beginning of each stage to clarify our conceptualisation of each stage.

In stepping through the key IEA stages, we draw on relevant literature and studies, and use existing studies, data and analysis of the region that we are aware of, to illustrate the technical side of how development decision-making could be improved through the IEA approach. Our intention is not to be comprehensive, rather indicative of the types of information that could assist technical practitioners when setting up the IEA process. As such there will undoubtedly be existing case

studies, analytical techniques, data and knowledge relevant to IEA in northern Australia beyond what is identified here, as well as data gaps that need filling as part of an enacted IEA process.

At the end of each stage, we provide a short discussion that draws from the gathered information and insights from IEA practitioners to identify the challenges experienced during the implementation of IEA, lessons learned, and the potential impacts of IEA at each stage. Through this we hope to help practitioners pre-empt and address the issues and challenges that may come about from implementing the IEA approach in northern Australia.

The Northern Australian context

Northern Australia (Figure 8) boasts environmental and cultural values of global, national, and local significance. Increasing focus on developing the region has led to northern Australia experiencing significant opportunities for investment and development, including for agriculture, aquaculture, energy, mining, housing and tourism. Current approaches to development planning and decision-making are proving insufficient for achieving sustainable development.

For investors, clear, viable development opportunities for progressing towards investment are not readily accessible. Both development and community interests have raised concerns about impediments to new investment and the achievement of sustainable development in northern Australia. Equally, a recent audit and review of the operation of the Commonwealth's Environment Protection and Biodiversity Conservation Act argues that current regulatory arrangements are not adequately protecting environmental values, particularly in the face of climate change (Samuel 2020b, 2020a).

Recent research work undertaken by the Cooperative Research Centre for Developing Northern Australia (CRCNA) suggests that these problems arise, in part, from the difficulty in considering the multiple and diverse environmental, social, economic and cultural values of the land- and seascapes of northern Australia in an integrated way (Dale & Marshall 2020; NAJA Business Consulting Services 2020a, 2020b). The CRCNA's work argues that current policy, planning and assessment approaches and decision-making processes are inadequate for meeting this challenge, leaving both investors and decision-makers who are seeking to protect important environmental and cultural values, and derisk new areas for development facing considerable uncertainty when assessing development opportunities. Identified problems include:

- lack of clearly articulated priorities for development and conservation across the north
- limited integrated, collaborative planning at the catchment or regional scale between governments, the private sector and the community
- fragmented and conflicting policy and process settings in project assessment and approval
- a limited focus on raising the capacity of development interests to develop and progress investment-ready proposals that can achieve regulatory obligations.

Conflict arising from these problems leaves industries, financiers and communities uncertain and risk-averse about investment, and importantly, it also places the environmental and cultural values of the landscape at risk. These issues are exacerbated by the changing climate of the north. High-quality investment and development requires proactive planning and robust decision-making processes that can consider and account for the significant environmental, social, cultural and economic values of the region in an integrated way, using the best available information.

This makes it an ideal region to consider the application of IEA, and it is in this context that we next step through the main stages of an IEA process for our preliminary analysis.



Figure 8. Map of Northern Australia, Courtesy of Australian Bureau of Statistics

IEA at multiple scales in northern Australia

Environmental and development decision-making in northern Australia occurs at multiple scales. In a general sense these scales include: i) national-level (e.g. threat abatement planning, bioregional planning), ii) State and Territory-level (e.g. strategic biodiversity and environment planning, state-level State of the Environment reporting), iii) regional (e.g. integrated catchment land-use planning, strategic assessments), iv) local (e.g. development precinct planning) and v) project (e.g. environmental impact assessment). A graphical representation of planning and decision-making at these scales is provided in **Figure 1**. Ideally, the IEA process should ensure alignment with these various scales of decision-making, assessment and planning, such that IEA outputs can provide insights to inform the relevant scale of decisions.

The importance of capturing these multiple scales has therefore guided our selection of seven main case studies to include in and inform the preliminary analysis included in this chapter. These case studies were selected from a list of IEA case studies identified during the technical workshop series with IEA experts in November 2020, with a focus on the regional, state and local scales. Key information on these case studies is provided in

Table 1, with further detail provided in the corresponding box examples at the end of this chapter.

Case study name	Scale	Location	Box link	Driver	Reference
Social and Economic Long- Term Monitoring Program (SELTMP)	Regional	Great Barrier Reef, Queensland	See Box 5.	Commonwealt h Government initiative	Marshall et al. 2017; Curnock & Marshall 2019; Marshall & Curnock 2019a; Marshall & Curnock 2019b
Geological and Bioregional Assessment Program	Regional (though in multiple locations within 3 states)	Cooper Basin (Queensland and South Australia), the Isa Superbasin (Queensland), and the Beetaloo Basin (Northern Territory)	See Box 6.	Commonwealt h Government initiative	Holland et al. (2019); Huddlestone- Holmes et al. (2020); Lewis et al. (2020)
Strategic Regional Environmental and Baseline Assessment (<u>SREBA</u>)	State	Northern Territory	See Box 7.	State/Territory Government initiativedevel oper	Department of Environment and Natural Resources (2020). SREBA Framework.
Analysing trade- offs between biodiversity, carbon and agricultural development in northern Australia	Multi-state	Western Australia, Northern Territory, Queensland	See Box 8.	Research project	Morán-Ordóñez et al (2017).
Fitzroy River	Local	The Kimberley, Western Australia	See Box 9.	Research project	Alvarez-Romero et al (2021).
Development by Design	Local	The Kimberley, Western Australia	See Box 10.	Research project	Heiner et al (2019).
Daly River	Local	Northern Territory	See Box 11.	Research project	Adams et al. (2014, 2016).

Table 1. Key information on case studies drawn on for the preliminary analysis

Preliminary analysis for northern Australia

Stage 1. Start-up

The aim of the start-up stage is to identify the need for IEA and lay the groundworks for the IEA process. Key components of the start-up stage include identifying the purpose and objectives of the IEA, identifying a lead agency and who needs to be involved, crafting a conceptual framework that will form the basis for the assessment process, and identifying the key elements of an impact strategy.

Table 2. below offers a preliminary analysis of key information for practitioners to consider during the start-up stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

Table 2. Preliminary analysis of the start-up stage for an IEA process in northern Australia

Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Identify purpose and objectives, and secure mandate for the integrated environmental assessment	The purpose for the IEA in northern Australia could vary considerably, from informing existing environmental impact and strategic assessment approaches, or regional planning, or government policies and programs under consideration. IEA outputs could also feed into State of the Environment reporting. Clear operational objectives would be needed to identify what information is to be sought through the IEA process, with direct and practical application. For example, the IEA process might have a central objective of protecting	A well-structured IEA framework in northern Australia could deliver outputs that serve multiple purposes. For example, it could complement and substantially improve existing environmental decision-making, reporting, development assessment and regional planning approaches. An IEA process in northern Australia with clearly articulated objectives could see improved protection of important cultural and ecological assets in northern Australia, whilst also identifying	Establishing a common IEA process framework that is suitable for and works across multiple purposes, objectives, and/or jurisdictions.	(State-scale) Strategic Regional Environmental and Baseline Assessment (<u>SREBA</u>) See Box 6. (Regional-scale) <u>Geological and</u> <u>bioregional</u> <u>assessment program</u> See Box 5.	Horizon scanning - e.g. Sutherland and Woodroof (2009) Three Horizons assessment - e.g. Curry & Hodgson (2008) Expert elicitation - e.g. Morgan (2014)	Pintor et al (2018): Expert Vetted Distribution Models and Biodiversity Hotspot Maps of Terrestrial and Freshwater Taxa of Conservation Concern in Northern Australia. <u>https://doi.org/10</u> .4225/28/5a9f31e 23e80b Department of Industry, Tourism and Trade (2000). MAGNT Archaeological Sites Register. <u>http://www.ntlis.</u>

	rare or fragile northern Australia ecosystems, habitats and cultural sites (see Levin et al 2013) . The region of northern Australia is vast, and spans multiple jurisdictions. Depending on the scale and scope of the IEA process, cross- jurisdictional agreements may be required to implement cross- boundary IEA.	appropriate sites for development. Using IEA to assess and plan at the northern Australia regional scale could lead to greater consistency in decision- making, and better environmental, social and economic outcomes.				nt.gov.au/metada ta/export_data?m etadata_id=2DBC B77120A506B6E0 40CD9B0F274EFE &type=html
Identify lead agency(s), technical team, participants, stakeholders	The agency leading the IEA process in northern Australia would likely be a state planning or environment agency, such as Dept of Environment and Natural Resources (NT), Dept of State Development, Tourism and Innovation (Qld) or Dept Planning, Lands and Heritage (WA), or a combination of agencies. Depending on the purpose, the Dept	The IEA process allows for engagement with Traditional Owners, industry and the community of northern Australia, encouraging greater acceptance of the approach and potentially planning, policy and program decision-making	Identifying a clear lead agency to drive the IEA process. In some instances there may be no clear lead agency for the IEA. Ensuring that all relevant northern Australia stakeholders and participants are identified, engaged and adequately supported to participate in the IEA process. Stakeholders will	(State-scale) Strategic Regional Environmental and Baseline Assessment (SREBA) See Box 6. (Regional-scale) <u>Geological and</u> <u>bioregional</u> <u>assessment program</u> See Box 5.	Stakeholder analysis, mapping - e.g. Reed et al (2009) Influence mapping e.g. Chungulla et al (in Woodward et al. 2020) Social network analysis - e.g. Alvarez-Romero et al. (2021), Adams et al. (2018)	National Native Title Tribunal (2021). Indigenous Land Use Agreements. https://data.gov.a u/dataset/ds-dga- 9e837144-8070- 4983-8bf0- 15e7ceb56ed7/de tails ABARES (2021). Catchment Scale Land Use of Australia. https://data.gov.a

