blueprint for marine science WESTERN AUSTRALIA

western australian marine science institution

Decommissioning offshore infrastructure: a review of stakeholder views and science priorities

January 2018

Building a unique collaboration between industry, government, research and community to improve marine science and ensure a competitive and responsible future Blue Economy off Western Australia.

Authors

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ACRONYMS USED IN THE REPORT

AFMA	Australian Fisheries Management Authority
Agri and Water	Department of Agriculture and Water Resources (Australian Government)
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
CCG	Cape Conservation Group Inc
CCWA	Conservation Council of Western Australia Inc
CRC	Cooperative Research Centre
CU	Curtin University
CWR	Centre for Whale Research
DBCA	Department of Biodiversity, Conservation and Attractions (formerly DPaW)
DEPT ENV	Department of the Environment and Energy (Australian Government)
DMIRS	Department of Mines, Industry Regulation and Safety (formerly DMP)
DMP	Department of Mines and Petroleum (Government of Western Australia) (now DMIRS)
DoF	Department of Fisheries (Government of Western Australia) (now DPIRD)
DoIIS	Department of Industry, Innovation and Science (Australian Government)
DoIRD	Department of Industry Research and Development (Australian Government)
DPaW	Department Parks and Wildlife (Government of Western Australia) (now DBCA)
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
ECCI	Exmouth Chamber of Commerce and Industry
EEZ	(Australian) Exclusive Economic Zone
EGFC	Exmouth Game Fishing Club
EPBC	Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
FPSO	Floating Production Storage and Offloading vessel
FTOL	Fishing Tour Operator’s Licence
GA	Geoscience Australia (Australian Government)
GDC	Gascoyne Development Commission
IMS	Invasive Marine Species
KBGFC	King Bay Game Fishing Club
KDCCI	Karratha and Districts Chamber of Commerce and Industry
LGA	Local Government Authority
MAC	Murujuga Aboriginal Corporation

MAF	Marine Aquarium Fishery
MLSU	Murujuga Land and Sea Unit
NBSFC	Nickol Bay Sport Fishing Club
NERA	National Energy Resources Australia
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORMS	Naturally Occurring Radioactive Materials
OEPA	Office of the Environment Protection Authority (Government of Western Australia) (now DWER)
OPGSSA	Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act
P&A	Plug and Abandon
PDC	Pilbara Development Commission
PFW	Produced formation water
PORT AUTH	Pilbara Ports Authority, Department of Transport (Government of Western Australia)
PPA	Pearl Producers Association
RDC	Regional Development Commission
SDA	Environment Protection (Sea Dumping) Act 1981
STF	Structures, Techniques and Feasibility
TRANSP	Department of Transport (Government of Western Australia)
UNCLOS	United Nations Convention on the Law of the Sea
UWA	The University of Western Australia
WAFIC	Western Australian Fishing Industry Council
WAGFA	Western Australian Game Fishing Association
WAMSI	Western Australian Marine Science Institution

Executive Summary

The Blueprint for Marine Science 2050 report identified that better knowledge about the effects of decommissioning offshore infrastructure is a priority for multiple marine and community sectors.

This report summarises the uncertainties, opportunities and issues that stakeholders have identified about decommissioning practice, and about applying the full range of decommissioning options in addition to the status quo: full removal. The report also provides the priority science questions that need to be answered to allow informed and efficient consideration of the full range of decommissioning options.

This report was delivered by the independent Western Australian Marine Science Institution and jointly commissioned by the government, fisheries, oil and gas, community, research, and regulatory sectors working together under the Blueprint for Marine Science Initiative.

Issues related to decommissioning were identified through semi-structured interviews and workshops with more than 120 stakeholders and association representatives from multiple sectors and the community from Perth, Exmouth, Karratha, Dampier, Port Sampson and Canberra.

The stakeholder consultation recorded more than 900 issues, opportunities and concerns. These 900 issues were grouped and synthesised down to 30 questions that could be addressed through scientific research.

Nearly all stakeholders identified that there should be clear evidence of the environmental acceptability of different decommissioning options before they are supported. Many stakeholders held the view that, if shown to be environmentally acceptable, alternative uses such as 'reefing' could provide social, economic and environmental benefits, but wanted the evidence to support these assumptions.

The consultation also identified a number of policy issues that are not science related such as managing navigation risks, which ultimately retains liability for infrastructure left in the ocean, the sharing of financial benefits from leaving infrastructure in-situ and managing resource allocation of any new fisheries or environmental resources created. A further range of issues were raised in regard to when new science is not required, but where improved communication with stakeholders about existing knowledge is necessary. The project also identified that a number of stakeholders were not satisfied with the current approaches to consultation regarding development operations, decommissioning activities, or policy discussion.

A series of expert workshops prioritised the science questions based on their importance to: enabling efficient planning and regulation of the full range of decommissioning options, maximising the benefits from alternative uses, and addressing stakeholder knowledge gaps. The priority science questions included:

- What are the direct environmental impacts on fish species including from contamination, noise, habitat removal and cumulative ecological effects?
- What is the timeframe for breakdown (corrosion) of the various standard components of oil and gas infrastructure?
- What are the main contaminants following decommissioning, will they be released into the environment, and what are the toxicity issues?
- Can the contaminants resulting from decommissioning be completely removed e.g. from sludge, scale, sands and drill cuttings?
- Does oil and gas infrastructure (pipelines and jackets) increase productivity of key fish species and biodiversity generally?

A scan of existing literature showed that there is a body of knowledge about the effects of decommissioning that can be drawn from existing studies and from global experiences in more mature oil and gas provinces such as the North Sea and the Gulf of Mexico. However, the expert panel identified that much of this knowledge could not be readily translated to the Australian context, or that it should be validated in Australian conditions, with local data and conditions before being applied. This was particularly true for issues around environmental impacts and fisheries recruitment given the uniqueness of Australian marine ecosystems.

The quantum and multi-disciplinary nature of science questions, and prospective benefits of resolving uncertainties prior to the coming decades of decommissioning activity, suggests a strategic program of inter-dependent science projects led by end-users and developed through careful planning. However, any science program needs to be developed in the context of an agreed decision making framework representing decisions by companies, regulators and the community to ensure the science is targeted and scaled appropriately. Stakeholders were strongly supportive of an independent approach to developing the knowledge required.

Implications from this project

The implications that can be drawn from the development of this report are that:

- there are knowledge gaps that need to be addressed through science before decision makers and stakeholders are able to efficiently and effectively consider the full range of decommissioning options as a matter of normal practice
- confidence of short and long term environmental risk and/or acceptability of different decommissioning options is the overriding priority for stakeholders
- stakeholders are uncertain about some issues and processes that are actually well defined. These issues should be the focus of a dedicated communication activity to inform stakeholders
- on-ground stakeholders often do not feel they are appropriately consulted on matters such as decommissioning. Understanding their concerns, using material such as this report, and improved approaches by all consulting organisations are recommended
- a range of policy and management matters need to be resolved alongside any new scientific knowledge and in consultation with on-ground stakeholders. A clear policy framework that makes the complex legal framework clear will likely benefit progress towards a streamlined approach to decommissioning and consultation with stakeholders
- an integrated science program approach will be more effective and efficient in addressing uncertainties than individual project by project approaches and:
    - a clearly articulated decision making framework considering company, regulator and community/consultee decision making needs to be developed to ensure the detailed scope and scale of science is targeted and does not become excessive
    - should begin in the short term to ensure outputs are ready to be applied to upcoming Australian decommissioning activities in the next 5-10 year period
    - will have considerable stakeholder support and is independently led
    - must include stakeholders during planning, delivery and guidance development stages
    - may be more efficient if bundled with engineering studies
    - should be national in focus to cover all current and future decommissioning areas.
- the information gathered through this project is substantively relevant to other oil and gas provinces across Australia, however Western Australian stakeholder views must not be assumed to be the same as those from other regions, and similar on-ground consultation should be undertaken to inform any national approach.

1 Introduction

1.1 Decommissioning offshore infrastructure

When offshore oil and gas facilities reach the end of their economic life and are no longer producing, the Company must safely abandon all oil and gas wells and remove the associated equipment. There are a number of ways this can be achieved and range from: the complete removal of the infrastructure, partial removal of infrastructure, or it can be left in place. 'Decommissioning' is not defined in legislation however it means to 'take out of service' (Techera and Chandler, 2015) and is the common term for this activity.

In Australia, it is generally assumed that decommissioning involves the complete removal of offshore oil and gas infrastructure, however there is the opportunity to leave infrastructure in place under certain circumstances and where a clear case for environmental acceptability can be made (NOPSEMA, 2016; Department of Mines, Industry Regulation and Safety, 2017).

Over the next 10-20 years an increasing number of offshore oil and gas facilities around Australia will cease producing hydrocarbons and will require decommissioning. The process of decommissioning offshore oil and gas infrastructure is extremely expensive at a project level, and will become a major cost to the industry as a whole. Given this cost and the safety and potential environmental risks associated with complete removal, there is interest particularly from the oil and gas industry in being able to readily apply the full range of decommissioning options to the growing number of projects.

However, without broadly accepted knowledge about the environmental, social and economic effects of decommissioning options, decisions by operators and regulators may be based on more precautionary approaches, require expensive and duplicative project-by-project studies to develop necessary evidence, and/or require extensive consultation and negotiation during regulatory and stakeholder engagement processes. This adds significantly to the cost of operations.

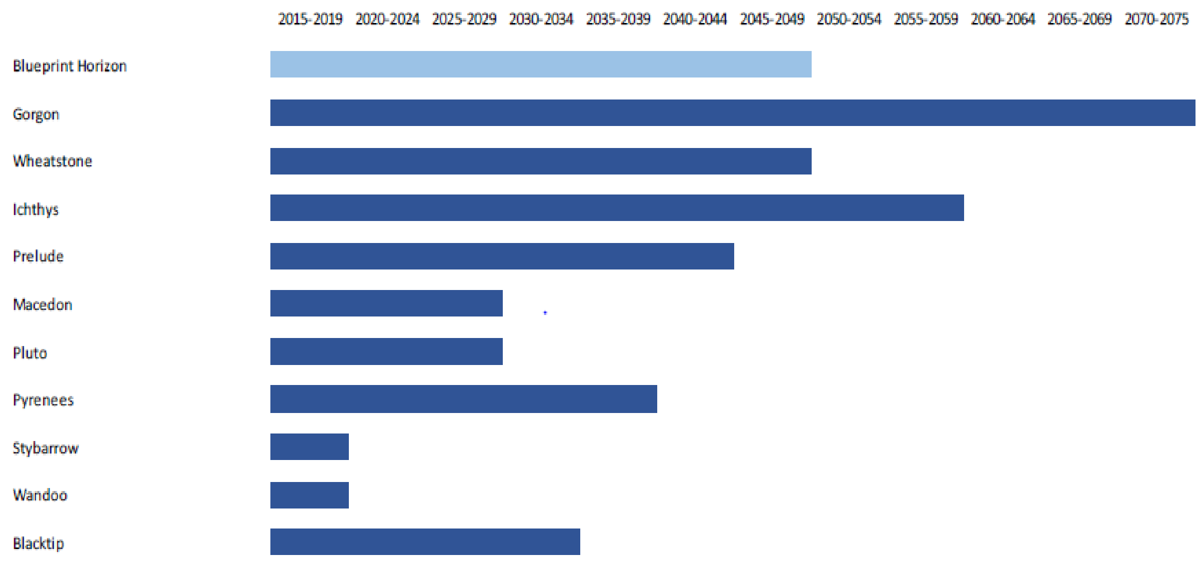


Figure 1. Expected operational life of selected WA oil & gas projects

(Source: The Blueprint for Marine Science Report 2050. Pg 47 Estimates taken from Company Annual Reports)

1.2 Summary of the regulatory framework

The legal framework for managing decommissioning is influenced by international, national and State or territory agreements and laws. Information Box 1 and Figure 2 show the extensive legislative framework that manages the physical and environmental aspects of decommissioning.

Despite this extensive legal framework, 'there is currently no clear policy guidance on whether in-situ decommissioning would be accepted and in what circumstances' (Techera & Chandler, 2015).

INFORMATION BOX 1: Legislation informing the process of decommissioning in Australia.

International Law
Geneva Convention 1958: anything abandoned or disused – notion of complete removal
UN convention on the Law of the Sea (UNCLOS) 1984 - constitution of the ocean & Freedom of the Seas in particular navigation
London (Dumping) Convention 1972 & Protocol 1996- included abandonment or toppling of platforms or other man-made structures at sea
National Law
Environment Protection (Sea Dumping) Act 1981
Environmental Protection and Biodiversity Conservation Act 1999
Offshore Petroleum and Greenhouse Gas Storage Act 2006
Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011
State – Western Australia
Petroleum Act 1936
Petroleum and Geothermal Energy Resources Act 1967
Petroleum (Submerged Lands) Act 1982

Given this lack of clarity and the fact that decommissioning in Australia is in its infancy with few examples of how processes and consultation have been undertaken, it is unclear if there is sufficient knowledge, policy and stakeholder support for alternative decommissioning options, i.e. leaving in-situ or partially in-situ, to become normal practice within the above regulatory framework.

This project was commissioned in part to determine the level of knowledge that is required for stakeholders to support this shift within the current framework. The process has, however, identified a range of policy issues that may also help identify opportunities to streamline or improve the current framework.

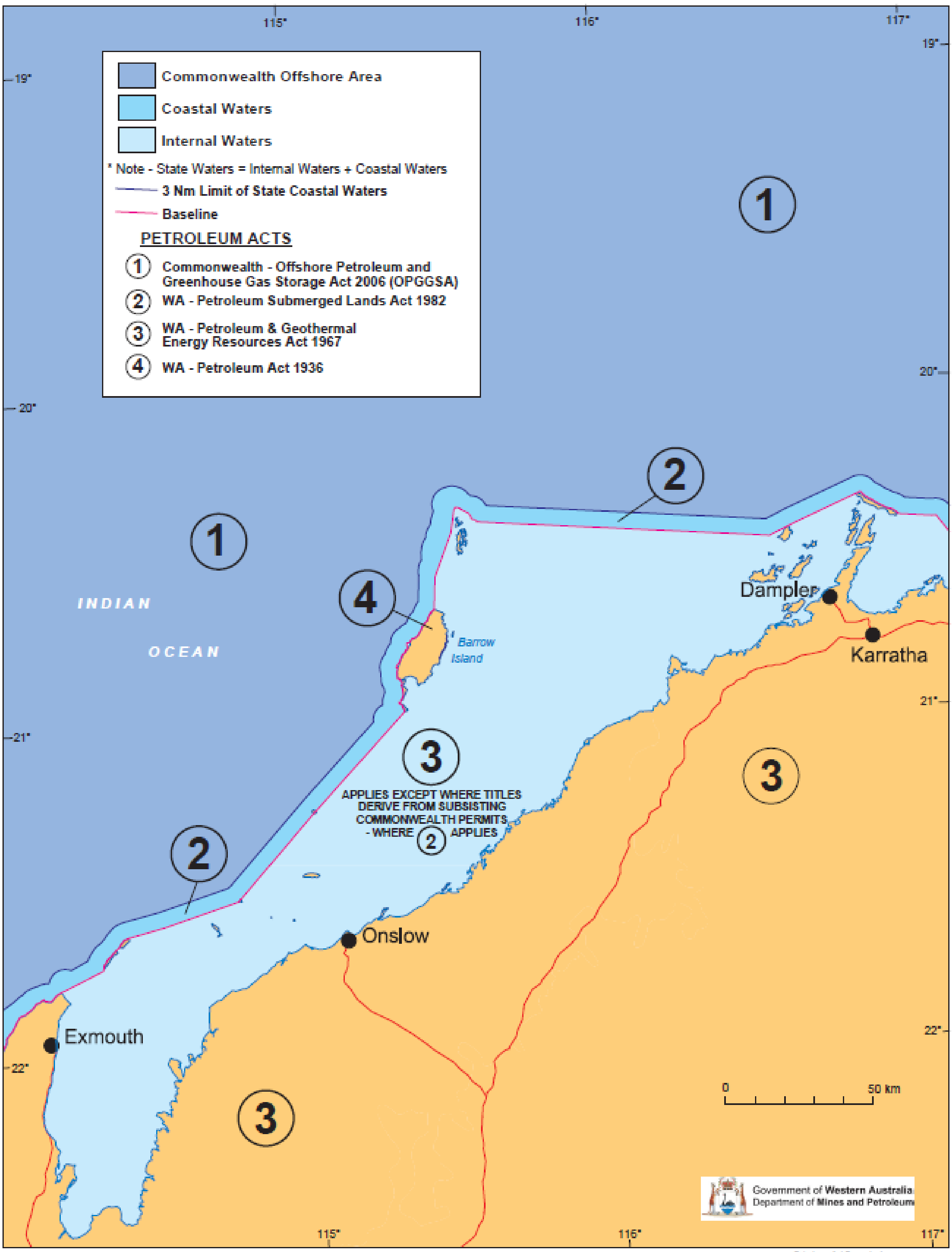


Figure 2. Relevant decommissioning legislation for State and Commonwealth waters of WA

(Source: Western Australian Government Department of Mines and Petroleum)

INFORMATION BOX 2: Decommissioning terms used in this report

There are a variety of terms relating to aspects of decommissioning. For the purposes of this report, the following terms are used:

Complete removal – the removal of all infrastructures above and below the seabed

Partial removal – the removal of some infrastructure only. This may range from:

- almost complete removal where infrastructure is removed to at or below the sea-floor, but foundations are left in place, through to
- minimal removal where topsides are removed and any navigational risks addressed.