	Agriculture, Water and the Environment (Cth) may also be an appropriate lead agency. The appropriate stakeholders and participants in the IEA process may vary depending upon the focus of the IEA. Key stakeholders to consider at a regional scale would include Traditional Owner groups (eg. NAILSMA, Kimberley Land Council), Industry groups (eg. National Farmers Federation, Minerals Council of Australia, Fisheries Research and Development Corporation), environmental groups (e.g. The Nature Conservancy, Australian Conservation Foundation).		likely vary depending upon the focus of the IEA.			u/dataset/ds-dga- 97bb9e54-f0df- 4073-9288- e0ebded53a96/d etails?q=catchme nt%20land%20us e%202021
Develop outline of the conceptual framework	The conceptual framework for the IEA process would need to be sufficiently adaptable to align with the purpose	The IEA process can adapt to different conceptual frameworks, helping to address different development	Identifying appropriate conceptual framework that addresses the broad range of potential	(Local-scale) An integrated assessment of financial, hydrological,	Multi-criteria decision analysis - e.g. Velasquez and Hester (2013)	*n/a

	and objectives for using IEA in specific northern Australian contexts.	issues for northern Australia.	applications for IEA in northern Australia.	ecological and social impacts of 'development' on Indigenous and non- Indigenous people in northern Australia - Stoeckl et al. 2013 - see Box 10.		
Identify key elements of an impact strategy	Depending on the purpose of the IEA process, the impact strategy may seek to focus on decision- makers, agency staff, developers and industry, farmers, the community of northern Australia. This information can guide IEA end-products, engagement, and knowledge brokering requirements.	Identifying key issues of concern to stakeholders and the community in northern Australia	Ensuring that impact strategy engages key northern Australia stakeholders, and identifies how IEA outputs will be used.	(Local-scale) Moving from reactive to proactive development planning to conserve Indigenous community and biodiversity values - Heiner et al 2019 - see Box 9.	Stakeholder analysis, mapping - e.g. Reed et al (2009) Expert elicitation - e.g. Morgan (2014)	*n/a

Challenges identified by case studies in the start-up stage

Identifying and agreeing on the purpose and objectives of the IEA was one of the key challenges raised by the case study leaders. This was identified as a challenge at the regional scale by SELTMP for its initial data collection phase (2011-2013), where considerable efforts were required in engagement and discussion amongst stakeholders to finalise the purpose and objectives for the study. In the Fitzroy River study (Álvarez-Romero et al 2021), there was initial agreement amongst stakeholders for the study as a typical multi-objective planning process. However, during discussions with stakeholders in the early stages, it became apparent that agreeing on a single plan was going to be very difficult - due largely to diverging views and goals about the future development of the catchment. This required a shift of focus for the study into a participatory scenario planning (PSP) exercise. In the Geological and Bioregional Assessments (GBA) study, the scope and aims of the program were well defined, however there was not a clear vision of who would use the results, and how they would be used.

Identifying key stakeholders and enabling their participation was another key challenge identified in the case studies. For the study of trade-offs between carbon, biodiversity and agricultural development (Morán-Ordóñez et al 2017), identifying the key researchers and end-users (managers) to involve in the study was a challenge. The Development by Design study (Heiner et al 2019) identified the challenge of supporting free, prior and informed consent of Indigenous communities in IEA processes, the need for increasing the capacity of Indigenous landowners to participate in land-use decision-making processes, and addressing the power imbalance in land-use and environmental decision-making, where multi-stakeholder processes often treat interest groups as equal stakeholders. For example, although Registered Native Title Body Corporates (RNTBC's) are in a central position in the land-use decision-making processes, they are largely under-resourced to adequately participate and give genuine free prior and informed consent to development proposals.

Lessons learned by case studies in the start-up stage

A number of lessons were offered for the start-up stage by case study leaders. The Daly River landuse scenario planning exercise found it beneficial to have the objectives of the study being set up very early on - in this case the objectives were set by the Northern Territory government before the study started, and in the process, stakeholder buy-in was secured early to undertake the study.

The SELTMP study found it useful in the start-up stage to look to the literature for guidance, helping to identify gaps in knowledge early on and draw upon existing studies and the social-ecological literature (e.g. in this case, the Millenium Ecosystem Assessment).

Grounding the study in the policy context and management challenges at the regional level was found to be helpful for the carbon, biodiversity and agricultural trade-off analysis (Morán-Ordóñez et al 2017). Involving researchers and managers from different institutions across the country and with good knowledge of the conservation challenges and opportunities across Northern Australia (e.g. CSIRO, The Nature Conservancy) helped in this, and was key to identifying critical elements to include in the assessment (e.g. carbon farming or agricultural development potential) and relevant datasets.

The GBA program found working with stakeholders and end-users early on to identify purpose and objectives for the IEA to be critical. Of particular value was identifying why the assessment was being undertaken, and how the information would be used, noting that an IEA could be conducted for a variety of purposes, (including scientific interest (to understand potential impacts), to provide information for a broad audience, or to assist in planning for future development), and that end users could be varied (i.e. the general public, research community, regulators, or project proponents (developers).

The Fitzroy River study (Álvarez-Romero et al 2021) identified several lessons in the start-up stage: i) invest in a systematic stakeholder mapping and analysis to ensure all key actors are involved from the beginning, ii) adapt the IEA planning process to ensure a safe and productive collaborative environment, iii) develop a theory of change to identify which decisions, policies and/or processes the project aims to (and can) influence and how, and iv) review existing formal and informal planning processes to identify previous relevant goals, outputs and available data.

Tailoring the IEA process and supporting the needs of the local community was identified as important in the Development by Design work (Heiner et al 2019). This includes identifying ways early on to assist Indigenous communities to participate in and respond to IEA processes, for example through collation and organisation of information, informed discussion, and demonstrating issues visually. For IEA initiated prior to development and land-use decision-making, this would likely improve understanding, make better use of community and scientific knowledge, and lead to better decisions and less risk for all parties involved.

Impacts identified by case studies in the start-up stage

Most case studies found it difficult to identify impacts of the IEA at the start-up stage. The Fitzroy River study (Álvarez-Romero et al 2021) found that this stage i) encouraged active participation of most of the key stakeholders that could influence or be affected by land/water use decisions, and ii) helped to develop a framework and approach for thinking about development in a different way and adapting for use elsewhere, and iii) developing a shared and broader understanding of the problem at hand and the context of planning for development in the region.

Stage 2. Institutional set-up

The aim of the institutional set-up stage is to establish the framework, process and coordination arrangements for the institutions involved in the IEA, and define the roles, responsibilities and commitments of institutions, participants and stakeholders who will be involved in the IEA process.

Table 3. below offers a preliminary analysis of key information for practitioners to consider during the institutional set-up stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.
Table 3. Preliminary analysis of the institutional set-up stage for an IEA in northern Australia

Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Establish institutional framework; Define appropriate process and coordination arrangements	The appropriate institutional framework may vary depending on the focus for the IEA - e.g. involvement of Dept Agriculture, Water and the Environment for matters of national environmental significance, or on Commonwealth land. Ideally the IEA process would complement and enhance existing environmental assessment, planning and decision-making processes in northern Australia.	Clarity over where each institution and partner sits in the IEA process for northern Australia Establishing a common, consistent process and knowledge base for environmental decision-making in northern Australia	The situation of different northern Australia agencies and partners within the institutional framework may vary depending upon the focus of the IEA Development of an appropriate cross- jurisdictional governance framework that fosters ongoing relationships and trust Ensuring the IEA process framework fits alongside the existing assessment and decision-making processes of the various jurisdictions.	(State-scale) Strategic Regional Environmental and Baseline Assessment (<u>SREBA</u>) See Box 6. (Regional-scale) <u>Geological and</u> <u>bioregional</u> <u>assessment program</u> See Box 5.	Stakeholder analysis, mapping - e.g. Reed et al (2009) Participatory planning - e.g. Forester (1999)	National Native Title Tribunal (2021). Native Title Determination Outcomes. https://data.gov. au/dataset/ds- nsw-a784e83c- 2a3a-4fc5-9382- 20270ab7b094/d etails?q= Australian Bureau of Statistics (2016). Local Government Areas. https://www.abs. gov.au/AUSSTATS /abs@.nsf/Details Page/1270.0.55.0 03July%202016? OpenDocument

	institutional arrangements and cross-institutional and cross-sectoral processes and arrangements through which the IEA will be undertaken.					
Define roles and responsibilities of institutions, participants, stakeholders; Secure commitment for resources and contributions	The resourcing and capacity of institutions (e.g. state government agencies) and partners (e.g. Traditional Owner groups, or community groups) to be involved in IEA in northern Australia may be limited and variable. Ongoing commitment to IEA is needed from multiple agencies and jurisdictions. Both the IEA coordination, and sectoral and organisational involvement, must be adequately resourced. The process of securing commitment should make these resourcing implications transparent.	Roles and responsibilities for northern Australia partners could be identified that help create co-ownership and shared responsibility for the IEA. Shared costs for a framework that can inform and enhance environmental decision-making.	Ensuring that all institutions and partners have sufficient resourcing and capacity to contribute to the IEA process commensurate with their roles and responsibilities. This includes resourcing for substantial stakeholder participation, including genuine Indigenous participation, and securing the required expertise to conduct the IEA. Securing ongoing commitment from multiple agencies and jurisdictions in order to operationalise IEA at the northern Australia regional scale.	(State-scale) Strategic Regional Environmental and Baseline Assessment (<u>SREBA</u>) See Box 6. (Regional-scale) <u>Geological and</u> <u>bioregional</u> <u>assessment program</u> See Box 5.	Stakeholder analysis, mapping - e.g. Reed et al (2009) Participatory planning - e.g. Forester (Forester 1999)	*n/a

Challenges identified by case studies in the set-up stage

The work required to secure stakeholder engagement and commitment in the set-up stage was a notable challenge identified for this stage, particularly through the SELTMP and Fitzroy River studies. SELTMP noted the substantial time and resourcing required from the team for stakeholder and end-user engagement required, for example, for the recent redesign of the SELTMP survey instrument. The Fitzroy River study (Álvarez-Romero et al 2021) identified the effort required to identify and ensure the commitment of stakeholders to a time-demanding and long process, and developing research agreements with Traditional Owners that facilitate trust between researchers and Traditional Owner groups.

The Fitzroy River study also identified challenges in assembling a research team that included all the required expertise (e.g. planning, economics, social science, GIS), finding the right professional facilitator(s) with right expertise and local experience, and understanding and coordinating with the other ongoing formal planning processes and studies.

The GBA program experienced challenges in understanding and working within the multiple regulatory contexts of their IEA, noting that the different jurisdictions had varying requirements and regulatory structures.

Changes in governance during the set-up stage proved a challenge for the continuity of the Daly River scenario planning exercise. The change of government in the Northern Territory led to a changed role for the advisory committee, which diminished their authority to make and implement decisions based on the outcomes of the study.

Lessons learned by case studies in the set-up stage

Well-structured and planned stakeholder engagement was a key lesson offered by the case studies in the set-up stage. This was identified in particular through the SELTMP and Fitzroy River study experience - for example through a stakeholder engagement plan. As well as guiding the engagement process, the plan would be well placed to ensure the engagement process is developed and managed such that it is not perceived as biased towards any particular stakeholder group or agenda, and might consider the hiring of a professional facilitator with good experience in the proposed study approach (e.g. PSP) and preferably with experience in managing multiple stakeholders and environmental projects in the region (i.e. someone that is trusted by stakeholders). The stakeholder engagement plan would also cover securing engagement with Traditional Owners, preferably early on in this set-up stage, and with reference to existing protocols and adapting them to the Traditional Owner group's requirements. When establishing research agreements, it would be helpful to secure enough time, meetings and help from a local and trusted person to help as advisor and broker.