Remain in-situ– infrastructure left in place, or toppled, after some level of removal

Reefing – the process of using decommissioned infrastructure to form an artificial reef in the expectation of some environmental, social or economic value. The infrastructure may be positioned in-situ (e.g. toppled in place) or placed elsewhere.

Decommissioning options – the full range of options described above

1.3 Business case for an improved evidence base

Decommissioning offshore infrastructure is an expensive process with individual projects for modest infrastructure costing in the 10s of $millions. They may also involve putting divers and other people in high-risk situations to remove infrastructure embedded in or on the sea floor.

The capacity of operators to minimise the cost and risk of decommissioning through the normal consideration of the full range of decommissioning options can be compromised because the community and decision-makers may not have confidence in the environmental or other effects these different options may have.

Further, it is not clear if stakeholders and the general community will support a shift in policy to regularly support options other than complete or near-complete removal. This is particularly true where a company is seeking a change in the existing legislation and/or a condition on a licence requiring full removal that was originally supported by the licensee and/or by stakeholders through consultation.

In this context, the primary outcomes for an improved evidence base are:

- Social licence for efficient policy and practice
- Improved regulatory confidence and reduced regulatory costs
- Prospective social and economic benefits from secondary uses of decommissioned infrastructure.

1.3.1 Social licence for efficient policy and practice

'Social licence' means that an activity has the ongoing support and/or acceptance of the community and other stakeholders to occur. As such, it is important that both policy and decisions are aligned with both social expectations, but are also cognisant of technical constraints and industry's capability to meet these expectations.

A key output from the Blueprint for Marine Science process was the need to ensure that the community and stakeholders had credible evidence about uncertainties they have about a particular marine activity, in this case decommissioning.

This would enable stakeholders to engage in policy formulation, or project consultation, from an informed position and avoid uncertainty or incorrect opinion driving either precautionary or risky policy or decision making.

If stakeholders support policy and decisions that enable the full range of decommissioning options to be considered, the savings to industry may be in the 10s of $million at a project by project scale and potentially in the $billions to the sector during the lifecycle of the Australian oil and gas sector.

1.3.2 Improved regulatory confidence and reduced regulatory costs for the public and industry

While regulatory agencies may be able to consider all decommissioning options, the cost of doing so on a case by case basis without any widely accepted evidence base that can be applied consistency between projects, may be prohibitive over the coming decades of decommissioning activity.

A similar situation occurred with dredging in Western Australia (WA). Estimates by the Office of the Environment Protection Authority (OEPA) and by the companies involved suggest an approximate cost of more than $250million for the environmental studies and monitoring required to enable the approval of four major dredging operations in the Pilbara, WA. This high cost was directly attributable to uncertainty in the ability to predict impacts of dredging on the marine environment and the need for regulators to fill the gap in that lack of confidence through high levels of management. In the absence of credible information about the implications of decommissioning options in the Australian context, it is anticipated that the regulation of decommissioning activities will result in a similar regulatory cost burden to avoid risk to the public interest.

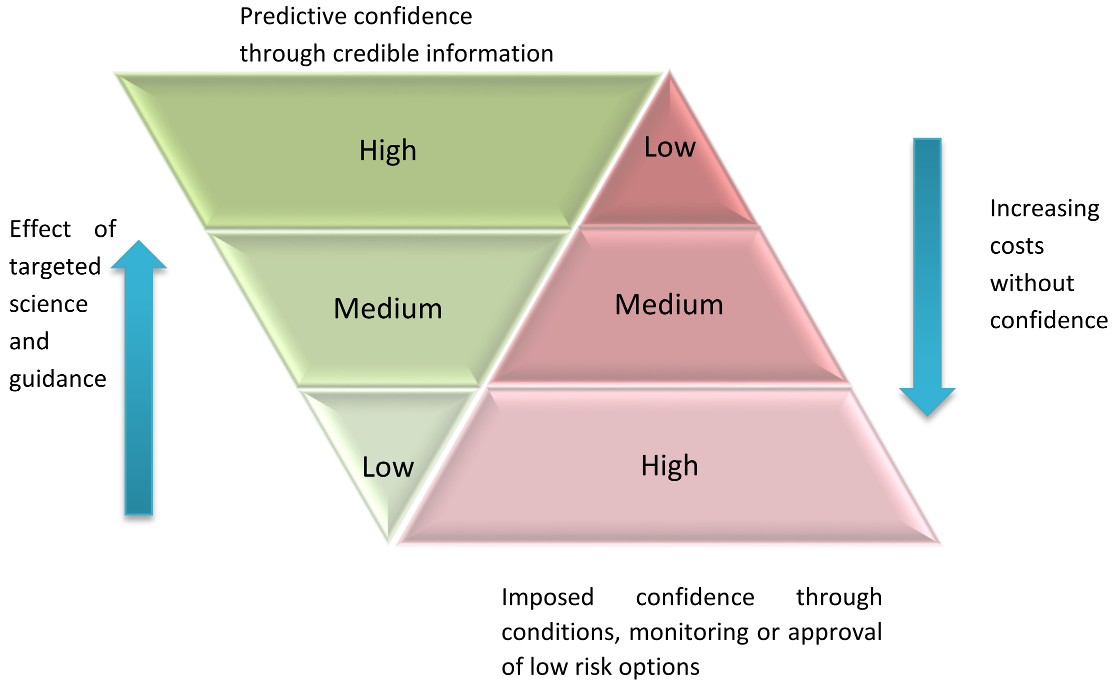


Figure 3. Relationships between knowledge and regulatory costs (adapted from R. Masini and the WAMSI Dredging Science Node program documentation)

Producing evidence, and guidance for its application, that is agreed by all relevant sectors will allow industry, stakeholders and the regulators to address issues more rapidly and ensure that well targeted monitoring and compliance activities are implemented.

1.3.3 Prospective social and economic benefits from secondary uses of decommissioned infrastructure

Decommissioning in Australia will often occur in regional areas where small changes to recreational and economic opportunities may have a substantial impact on the nearby regional community.

Initial advice from project partners is that the opportunities for tourism through diving, recreational fisheries and potentially enhanced productivity for commercial fisheries are all of substantial interest to local communities, tourism, recreation groups and regional local governments.

These benefits have been assumed based on the success of decommissioning in other parts of the world. A locally relevant evidence base to confirm and consistently quantifying these benefits would enhance the consideration of, and the likely delivery of these benefits, through policy consideration, and case by case decision making.

1.4 This project in context

The *Blueprint for Marine Science 2050* identified that credible knowledge on decommissioning operations (including cost savings) and any resulting environmental, economic, cultural and social impacts and opportunities should be a priority for the oil and gas industry as well as other marine stakeholders and regulators.

Following the *Blueprint for Marine Science 2050*, senior representatives of interested sectors joined the Premier's Marine Science Roundtable 2015 meetings and suggested that a joint project on decommissioning funded across sectors would make business sense to all parties. It was understood that this project, if delivered independently and in consideration of stakeholder concerns, would be more likely to influence regulatory policy and operational management of decommissioning. It would also exemplify a collaborative approach to marine science. The outcomes would enable a transfer of this knowledge to policy and decision-making organisations if required.

Consistent with the Blueprint approach, which was tested successfully in the WAMSI Dredging Node, this project is the first phase of a potentially three phase effort (Figure 4) to improve understanding of decommissioning strategies and provide tailored guidance and tools for related activities. A decision on subsequent stages will be made through the Blueprint Initiative after the completion of the project.