The Fitzroy River study (Álvarez-Romero et al 2021) also offered the lesson of allowing enough time and sufficient resources to secure the key expertise required for the research team, including external advice. Depending on the study at hand, the team may include expertise in GIS, spatial planning, hydrology, ecology, economics, social science, and experience working with Traditional Owners.

Impacts identified by case studies in the set-up stage

Most case studies found it difficult to identify impacts of the IEA at the set-up stage. For the Fitzroy River study (Álvarez-Romero et al 2021), impacts identified included: i) the improvement of participatory scenario planning processes, including detailed budgeting, research activities, and facilitation activities for workshops that can be used elsewhere, ii) the development of trust with and among the key stakeholders and improved design by including their suggestions, and iii) ensuring appropriate cultural protocols were followed and rights, intellectual property and

knowledge of Traditional Owners were formally protected; agreements also helped to clarify responsibilities and expectations.

Stage 3. Scoping and design

The aim of the scoping and design stage is to define the spatial and temporal boundaries for the IEA process, identify priority issues and sectors to assess, define the methodology to be used, identify indicators and data requirements, and further refine the impact and communications strategies for the IEA.

Table 4. below offers a preliminary analysis of key information for practitioners to consider during the scoping and design stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

Table 4. Preliminary analysis of the scoping and design stage for an IEA in northern Australia

Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Define spatial and temporal boundaries	Driven by the purpose and objectives of the IEA process, the spatial and temporal extents to be covered in northern Australia could vary considerably. The outputs to be derived from the IEA process - e.g. analyses for feeding into regional plans, or strategic assessments - will likely have specific spatial and temporal extents appropriate to the question at hand. The IEA process will need to be sufficiently flexible to adapt to these.	Exploring different geographic and cultural boundaries Informing factors to consider when defining appropriate scales for specific purposes (e.g. regional plan)	Identifying appropriate geographic and temporal boundary(s) for the IEA	(State-scale) Strategic Regional Environmental and Baseline Assessment (SREBA) See Box 6. (Regional-scale) <u>Geological and</u> <u>bioregional</u> <u>assessment</u> <u>program</u> See Box 5.	Participatory planning - e.g. Forester (1999) Participatory mapping - e.g. Brown & Raymond (2014)	Syktus et al (2020). Queensland Future Climate Dashboard: Downscaled CMIP5 climate projections for Queensland. <u>https://www.longp</u> addock.qld.gov.au/ gld-future-climate/ CSIRO (multiple) Northern Australia Water Resources Audit datasets. <u>https://data.csiro.a</u> u/collections/searc h/SQnawra/STsear ch-by-keyword/

Identify priority issues and sectors to assess	There are several key environmental issues across northern Australia that could be considered priorities for assessment - e.g. water, biodiversity, Indigenous cultural heritage, and sectors affecting those values - e.g. grazing, gas, mining	The IEA process can accommodate the multiple key environmental issues and sectors present in northern Australia The IEA could help identify drivers and influences (climatic, economic, cultural, demographic etc.) that may initiate or exacerbate environmental issues	Identifying the key environmental issues, when many are interlinked. Ensuring participation of all relevant sectors in the process to help identify priority issues.	(Regional-scale) Social and Economic Long- Term Monitoring Program (<u>SELTMP</u>) - see Box 4. (Local-scale) Walalakoo Healthy Country Plan	Participatory planning - e.g. Forester (Forester 1999) Trend analysis - e.g. Chandler & Scott (2011)	Department of Planning, Lands and Heritage (2021). Aboriginal Heritage Places (DPLH-001). https://catalogue.d ata.wa.gov.au/data set/aboriginal- heritage-places Pintor et al (2018). Expert Vetted Distribution Models and Biodiversity Hotspot Maps of Terrestrial and Freshwater Taxa of Conservation Concern in Northern Australia. https://doi.org/10. 4225/28/5a9f31e2 3e80b Pintor et al (2018).
						Pintor et al (2018). Threatening processes to taxa of conservation concern in Northern Australia.
						<u>mtps.//uui.org/10.</u>

						25903/5b72631b2 dd70
Define IEA methodology	Resolution of an appropriate methodology for northern Australia would need to ensure it aligns with the purpose and objectives of the IEA, and the various planning and decision- making processes that the outputs will inform.	The IEA process can adapt to different methodologies, helping to address different development issues for northern Australia.	Identifying appropriate methodologies that addresses the broad range of potential applications for IEA in northern Australia, and are sufficiently adaptable to address future information requirements.	(Regional-scale) Geological and Bioregional Assessment Program - see Box 5.	Expert elicitation - e.g. Morgan (2014) Participatory planning - e.g. Forester (1999) Threat assessment - e.g. Maron et al (2017) Risk assessment - e.g. Jones (2001), Burgman (2005)	* n/a
Identify indicators, data requirements and sources of information for the IEA process	Indicators, data requirements and sources of information may vary depending on the purpose and objectives of the IEA in northern Australia.	Consistent indicators and data and knowledge requirements could be identified across all jurisdictions in northern Australia	Identifying, accessing, and aligning multiple sources and required types of information in northern Australia - across different states, organisations etc.	<u>Seasketch</u>	Participatory planning - e.g. Forester (1999) Gap analysis - e.g. Scott et al (1993)	Pintor et al (2018). Threatening processes to taxa of conservation concern in Northern Australia. <u>https://doi.org/10.</u> 25903/5b72631b2 dd70
Identify target audiences for the IEA	The impact strategy will need to target IEA	For northern Australia, the impact strategy has	Ensuring the impact strategy communicates	(Local-scale) Moving from	Stakeholder analysis, mapping -	ABARES (2021). Catchment Scale

and develop the impact strategy	findings at all relevant participants and stakeholders. The appropriate target audience will likely vary depending on the purpose and objectives of the IEA. In some instances, outputs from the IEA may seek to inform and improve departmental planning or decision-making processes across multiple agencies.	the opportunity to engage Indigenous stakeholders in the IEA process. Identifying interested parties in development of northern Australia	to relevant stakeholders, and particularly Indigenous stakeholders, in appropriate languages. Identifying most relevant stakeholders in development sector in northern Australia	reactive to proactive development planning to conserve Indigenous community and biodiversity values - Heiner et al. 2019 - see Box 9.	e.g. Reed et al (Reed et al. 2009) Participatory planning - e.g. Forester (1999)	Land Use of Australia. <u>https://data.gov.au</u> /dataset/ds-dga- <u>97bb9e54-f0df-</u> <u>4073-9288-</u> <u>e0ebded53a96/det</u> <u>ails?q=catchment%</u> <u>20land%20use%20</u> <u>2021</u>
Identify key elements of the communication and outreach strategy	The communication and outreach strategy will need to reach all relevant stakeholders, including those speaking community languages, and consider elements of engagement, knowledge brokering	For northern Australia, the communications and outreach strategy has opportunity to engage Indigenous stakeholders	Ensuring the communications and outreach strategy communicates to relevant stakeholders, and particularly Indigenous stakeholders, in appropriate languages		Stakeholder analysis, mapping - e.g. Reed et al (Reed et al. 2009) Participatory planning - e.g. Forester (1999)	Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) (2021). Austlang dataset. <u>https://data.gov.au</u> <u>/dataset/ds-dga- 70132e6f-259c- 4e0f-9f95- 4aed1101c053/det</u> <u>ails?q=</u>

Challenges identified by case studies in the scoping and design stage

Ensuring that the IEA process was set up for current, emerging and future data needs was a challenge identified by case studies in the scoping and design stage. For example, in the SELTMP case study, practitioners noted the challenge of considering data and knowledge needs across time and designing a process that can accommodate these - i.e. the data needs for the initial iterations of the IEA may not be the same as those for future iterations.

Also a challenge in this stage was designing and adapting the IEA studies to fit with available methodologies and data. For example, identifying and accessing available data was a challenge identified in the carbon, biodiversity and agricultural trade-off analysis (Morán-Ordóñez et al 2017). Of particular interest for this study was information on agricultural development potential across the study region. Though some of this information became available and accessible through project collaborators, and proxies were able to be used for some elements of the analysis (e.g. proximity to infrastructure instead of specific soil type), for some elements the scope and design of the project had to change to fit available data. For example, the study team was interested in considering other values/interests such as mining or tourism potential, but these values were difficult to quantify in a spatially explicit way. The Fitzroy River study required adaptation of the original project to fit with the revised PSP approach, and led to engaging an external advisor with extensive expertise in scenario planning to assist. And though the sectors for inclusion in the study were identified through interviews and literature review, a particular challenge here was ensuring participation of organisations from all relevant sectors in the study (e.g. mining, agriculture).

In the GBA program, a particular challenge was identified in working out an acceptable level of data and knowledge with which to conduct the assessment, especially in instances where knowledge of ecological or other assets was limited. For instance, it might be relatively straightforward to assess the impact of development on some well-known species (e.g. finches), however it is much more difficult to assess the impact on the many other species we know little about (e.g. stygofauna).

Lessons learned by case studies in the scoping and design stage

A co-learning and co-design approach to the scoping and design of IEA was offered as a lesson from the case studies. For example in SELTMP, targeted stakeholder engagement helped to clarify the focus of the program, and how it fits into the broader array of data collection in the region. Focusing on a broad range of values that are of importance to indigenous land-owners (not restricted solely to listed species or cultural heritage sites normally considered in IEA processes) was identified by the Development by Design work, helping to identify and directly respond to community needs and aspirations. This may for instance build on existing local conservation plans (such as Healthy Country Plans), helping to ensure that the resilience and integrity of natural and cultural values are adequately considered in the process. Engaging as early as possible in this co-design process was seen as a valuable lesson from the Fitzroy River study - helping to ensure that the study boundaries and inclusions (e.g. ecological or cultural assets) are relevant and appropriate for end-users.

Identifying available data early on in the scoping and design process was a lesson offered by the case studies. The Daly River exercise was assisted by focussing on a data-rich catchment. For the carbon, biodiversity and agricultural trade-off analysis (Morán-Ordóñez et al 2017), it was noted that there is a wide amount of available data potentially useful for IEA, but there is a considerable value in knowing early on: 1) that the data exists and 2) how to get access to it. In this particular case study, project collaborators were able to help identify and access specific agricultural datasets. Going through this process early on will help IEA practitioners identify where compromises on the extent and type of data that can be collected and used in the study may be needed, or what type of analysis is feasible, in order to meet stakeholder expectations and end-user needs.

Also noted was that while the IEA process can get clearer with each iteration, information needs and outputs from the IEA can and likely will change as time and the IEA process goes on. For example, the process may need to adapt to shifting spatial and temporal boundaries for water, land-use and conservation planning, or accommodate cultural or other relevant information. As such, building adaptation into the initial design of the IEA process could be beneficial to accommodate any future changes. Alongside, documenting the process was also seen as beneficial, for example for SELTMP this has helped to clarify what has worked in the IEA, what has not, and why particular components of the study were considered in or out of scope, as well as helping with interpreting data collected as part of the study and feeding into study outputs.

Impacts identified by case studies in the scoping and design stage

Most case studies found it difficult to identify impacts of the IEA at the set-up stage. For the Fitzroy River, impacts identified included: i) the identification and collation of a rich set of data that will allow planning in the region, including outside the basin and understand data gaps and new topics and sectors of interest (e.g. bush food production, mineral sands mining), and ii) the identification of the main sectors and related organisations, including contact details for key people to involve in the process.

Stage 4. Planning

The aim of the planning stage is to bring together the key elements and content identified in previous stages into a clear and workable plan. Key parts of the planning stage include defining key activities for the analysis and assessment process, reviewing and refining the impact strategy and indicators of impact, further developing the communication and outreach strategy for the IEA, and establishing a monitoring and evaluation system for the IEA process.

Table 5. below offers a preliminary analysis of key information for practitioners to consider during the planning stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

Table 5. Preliminary analysis of the planning stage for an IEA in northern Australia

Key step(s)	Key considerations for the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Define key activities for the analysis and assessment process; Allocate financial and human resources	Various existing environmental assessment and decision-making processes in northern Australia Ensuring all partners in northern Australia are contributing financial and human resources as appropriate	Building in participatory processes that ensure Indigenous Australians have appropriate input into the analysis and assessment process Bringing together resources and expertise from different agencies, stakeholders and partners	Ensuring activities and data products are likely to fit in with and be useful for existing environmental assessment and decision-making processes of northern Australia Where agencies or partners have only minimal financial or human resources to contribute to the process.	(State-scale) Strategic Regional Environmental and Baseline Assessment (SREBA) See Box 6. (Regional-scale) Geological and Bioregional Assessment Program - see Box 5.	Multi-objective planning - e.g. Álvarez-Romero et al (2021) Participatory planning - e.g. Forester (1999)	National Native Title Tribunal (2021). Native Title Determination Outcomes. <u>https://data.gov.a</u> <u>u/dataset/ds-nsw-</u> <u>a784e83c-2a3a-</u> <u>4fc5-9382-</u> <u>20270ab7b094/de</u> <u>tails?q=</u>
Review and refine the impact strategy, identify indicators of impact	The impact strategy will need to target IEA findings at all relevant stakeholders	For northern Australia, the impact strategy has opportunity to engage Indigenous stakeholders	Ensuring the impact strategy communicates to relevant stakeholders, and particularly Indigenous	(Regional-scale) Integrated Iandscape-scale cassowary conservation at	Participatory planning - e.g. Forester (1999)	National Native Title Tribunal (2021). Native Title Determination Outcomes. <u>https://data.gov.a</u> <u>u/dataset/ds-nsw-</u>

			stakeholders, in appropriate languages	Mission Beach - Hill et al 2011		<u>a784e83c-2a3a-</u> <u>4fc5-9382-</u> <u>20270ab7b094/de</u> <u>tails?q=</u>
Develop communication and outreach strategy	The communication and outreach strategy will need to reach all relevant stakeholders, including those speaking community languages	For northern Australia, the communications and outreach strategy has opportunity to engage Indigenous stakeholders	Ensuring the communications and outreach strategy communicates to relevant stakeholders, and particularly Indigenous stakeholders, in appropriate languages		Stakeholder analysis, mapping - e.g. Reed et al (2009) Participatory planning - e.g. Forester (1999)	Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) (2021). Austlang dataset. <u>https://data.gov.a</u> <u>u/dataset/ds-dga-</u> <u>70132e6f-259c-</u> <u>4e0f-9f95-</u> <u>4aed1101c053/det</u> <u>ails?q=</u>
Establish monitoring and evaluation system for the IEA process	Monitoring and evaluation will help ensure the IEA process is functioning as intended	Continual improvement of the IEA process in northern Australia	Resourcing for monitoring and evaluation can be difficult to obtain	(Local-scale) Walalakoo Healthy Country Plan	Gap analysis - e.g. Scott et al (1993)	*n/a

Challenges identified by case studies in the planning stage

One of the main challenges identified by case studies in the planning stage was identifying appropriate analysis approaches to use in the IEA. Part of the challenge is selecting analyses that ensure results are robust, but also accessible, understandable and useful to end-users. Complex models may produce results obscure or inaccessible to many users and thus may not be trusted. The challenge is in balancing the need to be sufficiently comprehensive whilst engaging in a highly participatory process that is also aimed at creating a space for conversations and building relationships and new ways of thinking about development.

Lessons learned by case studies in the planning stage

A key lesson arising from the case studies was the value of a participatory planning process for the IEA. Working closely with end-users during the process and providing example inputs and outputs of the analysis (e.g. scenarios, land-uses maps) to stakeholders for early feedback allows for clarification of issues, validation of models, and better understanding of IEA outputs. In-depth workshops might be particularly valuable for some stakeholders and studies.

One of the lessons offered through the Development by Design process is the value of designing the IEA to report at multiple scales. While the Development by Design framework was set up for individual native title areas, at the same time it reports on a landscape level (e.g., catchment level) and the process can be undertaken in parallel across multiple groups on a broader regional scale. This allows Development by Design to build a bottom-up regional picture of community values aspirations and build the capacity in communities to assess local impacts while considering cumulative impacts.

For the GBA program's causal network method, the project team had the endpoints for the study identified early on (environmental values), but took some time to clearly define the activities (associated with gas development). Earlier and clearer definition in the planning stage of the activities being assessed would have helped the various researchers assessing the stressors they cause and how they impact on processes.

Impacts identified by case studies in the planning stage

Most case studies found it difficult to identify impacts of the IEA at the set-up stage. For the Fitzroy River study, impacts identified included: i) the development of a process to use participatory scenario planning to help inform future land use/water planning processes in contested landscapes; ii) development of a process to assess future scenarios based on peoples' wellbeing that goes beyond quantifying number of jobs, profit and affected threatened species, iii) enabling familiarity of stakeholders with participatory scenario planning concepts, tools and outputs that can be used to guide spatial planning, and iv) development of a large GIS database with varied applications in the region.

Stage 5. Implementation

The implementation stage is the largest part of the IEA process, and focuses on finalising the environmental issues and priorities to assess, gathering, processing and analysing available data and knowledge, presenting and discussing preliminary results with relevant stakeholders, and writing up the findings for review and publication.

Table 6. below offers a preliminary analysis of key information for practitioners to consider during the implementation stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

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Table 6.	Preliminarv	analysis of the	implementation st	taae for an IEA	A in northern Australia
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Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Validate priority environment and development issues, and their connection to the IEA framework	Substantial diversity of environmental and cultural heritage issues in northern Australia Diversity of knowledge systems Large uncertainties in northern Australian environmental and cultural knowledge and information	 Building a common set of priority environment and development issues for northern Australia Building a common understanding of how IEA framework can help deliver better environmental and community outcomes Inclusion of different knowledge systems in assessment processes, including Indigenous knowledge 	Ensuring that all stakeholders and partners have sufficient input into identifying priority environment and development issues Selecting priority environment and development issues	Strategic Regional Environmental and Baseline Assessment (SREBA) See Box 6.	Spatial analysis, mapping, prioritisation - e.g. Whitehead et al (2014, 2017) Participatory planning - e.g. Forester (1999)	Pintor et al (2018). Threatening processes to taxa of conservation concern in Northern Australia. <u>https://doi.org/10.</u> 25903/5b72631b2 dd70 Department of Planning, Lands and Heritage (2021). Aboriginal Heritage Places (DPLH-001). <u>https://catalogue.d</u> <u>ata.wa.gov.au/data</u> <u>set/aboriginal- heritage-places</u> Syktus et al (2020). Queensland Future Climate Dashboard: Downscaled CMIP5 climate projections

						for Queensland. https://www.longp addock.qld.gov.au/ gld-future-climate/
Collect, process and analyse data and knowledge	Cultural knowledge sensitivities in northern Australia Large knowledge gaps in northern Australia for environmental and cultural information	Bringing together multiple knowledge systems and information about northern Australia's environmental and cultural heritage into a common and agreed framework for analysis Identifying key knowledge gaps and prioritising data and information gathering	Ensuring social and cultural knowledge is appropriately collected, stored and used, including considered integration with other knowledge Ensuring environmental information is appropriately collected, stored and used Adjusting analyses in situations of limited data availability or accessibility.	An integrated approach is needed for ecosystem based fisheries management: Insights from ecosystem-level management strategy evaluation (Fulton et al 2014), see Box 2. Analysis of trade- offs between biodiversity, carbon farming and agricultural development in northern Australia - Moran-Ordonez et al - see Box 7. Moving from reactive to proactive development planning to conserve Indigenous community and biodiversity values	Spatial analysis, mapping, prioritisation - e.g. Whitehead et al (2014, 2017) Benefit-cost analysis - (e.g. Marglin 2014) Land-use change / dynamic modelling. Scenario analysis - e.g. see Alcamo & Henrichs (2008), Turner (2005), Franzese et al. (2013) Risk assessment - e.g. Jones (2001), Burgman (2005) Trade-off analysis – e.g. Brown et al (2001)	Pintor et al (2018). Threatening processes to taxa of conservation concern in Northern Australia. https://doi.org/10. 25903/5b72631b2 dd70

				(Heiner et al. 2019) - see Box 9.		
Present and discuss preliminary results with relevant partners and stakeholders	Diversity of partners and stakeholders in northern Australia, and interests and knowledge in IEA	Building a common understanding of how the IEA framework can help deliver better environmental and community outcomes, fostered particularly through a co-design approach	Communicating uncertainties in IEA products appropriately	Exploring alternative development futures for the Martuwarra (Fitzroy River) catchment through participatory scenario planning - see Box 8.	Scenario analysis - e.g. see Alcamo & Henrichs (2008), Turner (2005), Franzese et al. (2013) Risk assessment - e.g. Jones (2001), Burgman (2005)	*n/a
Prepare the draft outputs, organise peer review and finalise outputs; Arrange for publication	Diversity and number of partners involved in the IEA process for northern Australia, and varying interests and knowledge of IEA	Building common understanding across partners of how IEA contributes to addressing development decision challenges in northern Australia – particularly through outputs tailored for and targeted at end-users Building community acceptance of IEA in northern Australia Increasing transparency over environmental assessment and development decision- making	Ensuring that all stakeholders and partners have sufficient opportunity for input and review into the outputs Ensuring sensitive cultural and environmental information is appropriately handled during publishing	(Regional-scale) Geological and Bioregional Assessment Program - see Box 5.	Expert judgement	*n/a

Challenges identified by case studies during the implementation stage

Correcting and accounting for bias in data was the main challenge identified in the implementation stage for the carbon, biodiversity and agricultural trade-off analysis (Morán-Ordóñez et al 2017). In this study, the team gathered distribution data on as many species as possible (especially endangered species) and plant communities of conservation interest (habitats), however during implementation of the analysis was faced with the challenge that most biodiversity distribution data across northern Australia was biased towards areas of high accessibility. The team needed to 'correct/account' for this issue when making predictions of species distribution across the entire region.