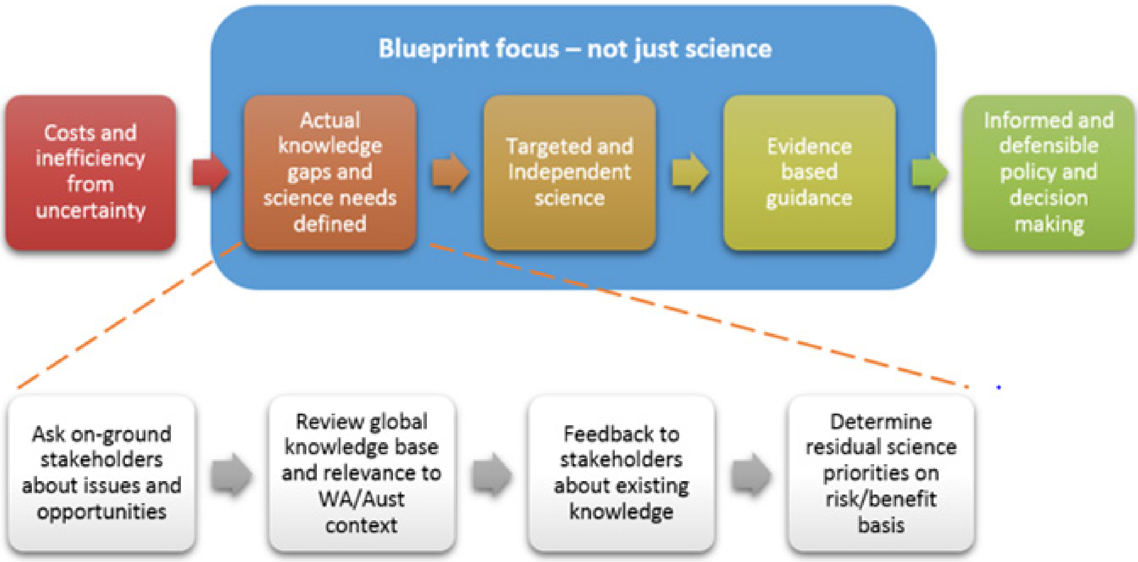


Figure 4. Blueprint science planning model – involving stakeholders at step one to ensure their support at the end

This particular project was commissioned to identify stakeholders, understand their issues, concerns and opportunities and identify if research had been undertaken elsewhere in the world that addressed the issues of uncertainty surrounding decommissioning.

This project is intended to enable the Blueprint participants to consider the value of a targeted and independent science program in delivering the outcomes identified in Section 1.3.

2 Approach

2.1 Project Scope

2.1.1 Objectives

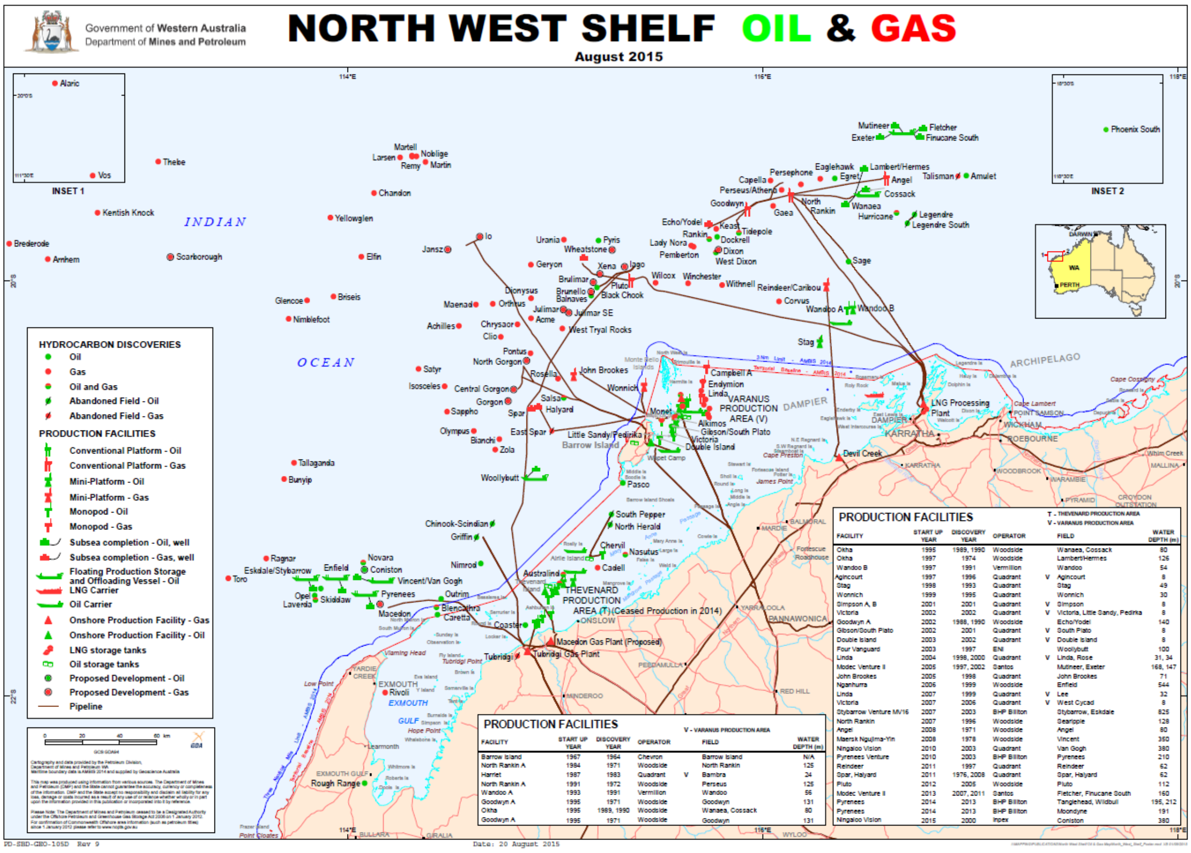
This project was scoped to deliver information into the first phase of a potentially ongoing Blueprint Initiative program. The objectives of this project were to engage with stakeholders to:

- Provide an independent forum for engagement and information sharing between all stakeholders on oil and gas decommissioning in the marine environment
- Document benefits, issues and the concerns of relevant stakeholders and community in regards to offshore infrastructure decommissioning
- Identify knowledge gaps, issues, opportunities and concerns that can be used to inform decommissioning activities
- Identify actual, prioritised and broadly agreed knowledge gaps to improve targeting of research investment
- Provide a forward plan to fill important knowledge gaps that will improve the confidence of stakeholders in understanding potential environmental consequences of different decommissioning options
- Build social licence showing the wider community a responsible, transparent and collaborative approach to resolving marine science issues and
- Provide a substantial resource that can contribute to similar stakeholder engagement processes in other parts of Australia.

2.1.2 Geographic scope

The area of the project included all Western Australian State and Commonwealth waters with a focus on the North-west and west coast (Fig. 5), the Timor Sea (Fig. 5), and a secondary focus on the south coast/Great Australian Bight. The water area under consideration was from the high water mark out to Australia's Exclusive Economic Zone (EEZ) or 200 nautical miles from the baseline.

Activities in other Australian oil and gas provinces (e.g. Victoria) were not included as it is not appropriate to assign the values of WA stakeholders to another state. It is anticipated, however, that there will be substantial cross over and this work may contribute to processes in other areas of Australia.



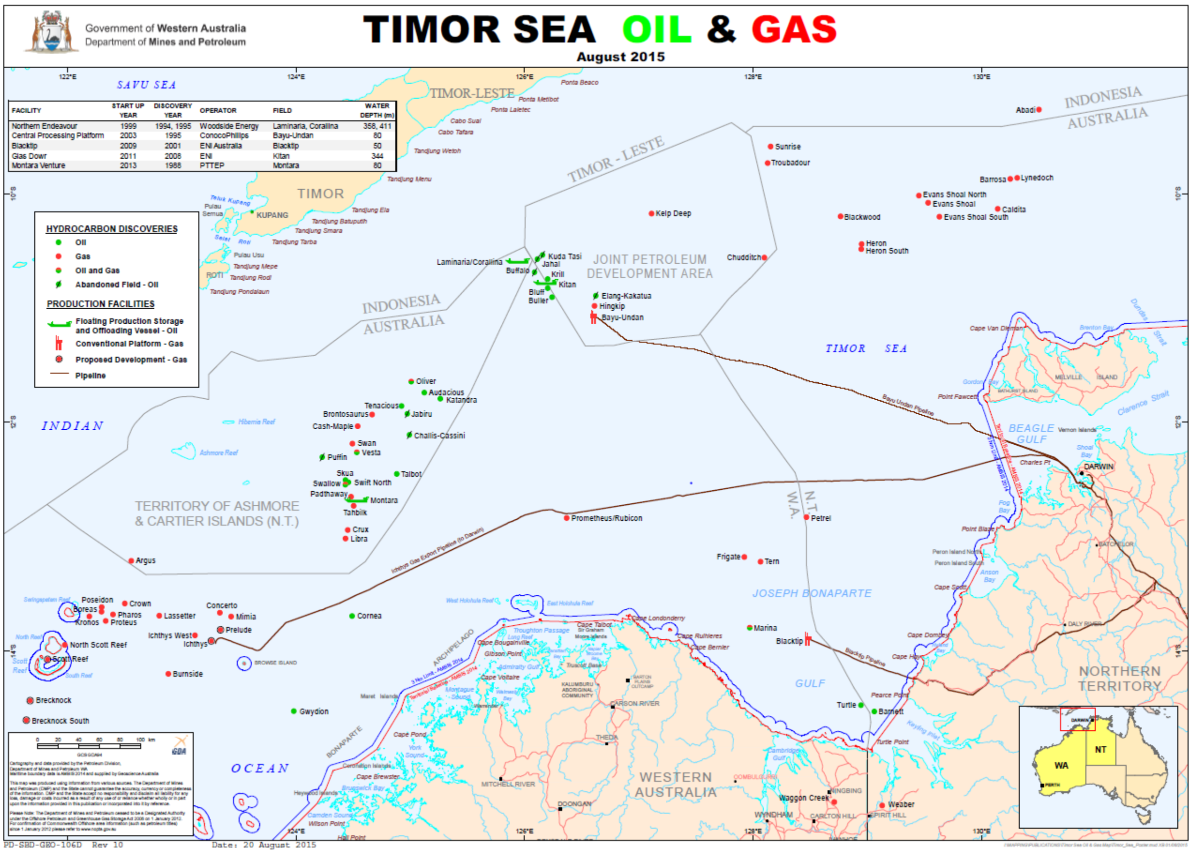


Figure 5. Existing and proposed oil and gas infrastructure in the North West Shelf and Timor Sea (Source: Department of Mines and Petroleum now DMIRS)

2.1.3 Infrastructure

Infrastructure in the project included:

- Platforms
- Pipelines (and any protection such as armouring)
- Wellheads
- Other subsea infrastructure.