Relatedly, the GBA program noted the challenge of conducting IEA in areas with limited information and knowledge available, requiring consideration of alternative assessment techniques and development of fit-for-purpose analysis methods.

The Daly River exercise noted during the implementation stage the challenge of stakeholder fatigue arising from the large amount of research work conducted over the years prior to this study.

Lessons learned by case studies in the implementation stage

Working closely with stakeholders and end-users during the implementation stage was a key lesson offered through the case studies. The Daly River study found it benefitted from conducting the stakeholder engagement via existing stakeholder groups (e.g. farm groups), and structures (e.g. utilising the Traditional Owner engagement framework developed under National Environmental Research Program to guide the engagement with Traditional Owners, ranger groups and Indigenous communities). For SELTMP, working with management agencies to identify data needs proved highly beneficial, helping to deliver targeted information and insights as needed by end-users. For the Fitzroy River study, lessons included providing regular updates, delivering outputs to relevant stakeholders, and delivering products to end-users before key policy decisions.

In the GBA program, expert elicitation proved a useful tool for reducing uncertainty and plugging knowledge gaps in areas with limited information. Building up the understanding of the region and a high quality knowledge base over time would help plug these gaps, and could be particularly useful for conducting cumulative impact assessments.

Impacts identified by case studies in the implementation stage

A common theme identified across case studies was the difficulty in knowing the impacts of the IEA. It is possible that the products and outputs were used in management, planning or decision-making, however in the main the use of the IEA outputs is not visible to the case study leaders.

The process of stakeholder engagement during the implementation stage delivered impact for the Daly River and Fitzroy River studies. The Daly River planning exercise potentially influenced stakeholder perception of what the development challenges are for the catchment. For example, using maps in the study to show the different extents of clearing for agricultural precincts considered in the study, triggered stakeholders to think more deeply about clearing extents. The Fitzroy River study (Álvarez-Romero et al 2021) contributed to creating new ways of thinking about development and consideration of development options, and helped to bring together actors from diverse sectors to participate in the IEA, which were otherwise isolated - contributing to shared understandings and building relationships.

There were also indications of the studies being picked up for use in broader planning processes. For example for SELTMP, case study information was known to be feeding into the Reef 2050 plan, local NRM body planning processes, (e.g. report cards on waterway health), and the GBR Outlook Report. It was also understood that management agencies are using SELTMP data to guide on-ground management activities and decision-making.

Stage 6. Communication of results and outreach

The main aim of the communication of results and outreach stage is to prepare relevant IEA products, promote IEA products and messages, and share relevant information with stakeholders and partners.

Table 7. below offers a preliminary analysis of key information for practitioners to consider during the communication of results and outreach stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

Table 7. Preliminary analysis of the communication of results and outreach stage of an IEA in northern Australia

Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Prepare relevant IEA products	Diversity and number of partners and stakeholders involved in the IEA process for northern Australia	Building a common understanding across partners of how IEA contributes to addressing development decision challenges in northern Australia Building community acceptance of environmental and cultural heritage planning and decision- making in northern Australia Increasing transparency over environmental assessment and development decision- making	Ensuring that all stakeholders and partners have sufficient opportunity for input and review into the outputs Ensuring sensitive cultural and environmental information is appropriately handled during publishing	Social and Economic Long- Term Monitoring Program (<u>SELTMP</u>) - see Box 4.	Stakeholder analysis, mapping - e.g. Reed et al (2009) Participatory planning - e.g. Forester (1999)	National Native Title Tribunal (2021). Native Title Determination Outcomes. https://data.gov.a u/dataset/ds-nsw- a784e83c-2a3a- 4fc5-9382- 20270ab7b094/det ails?q= ABARES (2021). Catchment Scale Land Use of Australia. https://data.gov.a u/dataset/ds-dga- 97bb9e54-f0df- 4073-9288- e0ebded53a96/det ails?q=catchment% 20land%20use%20 2021

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Promote the IEA products and messages; Organise media outreach	Diversity of northern Australia IEA stakeholders and partner interests Potential sensitivities of IEA products, particularly for cultural sites and information, and threatened species information Limited media channels in northern Australia for outreach	Building northern Australia community acceptance and legitimacy for IEA process and its contribution to improved environmental decision- making Building media and community awareness of the complexity of environmental decision- making, and how IEA can help deliver better outcomes for northern Australia	Ensuring sensitive information used in IEA, and available in its products, is secure and used appropriately, particularly cultural knowledge Communicating complex synthesis and analysis information in an accessible way for diverse audiences Ensuring that media communications are accurate and appropriate	Social and Economic Long- Term Monitoring Program (<u>SELTMP</u>) - see Box 4.	Message framing - e.g. Kusmanoff et al (2020) Science communication tools - e.g. Dennison et al. (2007)	Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) (2021). Austlang dataset. https://data.gov.a u/dataset/ds-dga- 70132e6f-259c- 4e0f-9f95- 4aed1101c053/det ails?q= ABARES (2021). Catchment Scale Land Use of Australia. https://data.gov.a u/dataset/ds-dga- 97bb9e54-f0df- 4073-9288- e0ebded53a96/det ails?q=catchment% 201and%20use%20 2021
Share relevant results with stakeholders	Diversity of northern Australia IEA stakeholders	Building acceptance, legitimacy and co- ownership of the IEA process for northern Australia	Reaching all interested stakeholders Presenting complex synthesis and analysis information in an accessible way	Social and Economic Long- Term Monitoring Program (<u>SELTMP</u>) - see Box 4.	Science communication tools - e.g. Dennison et al. (2007)	*n/a

Challenges identified by case studies in the communication of results and outreach stage

One clear challenge identified in the communication and outreach stage was ensuring that information is made accessible to and picked up by end-users. For example in the SELTMP case study, a challenge was noted of ensuring that management agencies know about and can reach the information from the IEA they need, in the way and format that they need it. The GBA program noted the challenge of ensuring sufficient resources are allocated for communications when scoping out the IEA.

In the carbon, biodiversity and agricultural development trade-off analysis (Morán-Ordóñez et al 2017), it was noted that the success of the IEA's communication strategy may depend upon the person delivering the communications. For example, their charisma, influence, and network (i.e. his/her existing access to policy-makers).

Consideration of the audience is another challenge for communicating IEA results. For example in the Fitzroy River study, it was noted that crafting communication products amenable to diverse audiences (e.g. Traditional Owners, agencies, farmers, NGOs) can be very difficult, due to language, differing interests, the type of outreach material needed for very different groups, and the different types of outputs to communicate.

Lessons learned by case studies in the communication of results and outreach stage

The case studies suggest value in offering a diversity of communications products. The Daly River exercise found that the findings workshops, field days, and project information sheets were useful for communicating messages and findings of the project. Project factsheets were found particularly useful for communicating findings to a broad audience – what the study was about, how engagement was going to be done, what the findings were. A plain language version of the outputs from the carbon, biodiversity and agricultural development trade-off analysis (Morán-Ordóñez et al 2017) was produced for a broad audience and distributed via social media.

Considering how end-users will use the data products, and potentially co-designing outputs with them, could also be of benefit. For example, the initial design of the SELTMP data portal (2017) had some end-user input, but was limited. Further consideration of how end-users engage with the information has led to a redesign of the portal, and the provision of additional information, e.g. on how SELTMP data links to the Reef 2050 plan. The team is also currently working on decision-support and data visualisation tools to help get information directly to management agencies.

A well-developed communications and impact strategy could also be of benefit, even though this can be time consuming. Ideally the strategy would include stakeholder-specific outputs, designed by professional communicators, and with key messages delivered in the most appropriate format (e.g. short video for Traditional Owners, factsheet for general public and industry, technical report for agencies and researchers). Advice on cultural matters would be sought as appropriate. The GBA program suggested embedding a science communicator and editor into the IEA would be valuable for delivering high quality and impactful communications for the IEA.

Impacts identified by case studies in the communication of results and outreach stage

As for the implementation stage, the difficulty in understanding the impacts of IEA communications stage was noted by several studies. Nonetheless, it was noted that insights from the SELTMP work are helping to raise awareness of Great Barrier Reef issues in the broader community. It was also identified that SELTMP data may be helping to build the social acceptability of management agencies (social licence) and upcoming management initiatives (e.g. novel management interventions, Crown of Thorns control, etc.). Predominantly this is achieved through joint communications and media releases when data is published. For the research community, some SELTMP information is also published in journal articles.

The results of the carbon, biodiversity and agricultural development trade-off analysis (Morán-Ordóñez et al 2017) were presented to government by scientific advisors, and to community groups, to promote the development of a more sustainable plan for Northern Australia. The impact of these communications remains unclear.

The results of the GBA program are to be communicated by a webtool (GBA Explorer), currently in preparation. The user acceptance testing to the webtool and its communication of the GBA program results so far has been very positive.

Stage 7. Monitoring, evaluation and learning

The aim of the monitoring, evaluation and learning stage is to facilitate ongoing evaluation and improvement of the IEA process for future iterations, and evaluate the contribution of the IEA process to its intended use.

Table 8. below offers a preliminary analysis of key information for practitioners to consider during the monitoring, evaluation and learning stage of an IEA in northern Australia. It identifies the key considerations, opportunities and challenges for IEA in the northern Australia context, as well as example case studies of IEA, analytical approaches, and datasets that relate to this stage.

Table 8. Preliminary analysis of the monitoring, evaluation and learning stage of an IEA in northern Australia

Key step(s)	Key considerations for IEA in the northern Australia context	Key opportunities presented by IEA for northern Australia at this step	Key challenges for implementing IEA in northern Australia at this step	Examples of existing plans or case studies, that demonstrate good practice of IEA or parts of IEA, that relate to this step	Examples of technical / analytical approaches that could assist this step of the IEA process	Examples of existing northern Australia datasets that relate to this step of the IEA process
Evaluate the IEA process; Identify lessons learned	Diversity of stakeholders and partners in the IEA process in northern Australia There will be a transition period for partners and stakeholders as the IEA process ramps up and they get used to its input into decision- making.	Continuing refinement of the IEA process for northern Australia, such that it delivers better outcomes for the community and environment	Ensuring stakeholders and partners have sufficient input into the evaluation and refinement process, and identifying what lessons have been learned from the IEA process Ensuring the IEA process continually delivers for all northern Australia partners and stakeholders, particularly where interests and knowledge systems diverge	Walalakoo Healthy Country Plan 2017- 2027	Participatory planning - e.g. Forester (1999) Expert elicitation - e.g. Morgan (2014)	n/a
Evaluate the contribution of the IEA process to end-use	Diversity of stakeholders and partners involved in the IEA process in northern Australia	Continuing refinement of the IEA process for northern Australia, such that it delivers better outcomes for the	Identifying impact of the IEA and related outputs Ensuring stakeholders and partners have	Walalakoo Healthy Country Plan 2017- 2027	Participatory planning - e.g. Forester (1999)	n/a

Con There will be a transition period for partners and stakeholders as the IEA process ramps up and they get used to its input into decision- making	community and environment sufficient input into the evaluation and refinement process Ensuring the IEA process continually delivers for all northern Australia partners and stakeholders,	Expert elicitation - e.g. Morgan (2014)	
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Challenges identified by case studies in the monitoring, evaluation stage

The challenge of evaluating whether or not the IEA study achieved its objectives was noted by several case studies. The impact of the Daly River study on planning and development decision-making was impeded somewhat by governance issues, particularly the de-coupled water and land-use decision-making, and the multi-step approvals process for development. There is also limited visibility reported for the Daly River exercise to identify where the findings of the study were used.