Terrestrial activities such as coastal processing or production facilities, jetties, wharfs and waste treatment facilities were not included.

2.1.4 Impacts and opportunities

All direct environmental, social, cultural and economic impacts were considered where they were likely relevant to most decommissioning processes. This project, and subsequent science activities, needs to provide the understanding and protocols to underpin a more informed approach to the decisions that are likely to occur at all, or the vast majority of, decommission projects.

Although the liability of infrastructure is an important issue, this was not within the scope of this project, however was noted during stakeholder discussions. Engineering costs were not to be considered.

2.2 A multi-sector led, but independent, project

This project was delivered as part of the Blueprint for Marine Science Initiative, by the Western Australian Marine Science Institution, supported by a steering group consisting of: Recfishwest (recreational fisher's representative organisation), WAFIC, APPEA, NERA, WAMSI, NOPSEMA, the WA OEPA and other WA State Government representatives.

The Blueprint Initiative recommends projects under its banner are guided by multi-sector teams and delivered independently to ensure:

A. Shared ownership of outcomes: The process is proposed to have input from all stakeholder groups to ensure support for, and adoption of, the findings. It will also maximise value from the project outputs.
B. Independent and transparent: Evidence developed internally by interested parties does not necessarily result in acceptance of that evidence by other stakeholders or the community. Undertaking a review process that is at arm's length but guided by the various sectors that are end-users from oil and gas, fisheries, government and community will ensure the findings are defensible and build trust and enhance public acceptance in commercial industry activities.
C. Improved targeting of science: The project will identify what science is important to improving the approach to decommissioning strategies. Through a review process and science planning that considers perceived versus real knowledge gaps, and identifies if more science or policy and consultation is the constraining factor on improved approaches. The resulting investment in science decommissioning will be highly efficient.
D. Multi-purpose: The project will combine both environmental, some operational (e.g. physical conditions effecting decommissioning strategies) as well as inter-industry effects (e.g. fishing activities). These will be undertaken concurrently rather than through several individual studies, saving time and costs.

2.3 Project Progress

This project focussed on the delivery of knowledge gaps by ensuring that stakeholder interests were the primary driver for what knowledge is required. Experts from the operational, regulatory, policy and research sectors of decommissioning activities were able to address those knowledge gaps.

The process followed is:

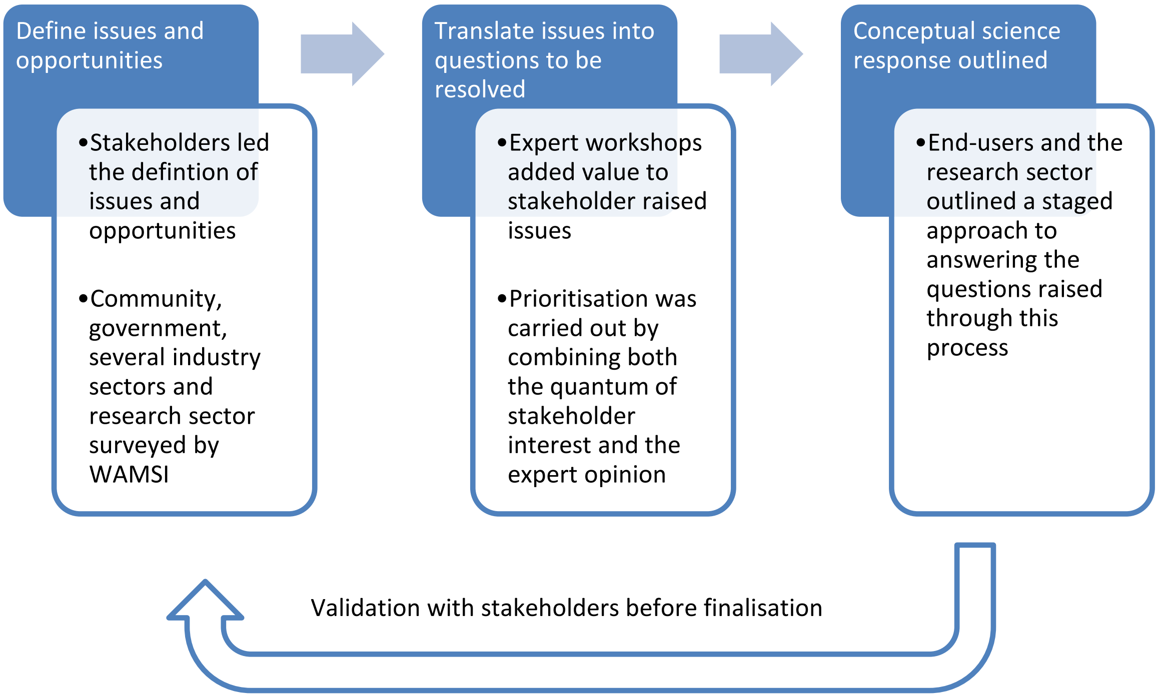


Figure 6. Project process

2.4 Limitations of the project

This study and the existing Blueprint project were specifically scoped not to address policy issues such as who holds the liability for partially decommissioned or reefed infrastructure). This matter is critical to any policy shift, but relates to a range of taxation, legal and safety issues.

It is important to note that while outside the scope of the Blueprint for Marine Science, in the extensive consultation delivered, these matters were considered particularly significant to stakeholders (refer Section 3.1.8). As such, all policy and management issues raised by stakeholders have been provided to the relevant sectors and authorities to progress further.

A range of other matters were also raised by stakeholders including structural engineering and process issues. These are critical for the range of decommissioning options and require further consideration, however were not addressed in this project (refer Section 6).

3 Stakeholder issues and knowledge gaps

3.1 Stakeholder engagement

3.1.1 Background to Stakeholder engagement

The WA Marine Science Blueprint Initiative is an end-user driven strategic framework to ensure a strategic approach to marine science that supports industry, the community and government. Part of this approach is to identify the knowledge needs of the community and especially those users of the marine environment with particular interest in each of the priority marine science themes identified in the Blueprint for Marine Science 2050 Report (WAMSI, 2015). Improving the transfer of knowledge and spanning the boundaries between the community, scientists, industry groups and decision makers is also implicit within the Blueprint initiative.

The WAMSI decommissioning project involved engaging a broad cross-section of stakeholders to better understand their issues, concerns and opportunities with the decommissioning of marine oil and gas infrastructure. It was also tasked with identifying existing knowledge gaps, validating these issues against a review of international literature and subsequently prioritising the outcomes (Section 4). A Steering Group made up of representatives from the project partners provided project oversight.

This action research project (Tacchi et al., 2003) used a qualitative methodology (Bryman, 2008) with participatory workshops and one-on-one semi-structured interviews (Patton, 1990) throughout the process. Workshops and interviews were recorded for any future clarification of information.

3.1.2 Important factors in stakeholder engagement

Stakeholder consultation and knowledge exchange can be challenging with numerous approaches outlined in the research literature (Cvitanovic et al., 2015; Nursey-Bray et al., 2012; Pecl et al., 2009). In the marine and fisheries sector, additional challenges have been identified because of the difficulties in accessing stakeholders, including: timing, location and other industry priorities (Shaw, 2014; Nursey-Bray et al., 2012; Pecl et al., 2009). Cultural differences also play an important role in understanding engagement processes and knowledge exchange (Cvitanovic et al., 2015) as does the identification of different cultural models between, for example, fishers and scientists (Stocker and Shaw, 2016).

As the stakeholder group was assumed to be extensive and included a large number of sectors (Table 1) a combination of approaches were used (Clarke et al., 2013; Cvitanovic et al., 2015; Shaw et al., 2013) to maximise the effectiveness of the process and increase the credibility of the outcomes.

The engagement process and knowledge exchange had to span a number of well-defined boundaries, for example between community members, scientists, the oil and gas industry, State and Commonwealth decision–makers as well as State and Commonwealth regulators. Because of the diversity of stakeholders and the sometimes controversial issues associated with the oil and gas industry, the methods were primarily structured using the principles of boundary organisation theory (Cash et al., 2006; Guston, 2001; Shaw et al., 2013; Clarke et al., 2013).

3.1.3 WAMSI as an organisation for effective stakeholder engagement

There are a number of factors that are considered important for effective stakeholder engagement. Described in the literature cited above, a capacity for convening, collaborating and translating information is particularly important.

In this context, 'convening' is understood to mean the capacity of an organisation to bring people together. Since being established in 2006, WAMSI has played the leading role in WA in bringing marine science research providers together to undertake the science and disseminate this knowledge to both the decision makers and stakeholders.

Another important factor is 'collaborating'. In this context collaborating can mean the co-production of knowledge or bringing knowledge together from different organisations. WAMSI has successfully achieved this with its collaborative Science Nodes.

The 'translation' or interpretation of marine research information into content that is readily accessible by decision-makers and the community has also been part of the WAMSI objectives and successful outcomes.

Importantly for this project, WAMSI is an independent unincorporated joint venture with multiple partners (http://www.wamsi.org.au/partnership). WAMSI has been established as an independent organisation and is perceived that way by stakeholders.

While the organisation undertaking stakeholder engagement fulfils an important role, the individuals actually participating in the engagement are also critical to the effectiveness of any interactions.

Throughout this process, WAMSI engaged a specialist in stakeholder engagement who was considered to bring salience, credibility and legitimacy to both the issue of decommissioning as well as the stakeholder groups. Although these attributes are described in the literature above (Section 3.1.1 and 3.1.2), 'salience' in this context responds to the question of relevance and importance to the stakeholder's industry or livelihood: is the individual or interviewer familiar with the sector and or the community, do they have the capacity to ask the right questions, and are the questions in the correct context and relevant to the stakeholders?

'Credibility' and trust goes to the heart of effective engagement. Is the shared information credible and is the individual concerned trusted? Does the individual respect and value the stakeholder's position, and in this project, does the individual appreciate and value the small coastal communities associated with the majority of the offshore oil and gas developments?

'Legitimacy' brings together credibility and salience. It is also understood to be the perception of fairness and lack of bias (Clark et al., 2013) in the interviewer. If the individual is perceived to have legitimacy by the stakeholders they can often provide strong linkages to the community and the stakeholders.

3.1.4 Identification of stakeholders

Potential stakeholders (190) were identified by the project partner organisations, other representative agencies, community groups, previous networks and snowball sampling (Goodman 1961; Walter, 2010; 2013).

The stakeholders that were identified, represented individuals and groups from the following sectors:

- State and Commonwealth Departments
- Research organisations
- Fishers
- Tourism
- Conservation
- Indigenous
- Other community.

Contact details were provided and, in some instances, more appropriate personnel were recommended.

Individuals were contacted, the project explained to them, and they were then invited to participate in the project. Contact was made by phone and email. Interviews were carried out with individuals, in workshops, or by phone.

3.1.5 Information and discussion paper

A brief information paper (Appendix 3) was developed to send to all participants prior to any discussion. The information paper provided a brief background and outline of the project, including the scope and location of the project. An overview of the options for decommissioning offshore oil and gas infrastructure was given as well as brief descriptions and illustrations of the general types of infrastructure found in Australia. The paper was a short introduction with basic information only, however it was used to provide some background to further discussions and to outline the future steps of the project. More than 150 copies of the information paper were sent to stakeholders and in many case these were re-sent out by the organisation representatives to their members for feedback on the topic.

3.1.6 Sharing of information

Interviews and workshops were held in Perth, Exmouth, Dampier, Karratha and Port Samson. More than 120 individuals participated and of these, a number were representing large organisations.

Table 1. Stakeholders, participants and representatives

Representative Group	Number of Individuals	Group / affiliations
Commercial fishers	21	WAFIC, PPA, Trawl, Trap, Line, Mackerel, Aquarium fishers
Recreational fishers	21	Recfishwest KBGFC, EGFC, WAGFA, NBSFC
Tourism	8	Ex Visitors Centre, FTOL, other operators including accommodation providers, charter operators
Community – LGA, RDC	6	PDC, GDC
Community – Chamber of Commerce	9	KDCCI, ECCI, Marine service providers, small business operators
Conservation	5	CCWA, CCG
Indigenous	1	MAC
Government regulators	4	DMP, NOPSEMA
State Government Agencies	15	DoF, DMP, Transp, OEPA, DPaW, Pilbara Ports
Commonwealth Government Agencies	10	AMSA, Agri and Water, Dept Env, DoIIS, DoIRD, GA, AFMA
Science	18	AIMS, UWA, CU, CWR

Please note the numbers in Table 1 are understated by sector as there was considerable cross over e.g. with local government workers representing recreational fishing groups and conservation members being small business operators etc

The structure for each interview and workshop was similar. A PowerPoint presentation was developed which expanded on the information outlined in the discussion paper and also provided a summary of legislation relevant to decommissioning in WA. Examples of decommissioning experiences in other jurisdictions were also illustrated.

Discussions, questions and information-sharing generally occurred throughout the interviews and workshops. Notes were taken and all engagements were recorded for any later clarification of issues. The following prompts were used as thought-starters if discussions had been limited or of a single focus:

- Environment
- Shipping and navigation
- Fishing
- Tourism
- Depth, location and weight
- Waste
- Safety and technical feasibility
- Disposal / recycling / reuse
- Research and education.

More than 900 issues, gaps and opportunities were captured from the stakeholder engagement process. These issues were roughly sorted into the themes listed above. A large number of stakeholders raised additional issues related to the management of future decommissioning and concerns with the oil and gas industry operations. These issues are not included in the scope of this project, however will be passed on to the relevant organisations, Departments and industry groups.

The summary of issues raised by stakeholders is shown in Appendix5.

Issues relating to relevant outcomes from the stakeholder engagement approach included:

- Strong willingness to be engaged in this and similar Blueprint processes, provided consultation is genuine and inclusive
- Support and willingness from stakeholders for being engaged by an organization independent of government and industry and scepticism about alternative approaches
- Preference, by fishers, for being engaged by individuals with an operational background in their sector
- Scepticism by some stakeholders, including government officers, of reviews directly commissioned by the oil and gas sector or their advocacy groups
- Advice that one-off and written consultation processes used by the oil and gas sector and some government agencies does not allow for genuine engagement by many of these stakeholders
- A limited understanding about matters they are being consulted on, in this case the specifics of decommissioning, and therefore their capacity to comment
- Universal interest from stakeholders in continuing to be engaged in this process
- The capacity for many stakeholders, even informed stakeholders, to define scientific and researchable knowledge gaps is limited.

Some of these findings, particularly regarding capacity to engage and the consultation approach, may raise questions about the validity and efficacy of consultation activities in regulatory and /or policy development processes.

The lack of capacity for some stakeholders to define specific issues supports the staged approach to this project and the multiple opportunities for these stakeholders to validate each stage to both enhance their ability to engage on this issue, but also ultimately support the recommendations for science prioritization.