Likewise, the challenge of monitoring the outcomes of the IEA on end-uses was noted by the GBA program. In this particular case, the impact on development approvals and compliance requirements.

The challenge of gaining feedback from participants in the IEA was noted by the Fitzroy River study. Though time was provided at the end of workshops for monitoring and evaluation activities, not as many responses from participants were received as planned. Moreover, changes in people attending the different workshops impeded longitudinal surveys.

Lessons learned by case studies in the monitoring, evaluation stage

Documenting the IEA process was a key lesson offered by the case studies, particularly for ongoing processes. For example, for SELTMP, documenting the process of feeding stakeholder input into the survey design will assist with future iterations of the IEA, as well as facilitating interpretation of the data once it is collected and analysed. Moreover, consideration of governance, monitoring and evaluation of the IEA process during the planning phase proved useful for future iterations. Documenting the process helps to clarify what has worked, what did not, and why things were or were not in scope.

Evaluating participants' perceptions about the process and usefulness of the outputs of the IEA was identified in the Fitzroy River study as valuable. Monitoring and evaluation of participation was seen as helpful for identifying areas for improvement during the process and ways to enhance impact (e.g. improving outputs).

Impacts identified by case studies in the monitoring, evaluation stage

Like for other stages, identifying the impacts of case studies was difficult for most. For the Daly River exercise, the study findings were intended to be used by DRMAC to guide planning for development precincts. It was unclear to the study leaders as to what extent this happened.

Similarly for the carbon, biodiversity and agricultural development trade-off analysis (Morán-Ordóñez et al 2017), the study was undertaken to feed into the development plans for northern Australia. It was unclear to the study leaders to what extent this has occurred.

Box 5. Social and economic long-term monitoring for the Great Barrier Reef

Social and economic long-term monitoring for the Great Barrier Reef

The Social and Economic Long-Term Monitoring Program (SELTMP) was initiated in 2011 through the Australian Government's National Environment Research Program as a novel attempt to monitor the social and economic dimensions of social-ecological change in the Great Barrier Reef (GBR). Baseline data was collated from existing datasets and collected where gaps were identified, using standard survey techniques. In 2017, SELTMP was commissioned by the Great Barrier Reef Marine Park Authority to collect and interpret a second data point. Data collection will soon begin for the 2021 data collection and interpretation.

The formal monitoring framework of the SELTMP is based on the DPSIR approach (Drivers – Pressures – State – Impact – Response) of the Millennium Ecosystem Assessment. A mixed methods approach is used to collect survey data from each identified stakeholder group, using telephone interviews, online surveys and face-to-face surveys. Data analysis focuses on assessing the current condition of the human dimension within the region, using five clusters: Aspirations, capacity and stewardship, Community vitality, Culture and heritage, Economic values, and Governance (Marshall et al. 2017).

Already some substantial social and cultural changes have been identified by comparing the 2013 and 2017 surveys. For example, residents and tourists showed increases in stewardship sentiment and ratings for place values associated with the GBR, which together indicate increasing public sentiment for the GBR in response to the major biophysical disturbances experienced in 2016 and 2017 (Curnock & Marshall 2019; Marshall & Curnock 2019b). However, these changes were not consistent across all groups. Only minimal social and cultural changes were observed among commercial fishers over this period (Marshall & Curnock 2019a).

Through time, SELTMP sampling will enable correlations and potentially predictive modelling of humanenvironment responses to significant environmental and/or societal events through detailed analyses and information synthesis. Synthesis and integration of data will help improve system understanding and underpin decisions for more effective management of the GBR.



Box 6. Assessing the environmental impacts of shale and tight gas development

Assessing the environmental impacts of shale and tight gas development

The potential environmental impacts of shale and tight gas development are currently being assessed through the Australian Government's Geological and Bioregional Assessment Program. Studies are underway in 3 geological basins in northern Australia: the Cooper Basin (Queensland and South Australia), the Isa Superbasin (Queensland), and the Beetaloo Basin (Northern Territory). Knowledge and data produced through the program will inform decision-making and enable coordinated management of impacts likely to arise from shale and tight gas development.

In Stage 1 of the program, completed in 2018, three priority geological basins were identified in consultation with state and territory governments and industry with the greatest potential to deliver shale and/or tight gas to the Australian east coast market within the next 5-10 years. Stage 2 of the program, completed in 2020, focussed on integrating data, knowledge and conceptual models to produce geological and environmental baseline assessments. Gaps in information were identified to guide the collection of additional data where needed, alongside geological basin assessments and environmental data syntheses. These assessments will form the basis for the impact analysis. Stage 3, to be completed in 2021, aims to analyse the potential impacts likely to arise from shale and tight gas development to water and matters of national environmental significance, such as threatened species, ecological communities, wetlands, and cultural heritage sites. In consultation with industry, state governments and Commonwealth agencies, a range of development scenarios will be explored to assess impacts such as changes to groundwater quality, surface water flows, damage to or loss of cultural heritage, habitat fragmentation and loss, introduction of invasive species, and contamination of soil, groundwater and/or surface water.

Following a risk assessment approach, hazards were systematically identified considering possible ways that activities across the life cycle of gas development may impact on ecological, economic and social values (Holland et al. 2019; Huddlestone-Holmes et al. 2020; Lewis et al. 2020). Severity and likelihood scores for each hazard were then agreed with experts from government, industry and members of the assessment team. Preliminary conceptual models have been produced to help explore these impacts (an example is provided in **Figure 10** below).



Figure 10. Preliminary conceptual model of linkages between existing drivers, threatening processes and causal pathways leading to potential impacts from future shale and tight gas development on the Gouldian Finch. From Huddlestone-Homes et al (2020).

Box 7. Establishing appropriate baselines to assess the impacts of onshore gas activities

Establishing baselines to assess the impacts of onshore gas activities

The 2018 Scientific Inquiry into Hydraulic Fracturing in the Northern Territory investigated the likely risks associated with hydraulic fracturing of onshore shale gas reservoirs in NT, the nature and extent of impacts on environmental, social, cultural, and economic conditions of the NT, (Scientific Inquiry into Hydraulic Fracturing in the Northern Territory 2018). Amongst the Inquiry's findings was a recommendation for a Strategic Regional Environmental and Baseline Assessment (SREBA) to be conducted to address the lack of adequate pre-development assessment and environmental baseline data and assist in understanding the likely impacts. The data collection phase of the SREBA is now currently underway for the Beetaloo subbasin.

In essence the SREBA is a set of studies at a regional scale aimed at filling identified knowledge gaps and establishing appropriate baselines to assess potential impacts of onshore gas activities in the Northern Territory. Its key purpose is to provide information to assist decisions about the development of the onshore gas industry, including on water and biodiversity, to inform land use planning, and collect baseline data as a reference point for ongoing monitoring (DENR 2020). The intent of the SREBA is to inform but not replace project-level impact assessment and approval processes, nor other social and environmental impact statements as required by regulators. Information obtained from the SREBA could be used in the design and planning of future development, particularly at a regional scale, to minimise impacts for the onshore gas industry.

The assessment process is guided by the SREBA framework, which works across 6 domains: water quality and quantity, aquatic ecosystems, terrestrial ecosystems, methane and greenhouse gas, environmental health, and social, cultural and economic. Technical guidance notes are provided for each of these domains to assist in the production of baseline reports, which themselves will contain a description of the methods, results, analyses and synthesis products, as well as cataloguing the data used.

A diagrammatic representation of the key elements of the SREBA process is provided in Figure 11.



Box 8. Analysing trade-offs between biodiversity, carbon and agricultural development in northern Australia

Analysing trade-offs between biodiversity, carbon and agricultural development in northern Australia

In this study, Moran-Ordonez and colleagues (2017) used land-use scenarios to explore trade-offs and synergies among biodiversity conservation, carbon farming and agricultural production in northern Australia. The tropical savannas of northern Australia are largely intact, remnant open forests and woodlands, containing nationally listed ecological communities and species. It is also slated for considerable economic investment and agricultural development over the next 20 years, whilst also seeing substantial uptake of carbon farming initiatives. Using spatial prioritisation, Moran-Ordonez and colleagues quantified the impacts of development options across multiple species and ecological communities and explored five alternative land-use scenarios: ranking sites in the landscape by biodiversity values ("biodiversity-only"), by carbon-storage potential ("carbon-only"), by agricultural opportunity ("agriculture-only"), by combining biodiversity, carbon and agricultural values ("all-equal"); and by combining biodiversity, carbon and agricultural values biodiversity features heavily ("biodiversity-weighted").

The results show substantial overlap between agricultural potential and biodiversity values, suggesting that agricultural development in the region could have considerable impacts on biodiversity, and trade-offs will be necessary. There is also a substantial proportion of sites of low biodiversity value but high agricultural potential, which suggests that there is considerable opportunity to avoid land-use conflict. Through the all-equal scenario, the study showed that the biodiversity features considered could maintain their representation even with relatively high levels of agricultural development – though understanding their long-term persistence would require further research.

The authors argue that these approaches can help quantify the impacts of different development options, and provide support to complex, multi-objective land-use planning decisions.



Ordonez et al (2017).

Box 9. Exploring alternative development futures for the Martuwarra (Fitzroy River) catchment through participatory scenario planning

Exploring alternative development futures for the Martuwarra (Fitzroy River) catchment through participatory scenario planning

There are various development plans for the Martuwarra (Fitzroy River) catchment. Proposals for new developments include irrigated agriculture, increasing livestock production, carbon farming, extraction of mineral resources, nature and cultural tourism and many others. But at hand is the question of how to balance increases in productivity, traditional uses and nature conservation? We are at an intersection where major decisions (from local to national levels) will be made regarding the future use of land and water resources. Making these decisions requires a conversation about different development pathways for the region.