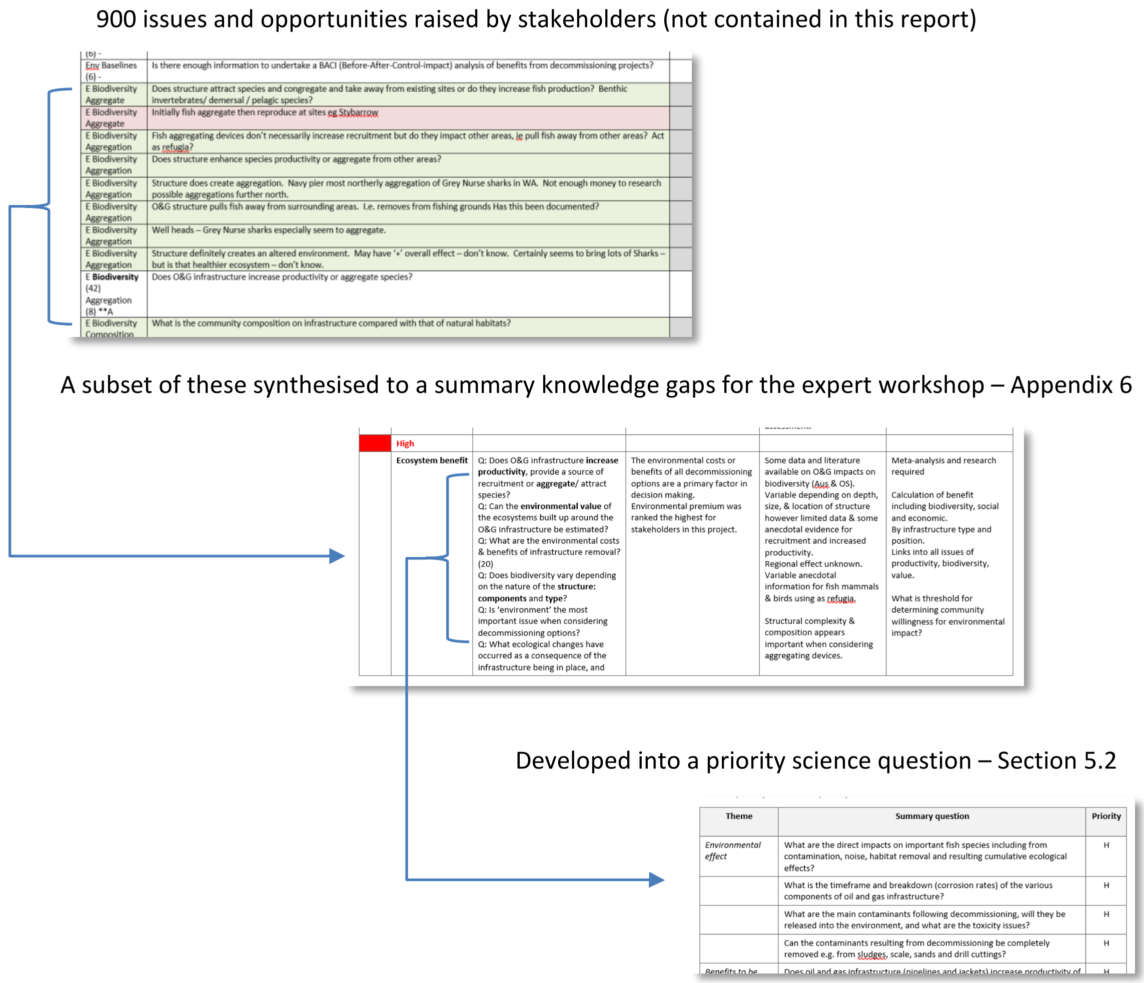


Figure 7. Simple flow diagram illustrating engagement and synthesis process

3.1.7 *Issues by sector*

A large number of stakeholders and representative groups participated in workshops and interviews (Table 1) and shared their views on decommissioning. Although the sampling was not designed to quantify responses by sector, some generalisations can be made from the data collected. For example: most sectors were concerned about the environmental risk of all aspects of decommissioning.

The environmental premium appeared to be the most important consideration for future decision making. Recreational fishers and some commercial fishers were happy to have structures left in place if there were productivity and ecosystem benefits resulting in increased fishing opportunities. Navigation issues, safety and liability were significant – particularly for marine operators and fishers. Fishers were also concerned about resource sharing issues. Small business operators, local government and regional development authorities placed a greater emphasis on economic benefits of alternative decommissioning strategies, particularly at the local community and regional level. Liability and future management of structures as well as any flow-on benefits from cost savings was an issue frequently raised across all sectors (Appendix 7 – Policy and Management issues raised by stakeholders). Tables 2 summarises the main issues raised by each of the stakeholder groups, highlighting the themes of environment, navigation and safety, economic issues, corrosion, pollution and contamination, opportunities and policy and management issues.

Table 2. Summary of the main issues raised and their primary relevance to each of the representative groups

Main Issues	Commfishers (A) [1]	Commfishers (B) [2]	Rec fishers[3]	Tour.[4]	Comm. (A) [5]	Comm. (B) [6]	Cons.[7]	Ind.[8]	State Govt[9]	CommGovt[10]	Science Agency[11]
Environmental issues - productivity, impacts, invasive species	X	X	X	X	X	X	X	X	X	X	X
Safety and risk issues - navigation hazards, issues relating to hook-ups, visibility		X	X			X			X	X	
Maintenance issues - corrosion/contamination, stability, pollution, end of line responsibility, liability for ongoing maintenance	X	X	X		X	X			X	X	X
Resource sharing issues –competing sectors, exclusion zones, information transparency, flow on benefits from cost savings	X	X	X	X							
Opportunities for future uses, reefing, tourism development, accommodation	X		X	X	X						X
Economic issues - opportunities (business), liability				X	X	X			X		X
Aesthetics and accessibility				X							
Case by case considerations	X	X						X			
Recycling							X				
Connectivity and interrelationships - environmental, social, cultural and economic - all options of decommissioning					X	X		X			X
Community acceptance of decommissioning approach									X	X	X

Legend for Table

[1] Commercial fishers (WAFIC, PPA, Trap, Line, Mackerel, Aquarium fishers)

[2] Commercial fishers (Trawl fishers)

[3] Recreational fishers (Recfishwest, KBGFC, EGFC, WAGFA, NBSFC)

[4] Tourism (Ex Visitors Centre, FTOL, other operators including accommodation providers, charter ops

[5] Community – LGA, RDC (Dampier, Exmouth, PDC, GDC)

[6] Community – Chamber of Commerce (KDCCI, ECCI, Marine service providers, small business operators)

[7] Conservation (CCWA, CCG)

[8] Indigenous (MAC)

[9] State Government Agencies (DoF, DMP, Transp, Pilbara Ports, OEPA, DPaW

[10] Commonwealth Government Agencies (AMSA, Agri and Water, Dept Env, DoIIS, DoIRD, GA, AFMA)

[11] Science (UWA, AIMS, CU, CWR)

3.1.8 Issues relating to the policy of decommissioning

A more comprehensive list of stakeholder policy and management issues is available in Appendix 8. It is understood that the policy issues identified by stakeholders are as critical as some of the bio-physical issues and require consideration by the appropriate management and regulatory agencies. These issues will be sent to the relevant management and regulatory sector to be progressed and resolved.

The key non-scientific issues that may need to be addressed to support orderly decommissioning activities include:

- Liability, including future environmental and navigation issues
- Resource sharing between commercial fishers, recreational fishers and conservation
- Opportunities of enhanced fisheries and or habitats created
- Consideration that any science program should improve the fundamental knowledge of decommissioning effects and underpin an improvement across all assessments
- Concern that when resource companies are on-sold, the capacity and resources for complete removal or other costly decommissioning options may not be available.

These issues are not further considered in this document as they are not part of the project scope. Despite this they are considered important and will be further considered in the development of the future science planning process.

4 Relevant existing knowledge

Although decommissioning is part of the lifecycle of offshore oil and gas developments, the prospect of decommissioning thousands of oil and gas installations around the world has generated considerable engineering, scientific, policy and opinion pieces on the various options and aspects of decommissioning. Significant amounts of the data and literature generated has come from the UK and USA (http://www.insitenorthsea.org/) – with particular focus on assets in the North Sea and the Gulf of Mexico.

Although Australia has decommissioned a number of oil and gas facilities (Appendix 2, there is very little data available on the operational aspects, environmental conditions and almost no scientific literature or accessible information on the outcomes.

As part of this project, and to better understand some of the questions and issues about decommissioning raised by industry and stakeholders, APPEA commissioned a review of international scientific literature to seek out information, technical studies and examples of issues pertaining to aspects of decommissioning (APPEA, 2017). The issues included:

- Decommissioning options and techniques for oil and gas infrastructure
- The impacts of oil and gas infrastructure on marine biodiversity
- The risk and benefits of decommissioning options to biodiversity, fisheries, shipping, tourism, and human health
- Potential management controls and monitoring considerations for decommissioning; and
- Frameworks for the assessment of decommissioning options.

The report accessed generic data from around the world and also sought expert opinion from the Decommissioning Ecology Group with regard to the influence of oil and gas infrastructure on marine biodiversity.

The report (APPEA, 2017) provides a summary of available information on aspects of decommissioning particularly the risks and benefits of decommissioning options to biodiversity, fisheries, shipping, tourism and human health. The document does cover a number of the issues raised by stakeholders during the engagement process and is an excellent background document for future stakeholder engagement.

Given the issues raised by stakeholders and prioritised by regulators, industry and research, it is likely that further more detailed reviews will be necessary prior to the commencement of any future science program. As in the WAMSI Dredging Node (http://www.wamsi.org.au/dredging-science-node/dsn-reports), extensive reviews of existing international literature were completed during the initial phase of each project. The dredging reviews, combined with a comparison against confidential local data provided by industry, allowed for a thorough assessment of the suitability of global evidence in relation to the Australian context. It enabled the subsequent finessing of experimental design to deliver directly applicable outputs, and the level of confidence required by regulators and industry to be worthy of adoption. The result was a concentrated and collaborative scientific effort which generated world class outcomes, specific to Australian dredging issues.