To support these discussions, this NAER-NESP project (Álvarez-Romero et al. 2021) guided a participatory scenario planning exercise to construct and assess the outcomes of alternative development scenarios for the Martuwarra (Kiatkoski et al. 2021). Major components of this exercise included assembling a scenario planning team to exchange views about development, explore alternative development options, imagine possible futures and explore their potential outcomes. Land-use maps that represented these narratives were then created to represent and explore these possible futures. The possible outcomes of these scenarios were then discussed by the team and each scenario was then scored based on its effect on well-being categories. The scores from participants varied widely, but in general indicated that protecting important values of the region would likely lead to well-being improvements.

Through a series of workshops, the scenario planning exercise aimed to create a shared space for constructive and objective conversations about the future development of the Fitzroy River catchment. Through this process the project contributed to developing common understandings about different development options for the region and systematically explored the possibilities, as well as the potential outcomes of different development trajectories.





Figure 13. Examples of the Fitzroy River catchment scenarios used in this study. Scenarios were described using maps representing possible distribution of land uses, selected broad indicators (e.g. gross value of production, employment for Indigenous/non-Indigenous people, surface and groundwater use), and illustrations such as this one showing key differences between scenarios.

Box 10. Integrating biodiversity and cultural values to facilitate use in impact assessment processes

Integrating biodiversity and cultural values to facilitate use in impact assessment processes

Heiner et al (2019) outline the 'Development by Design' framework for integrating biodiversity and cultural values for use in EIA processes. The study uses the Nyikina Mangala Native Title Determination Area in the Kimberley, Western Australia, as a case study. The Nyikina Mangala community faces a convergence of issues relating to the need for integrated analysis and decisions about management and protection of environmental and cultural values in the face of development pressures – particularly agricultural expansion, mining and petroleum developments.

The study developed spatial datasets to represent cultural, social, and biodiversity values of the Nyikina Mangala community across the Native Title Determination area, specifically: Cultural and Heritage sites, Freshwater Places, Native Animals, and Bushtucker/Bush Medicine Plants. A decision-making framework was then developed with the community working group to assess development proposals and define negotiations for mitigation measures following the mitigation hierarchy.

Analysis showed considerable overlap between cultural and heritage sites and freshwater values, and potential habitat of protected species. The community working group identified development-avoidance areas as cultural heritage sites and freshwater protection zones around major tributaries, floodplains, and riverine wetlands.

The authors argue that proactively mapping cultural, social, and biodiversity values and forecasting impacts at the landscape level, through the Development by Design framework, could help predict and avoid impacts to social and biological values.



Box 11. Assessing trade-offs between conservation, development and social values in the Daly River, using optimal land-use scenarios

Assessing trade-offs between conservation, development and social values in the Daly River, using optimal land-use scenarios

Adams et al (2014, 2016) combined scenarios of optimal land-use and social evaluation to assist in agriculture development planning for the Daly River catchment, Northern Territory.

Coupling optimal land-use design and social evaluation of environmental outcomes, Adams et al assessed the performance of four land-use scenarios against planning objectives and existing land-use policies. The four development scenarios explored two clearing levels (10 and 20%) and the presence or absence of spatial precincts for concentrating irrigated agriculture. Using measures of stakeholder satisfaction, the land-use scenarios were also assessed to explore how they performed against social preferences.

The analysis showed that aside from a small fraction of conservation objectives which could not be met due to current land-uses, all other conservation and development objectives could be met under the proposed scenarios. The scenarios aligned well with existing vegetation clearing guidelines and existing policy settings. Agricultural and Indigenous residents, two key stakeholder groups in the catchment, had divergent satisfaction levels with the amount of clearing and agricultural development proposed in the scenarios.

The study suggested that lower levels of vegetation clearing (10%) best aligned with stakeholder preferences. The authors suggest that the study's approach is useful for exploring potential conflicts between conservation and development as part of the land-use planning process.



Chapter 4: Issues and challenges for implementing Integrated Environmental Assessment in Australia

Key messages:

- IEA offers considerable potential for improving development decision-making in Australia
- Implementation of the IEA process is likely to face a number of issues and challenges, including current systems of environmental decision-making, the multiple scales of decisionmaking, gathering and sharing knowledge, ensuring stakeholder participation, and ongoing implementation of the process
- Our exploration helps identify ways that practitioners and decision-makers can manage these issues and challenges

Though IEA offers much potential for improving development decision-making in Australia, implementing a foundational IEA process would not be without its challenges. With a view to guiding the implementation of the IEA approach in Australia, specifically to improve development planning and decision-making, this chapter aims to explore at a general level the main issues and challenges likely to be experienced when implementing the IEA approach. Through this exploration, the chapter's objective is to facilitate and guide further consideration and development of the IEA approach for the Australian context.

The chapter's focus is intentionally broader than the previous chapter, though it refers in parts to the northern Australia context to provide examples and specificity. Through this exploration, we hope to help practitioners pre-empt the key issues and challenges that will likely arise when implementing a foundational IEA approach in Australia, and offer general guidance for addressing these challenges.

As for Chapter 3, we envisage here IEA as a foundational process that facilitates the gathering, synthesising and analysing of knowledge and information from a wide range of sources - including Indigenous knowledge systems - which can then be drawn from to inform decision-making at multiple scales, for example in strategic assessments, environmental impact assessments, regional planning, natural resource management (NRM) plans, Healthy Country Plans etc. A graphical representation of this conceptualisation is provided in **Figure 1**.

Importantly, the IEA process in this chapter is one envisaged operating at a multi-state or national level. The issues and challenges explored here have been identified both through the preliminary analysis of IEA in northern Australia provided in Chapter 3, as well as from the knowledge and experience of technical practitioners and the project team.

Current systems of governance for environmental decision-making

IEA offers opportunity to feed insights into and support development decision-making, and aid the governance of environmental, cultural, social and economic assets. A key challenge, however, is ensuring that the development and implementation of a foundational IEA process has duly considered, and has an appropriate structure for working within, the relevant local systems of governance. This can be particularly challenging in situations with multiple agencies with differing priorities, and where insights from the IEA process are required to feed into multiple existing decision-making processes (McCaig 2005).

The multiple layers and complexity of governance arrangements in Australia suggest a notable challenge for the establishment of a foundational IEA process. It is likely that the IEA process would need to inform multiple regulatory, policy and decision-making processes, at multiple scales, for example Commonwealth, state/territory and local government development processes. Already there are challenges in bringing these separate decision-making processes together to address

environmental decline, particularly for dealing with cumulative impacts (Samuel 2020a). Recent work by the CRCNA in northern Australia highlights this governance complexity, and how in part this works to impede regional planning and decision-making, resulting in a lack of clearly articulated priorities for development and conservation, limited integrative, collaborative planning across governments, fragmented and conflicting policy and process settings, and limited focus on assisting development interests to progress investment-ready proposals that will likely meet regulatory requirements (Dale & Marshall 2020; NAJA Business Consulting Services 2020a, 2020b).

Though challenging, the IEA process would need to take into account and likely be situated within existing systems of governance and decision-making processes. A key focal point for the early stages of developing an IEA process to help address this challenge therefore would be the mapping out of the various assessment, planning and decision-making processes that the IEA products would inform. There may also be opportunity to identify points at which the information and knowledge gained through these processes could feed back into the knowledge gathering components of IEA. Engaging the various institutional stakeholders early on in the development of the IEA process would be critical for ensuring that all relevant existing assessment, planning and decision-making processes are considered, and outputs are designed to fit the needs of end-users. Co-design of the IEA process would help ensure that the process is embedded within and aligns with existing processes, and ensure that insights provided through the IEA are picked up and used.

Ensuring IEA delivers at the multiple scales of planning, assessment and decision-making

An established IEA process can allow for knowledge and data analysis across multiple spatial scales, with outputs and insights informing planning and decision-making at relevant scales. The process could also allow for planning and decision-making that works across and between different scales. For example, information obtained at a local scale, (i.e. at the bioregion or local government scale), would feed information up into reporting and assessment at a broader scales (e.g. national or state scales). Equally, insights created at the national or regional scale may need to be fed down into local-level decision-making. A primary challenge therefore is ensuring that the IEA process is set up in such a way that it can sufficiently support the delivery of scale-appropriate assessment, planning and decision-making at and across these different scales.

A challenge for establishing a foundational IEA process in Australia would be the need to feed insights into the various existing planning, assessment and decision-making processes at multiple spatial scales. For example, at the national scale, there is opportunity for the IEA outputs to feed into bioregional plans, or national-level State of the Environment reports. At the State level, IEA outputs might be used to inform state-level plans, strategic assessments, and state-level State of the Environment reports. At the regional level, IEA might be used to inform regional and catchment scale plans. At the local level, IEA might be used to inform development precinct planning. And at the project level, IEA might be used to inform project-specific impact assessments. There would also need to be ways for the relevant information to be shared between the various scales. For example, ensuring that information used to inform and develop regional plans also informs decisions at the national and project levels, and vice versa. The challenge, therefore, is ensuring that the foundational IEA process for Australia can deliver appropriate insights at scales relevant to the policy, planning and assessment decisions that the process is seeking to support. Within the process, care is needed to ensure that IEA outputs address all relevant environmental, social, cultural and economic issues, and that this information is appropriately fed into the existing planning and decision-making processes. A further but equally important challenge is ensuring that relevant information is fed between these scales to support decision-making.

A key focal point early on in the development of an IEA process to help address this challenge therefore would be the mapping out the various scales of the assessment, planning and decision-making processes that the IEA products would inform. Also important would be identifying the key

informational links between the different scales. Further, it would be important to ensure that the spatial scale at which the information and knowledge used in the IEA process is appropriately documented, and taken into account during the synthesis and analysis, and output process. An iterative design process may be needed that over time, will help refine the framework and align it with information needs. A pilot application of IEA at a regional scale could help identify how these informational linkages with existing planning and decision-making processes at various scales can work in practice.

Data and knowledge gathering, sharing, filling knowledge gaps, and updating over time

The information and data feeding into the IEA process is central to the quality of the outputs and insights delivered to decision-makers. Ideally an established IEA process would gather, synthesise and analyse information drawn from the best available knowledge. One key challenge here is the initial set-up of the IEA process, which would involve considerable effort to identify the existing relevant datasets and knowledge, gain access to that data and knowledge, and then ensure that the data and knowledge is suitable and integrated appropriately for the various purposes of the IEA. Beyond this initial set-up, there is also an ongoing challenge of ongoing data and knowledge collation that needs consideration.

For establishing a foundational IEA process in Australia, a key challenge would lie in gathering data, information and knowledge across multiple jurisdictions, agencies, organisations, as well as gaining information and knowledge from community groups. The data gathering, sharing and updating process has the potential to be resource intensive, especially when covering a broad diversity of knowledge and data types, as indicated in our preliminary analysis of northern Australia. Some holders of relevant information and knowledge may be unwilling to provide access, or only in limited situations. Amongst the challenges for data and knowledge, is the particular need to be respectful of sensitive information, such as cultural knowledge is used within appropriate frameworks (see Woodward et al. 2020). It is also likely through this process that considerable knowledge gaps would be identified, particularly in the initial phase of process establishment. Some of these knowledge gaps will be difficult to fill, particularly for social and cultural information.

A key focal point early on in the establishment of an IEA process to help address this challenge would be the clarification of the key data and knowledge that is necessary, and what data and knowledge is actually available to feed into the IEA process. The process outlined above of mapping out the various planning, assessment and decision-making processes that the IEA will inform, and what information feeds current processes, could help identify broad categories and types of data and knowledge that are likely to be needed. Knowledge gap analysis could help identify crucial gaps in data and information. In instances where substantial knowledge gaps exist, these could be filled using structured methods such as expert elicitation or judgement, or targeted empirical research. Longer-term, it might prove useful to establish consistent frameworks and standards for data and knowledge collectors, and a centralised repository of available data and knowledge sources (e.g. providing meta-data), matched with a verification process for feeding information into the IEA process. Perhaps managed by a specified data custodian, similar to the national environmental information custodian identified in the recent EPBC Act review (Samuel 2020a), this would create confidence in the knowledge and data used in the IEA, and efficiencies for the ongoing process of data gathering and synthesis.

Public and stakeholder participation, and legitimacy

Purposeful and ongoing engagement of relevant stakeholders, and provision of participatory processes, is central to the success of IEA. It is important not only for improving decision-making, but also to develop legitimacy and co-ownership of the IEA process. Ideally IEA would engage all relevant stakeholders as appropriate to the decision being made, in ways that are meaningful and connected

to them. This may include, for example, governments, scientists, non-government organisations, industry, Traditional Owners and representatives from local community groups. Fundamental to stakeholder participation is ensuring that adequate processes are available, that these are understood and considered legitimate, that all relevant stakeholders feel genuinely included, and that power imbalances are removed. Of fundamental benefit to a proactive IEA process, highlighted by the preliminary analysis of northern Australia in this report, is the meaningful engagement and participation of Indigenous Australians, which in some instances may require building capacity for Indigenous people to participate. Depending on the scale and scope of the IEA process, and the outputs sought, meaningful stakeholder participation could be a considerable challenge.

It is likely that an IEA process in Australia would serve multiple decision-making processes, across multiple levels of governance. This would likely mean facing the challenge of developing multiple processes for and levels of public and stakeholder participation. Moreover, depending on the level of decision-making and planning, public and stakeholder participation might cross multiple jurisdictions. Perhaps one of the key challenges, as indicated in our preliminary analysis of northern Australia, is in identifying priority and key stakeholders. In most instances, it is likely that the participatory processes for IEA in Australia would be resource intensive. And depending on the location, the process could also face language and cultural barriers to meaningful engagement and participation.

A key focal point early on in the establishment of an IEA process to help address this challenge would be identifying appropriate entry points for stakeholder participation and engagement. For example, there may be considerable benefit in focusing participatory processes in the start-up, setup and scoping stages of the IEA, to ensure that stakeholders' views inform the development of the assessment and associated products. A stakeholder mapping exercise early on could help identify the key stakeholders and prioritise those to include in the process. Appropriate selection of stakeholders could also work to build ongoing legitimacy of the IEA process.

Initial and ongoing implementation

Ideally IEA is set-up as an ongoing assessment process, with the intention of running long-term. This provides opportunity for the process to be continually updated with new knowledge and information, whilst feeding insights into decision-making through a consistent analysis framework. With this intention comes a requirement for the process to evolve with policy and legislative change, as well as to match societal expectations. The in-built monitoring and evaluation stage of the IEA process can help enable ongoing implementation. The challenge, however, is working with all relevant stakeholders to establish the IEA process such that it can be supported through time. This may be enabled, for example, by exploring through a pilot process the benefits of the IEA approach, and the institutional changes needed to support ongoing implementation.

Given the governance context in Australia, it is likely that multiple jurisdictions would be involved in establishing an IEA process and supporting it long-term. One key challenge here in the initial set-up is ensuring that all jurisdictions see sufficient benefits and have sufficient buy-in to set-up supporting agreements and commitments (e.g. funding, data-sharing) that ensure longevity for the process. Another challenge could be identifying which agency(s) or institution(s) is in charge of establishing and maintaining the IEA process, whilst ensuring that the requirements of the supporting institutions and jurisdictions are met. In the longer-term, the multiple jurisdictions involved would need to remain engaged and benefiting from the process to ensure its ongoing support. This could prove challenging where data and insight needs shift in different jurisdictions as time goes by.

A key focal point early on in the establishment of the IEA process to address this challenge would be ensuring that the initial design adequately informs existing planning, assessment and decisionmaking needs, across all jurisdictions. Also important would be ensuring that adequate resources are provided that match the mandate and scope for the assessment, and required outputs, with any
costs involved in the initial set-up or ongoing maintenance of the IEA process shared equitably. Insufficient resourcing could mean that the assessment is not sufficiently inclusive or comprehensive, risking loss of stakeholder buy-in and beneficial outcomes from the approach. Regular reviews of the IEA process would also help ensure that the outputs are meeting the needs of the various jurisdictions.

Chapter 5: Conclusions and future work

Conclusions

Finding robust ways to enable sustainable development will remain an ongoing challenge. Existing planning and assessment frameworks are impeded by the complexity and uncertainty of sustainable development decision-making. Informed planning and decision-making that enables high-quality investment whilst protecting environmental and cultural assets requires assessment frameworks that are able to synthesise information from multiple knowledge and information systems and produce insights and outputs directly relevant to the task at hand.

The challenge of sustainable development is particularly pronounced in northern Australia. Increasing focus on development of the region is bringing opportunities for investment and development, within a region of environmental and cultural values of global, national and local significance. Existing approaches to development planning and decision-making are proving insufficient, evidence suggesting these frameworks are struggling to consider the multiple and diverse environmental, social, economic and cultural values of the land and seascapes in an integrated way. This is placing investment, and the significant environmental and cultural assets of the north at risk.

Through enabling the integration of multiple knowledge systems under a single and coordinated analysis framework, IEA offers substantial opportunity to help address planning, assessment and development decision-making in Australia. It provides an established process for bringing multiple knowledge sources together to provide insights into development planning and decision-making.

With a view to guide the development of the IEA approach in Australia, this report has outlined the IEA approach at a general level, provided some case study examples of IEA, and provided detail on an example process framework. To help ground the IEA approach, it has then stepped through a preliminary analysis of IEA in northern Australia, using case study examples to help illustrate what IEA can do. Our intention through this approach was to help guide further applications of IEA and IEA practitioners seeking to engage in IEA. It has also drawn on the experience of IEA practitioners, identifying a number of issues and challenges that implementing IEA faces in Australia. Our exploration of the challenges likely to be faced in the establishment of a foundational IEA process for Australia, has enabled the development of suggestions on how practitioners can get in front of these issues and manage them.

Importantly, we have sought to ground at a high level IEA in the Australian context, and envisaged IEA as a foundational process that facilitates the gathering, synthesising and analysing of knowledge and information from a wide range of sources - including Indigenous knowledge systems - which can then be drawn from to inform development planning and decision-making at multiple scales. Outputs from this type of IEA process could directly inform existing processes, for example strategic assessments, environmental impact assessments, regional planning, natural resource management (NRM) plans, Healthy Country Plans etc. Likewise, the IEA process could be informed by data and knowledge arising from these existing assessment processes.

Our conceptualisation of IEA offers a scalable approach, one that we envisage operating most usefully at a multi-state or national level. Importantly, our conceptualisation of IEA for this report offers opportunity to get in front of development issues and be proactive, reducing the reactive application of planning and environmental assessment.

It is our view that it is timely to further the development of a foundational IEA process for Australia. Within this we offer the following recommendations to further the development of IEA in Australia.

Future work

With the continuing and increasing development pressures across Australia, there exists considerable opportunity to take advantage of the opportunities presented by use of an IEA approach and be proactive in development planning and decision-making at multiple scales. Central to this is the further development of an IEA process that complements and feeds into existing environmental decision-making, assessment and approval processes.

Developing a suitable IEA process that encompasses the multiple jurisdictions across the country would require the initiation of a suitable co-design process, that offers genuine and continuing engagement with key stakeholders. A useful step in the co-design process would be the establishment of an IEA partnerships committee that draws together key stakeholders to identify the framework for an IEA process suitable for addressing the development challenges faced by Australia.

As part of developing and testing that framework, it would be useful to develop a co-designed pilot project for a specific region or problem, for example, in northern Australia. Preferably this pilot would have direct links to a current planning or development decision-making need, and preferably with relevance at multiple scales. In our view a proactive pilot application of IEA would prove particularly beneficial at a regional scale, for example feeding into a bioregional planning or strategic assessment process. Regional planning at this scale that draws on IEA will allow for exploration and establishment of a cohesive vision and delivery system for protecting environmental, social, cultural and economic assets, and progressing development opportunities.

A particular opportunity to mobilise, trial and institutionalise a stronger approach to IEA now rests with the next three years of CRCNA investment in Western Australia, the Northern Territory and in Queensland on stronger placed-based approaches to planning for agricultural development. In partnership with the CRCNA, all three jurisdictions and key stakeholders will be exploring priorities for and best practice approaches to improve planning in areas of agricultural development potential. Combined with aligned scientific investment, for example across future marine and terrestrial NESP hubs, this presents a significant opportunity for the Commonwealth, the jurisdictions, and researchers to explore some innovative approaches to the trial, evaluation and adoption of IEA.

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Appendices

Appendix A: Meta-data compendium of datasets for IEA in northern Australia

A meta-data compendium of datasets and information useful for consideration as part of implementing IEA in northern Australia is available via the following link:

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Hardy, M., Burrows, D., Dale, A., Douglas, M., Jordan, A., Karoly, D., Morgain, R., Morris, S., Parris, K., Álvarez-Romero, J.G., Archer, R., Bekessy, S., Bluhm, S., Boruff, B., Brooks, A., Colman, R., Cooper, S., Dickson, F., Dunstan, P., Edgar, B., Garnett, S., Goolmeer, T., Grose, M., Gonzalez, M.G., Hedge, P., Hopkins, M., Janke, T., Kennard, M., Pannell, D., Russell-Smith, J., Simmonds, J., Trewin, B., Turnbull, J., Leeuwen, S. van, Williams, K. & Wintle, B. (2021). Meta-data compendium of datasets for integrated environmental assessment in northern Australia. DOI: 10.26188/17082797

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Report production

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Further information: http://www.nespthreatenedspecies.edu.au

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