For this project, the Decommissioning Project Steering Group recommended a review stage similar to that of the Dredging Science Node be included in a prospective science program. It will enable a focus on data that can be transposed in to the Australian context. This form of review is a substantial undertaking and outside of scope for both this and the APPEA report described above.

INFORMATION BOX 3: What can happen in the absence of collaboration, consultation and effective engagement?

Brent Spar was a North Sea oil storage and tanker loading buoy in the Brent oilfield. It was owned by ESSO and Shell and operated by Shell UK. In 1991 it was considered to have no further value and was therefore to be decommissioned. The Brent Spar was 147m high, 29m in diameter, and displaced 66,000 tonnes.

Disposal options were evaluated in compliance with national and international regulations. The Best Practicable Environmental Option was developed and the UK government issued a Licence for its disposal at sea. The Company chose the deep sea disposal option on the basis of three main criteria: safety, cost and environmental impact. The site was approximately 250km from the west coast of Scotland in 2.5km water depth.

In 1995 Greenpeace mobilised a world-wide, high-profile media campaign against the plan, including widespread boycotting of Shell service stations. Greenpeace protestors occupied the Brent Spar for over 3 weeks. In the face of huge public and political pressure, Shell decided to withdraw their plan to sink Brent Spar. It was dismantled and partially re-used for a Harbour extension in Norway. During the dismantling, an endangered cold-water coral was found growing on the platform legs.

It is estimated that the final cost to Shell was between £60m – £100m (~ AUS$160m).

Issues:

- Shell failed to communicate their plans sufficiently to the public
- Shell had severely underestimated the strength of international public opinion
- Greenpeace over-estimated the quantity of oil remaining in the storage and loading buoy, and
- Greenpeace were also criticised for their lack of interest in facts.

Images of Brent Spar and the protest surrounding its decommissioning. Images obtained from the internet.

SOURCES:

Abbott, A. (1996). Brent Spar: When science is not to blame. Nature 380.6569: 13-14.

Fisheries Research Services. (1995). Case Study: Brent Spar. FRS Marine Laboratory, PO Box 101, 375 Victoria Road, Aberdeen. AB11 9DB UK.http://pixbox.co.uk/ct/downloads/Shervin_Setareh-Brent_Spar_Case_Study-1995-Questions.pdf

5 Science priorities

5.1 Framework for prioritisation

The prioritisation was completed in workshops that included experts from the regulation, industry, management and research sectors involved in different aspects of decommissioning (Appendix 6). The people involved well placed to identify how the different stakeholder identified questions, once addressed, would improve regulatory and operational processes and therefore their relevant priority.

Prioritisation was completed by considering the questions derived from stakeholder engagement against a framework of value provided by answering those questions. The framework considers the value in the context of drivers drawn from the Blueprint Implementation Strategy of:

- efficient and effective policy and regulation
- cost efficiency for industry
- social licence to operate for both industry and government
- multi-sector benefits from improved approaches.

The prioritisation framework outlined in Table 3 below was guided, informed and underpinned by the knowledge provided by the expert panel involved in the workshop. Clearly, the consensus agreement among the expert panel was that this project needs to provide an evidence base to support informed policy debate and decision making processes.

It should be noted that there is a clear interrelationship between Blueprint projects and policy development. This interrelationship can be defined as providing a clear pathway of uptake to the management processes that operate within State and Commonwealth governments. It is not the role of Blueprint projects to develop policy that is clearly the role of government departments and regulatory authorities. However, it is clearly the role of Blueprint projects to inform policy, encourage debate and provide evidence to underpin reform and to provide direct advice and input into decision making processes. It is by providing this information that Blueprint projects will provide a direct pathway into management, as the relevant government agencies and regulators are involved directly in the Blueprint project steering groups.

Table 3. Prioritisation framework

Priority	Value	Driver	Type of science activity
Higher priority	Science to inform a review of the precautionary 'extensive removal' policy application that is evidence-based and credible to stakeholders	Efficient and effective policy and regulation Social licence to operate for both industry and government	Research proving the environmental and navigation impacts of decommissioning strategies are acceptable
Moderate priority	Science to underpin claims in 'cost-benefit' assessment of comparative decommissioning strategies	Cost efficiency for industry Multi-sector benefits from improved approaches	Research underpinning calculations of the social and economic value-add from different decommissioning strategies
Lower priority	Science that will assist industry and regulators making decisions	Efficient and effective policy and regulation	Science to support operational efficiencies
Communication priority	Areas where evidence exists and is generally accepted, so new science is not a priority, but some stakeholders are not aware of it	Social licence to operate for both industry and government	Science communication

5.2 Questions for science

The general application of the above prioritisation framework resulted in the priorities for science as described in Table 4 below.

Table 4. Summary of questions raised and prioritisation category

Theme	Summary question	Priority
Environmental effect	What are the direct impacts on important fish species including from contamination, noise, habitat removal and resulting cumulative ecological effects?	H
	What is the timeframe and breakdown (corrosion rates) of the various components of oil and gas infrastructure?	H
	What are the main contaminants following decommissioning, will they be released into the environment, and what are the toxicity issues?	H
	Can the contaminants resulting from decommissioning be completely removed e.g. from sludges, scale, sands and drill cuttings?	H
Benefits to be realised	Does oil and gas infrastructure (pipelines and jackets) increase productivity of key fish species and biodiversity generally?	H
	What are the economic benefits to local and regional communities for all options of decommissioning?	H
	What types of infrastructure maximises benefits for fishing and other recreational activities?	M
	Can existing infrastructure be enhanced to optimise fishing and other recreational activities?	L
	Are there alternative opportunities for decommissioned infrastructure (e.g. tourism, recycling, reefing elsewhere)?	L
Risks	What are the navigation issues with regards to options other than ‘full removal’?	H
	Is there connectivity between structures and does this provide ‘stepping stones’ for introduced marine pests?	H
	Do introduced marine pests colonise oil and gas infrastructure more readily than natural structures?	M
	Does oil and gas infrastructure act as refugia (fish, mammals, birds) and what are the risks to these species on removal?	L
	Over time, what are the risks of ‘toppled’ or ‘reefed’ structures becoming unstable or moving and creating hazards for trawlers, other vessels and recreational interests?	H
	What are the human health and safety issues associated with decommissioning?	L
Management	What is an agreed approach to quantifying the benefits of decommissioning options?	H

	Is it possible to measure the cumulative regional impacts of decommissioning options?	H
	Are there efficient and effective monitoring processes to gauge effects of decommissioning options over time?	M
	If there are cost savings for decommissioning options (e.g. reefing), will there be flow-on benefits for the community?	M
	Are there management processes in place to deal with resource sharing issues with various decommissioning options?	L
	Will the future design of offshore infrastructure be informed by a range of decommissioning options?	L

Where H = high priority, M = medium priority and L = low priority

The stakeholder priorities defined in Table 4 above, are informed and driven by what stakeholders wanted to know. In this regard, the data is skewed by the number of times an issue was raised by stakeholders. These issues are at the forefront of stakeholder perceptions as they have been raised on multiple occasions. These were considered by the expert panel at the prioritisation workshop. While some of these issues clearly need new science undertakings, others simply require the provision of advice in the form of information to satisfy the needs of stakeholders. While much information is known there is no clear dissemination process to inform the relevant stakeholders. This gap in communication needs to be addressed by this project.

Underpinning questions

Considering the above summary questions derived from stakeholder consultation, experts have defined several more questions that need to be answered first to allow work on the above priorities. These underpinning questions include:

- What are the corrosion/deterioration rates and outputs of industry-standard materials?
- What is the connectivity between ecosystems and in-situ infrastructure and /or reefing sites?
- What physical forces (e.g. currents and storms) affect stability and connectivity related effects in key decommissioning and reefing regions?

6 Prospective science program to address the priorities

The level of uncertainty outlined in previous chapters, alongside the potential cumulative cost of this uncertainty in future decommissioning processes, suggests a strong case for a strategic scientific response. To assist subsequent stages of science planning the project Steering Group has outlined the pre-conditions for a highly valuable program, a conceptual approach to guide detailed planning, and potential options for resourcing an at-scale program.

6.1 Pre-conditions for a useful science approach

The Blueprint Initiative identifies that science in response to its issues should be end-user led but independently delivered, targeted, informed by sharing data between participants, strategically funded, and couched in international efforts.

The WAMSI Dredging Science Node has been identified and has demonstrated the major additional value of low-cost collaborative governance and data arrangements being resolved prior to science planning. This reflection has been used to shape the following recommended pre-conditions in Table 5 below.

Table 5. A Decommissioning science model adapted from learnings in the WAMSI Dredging Science Node

Collaborative and credible response	The breadth of science suggested through this report will benefit from a collaborative approach utilising the best capability from multiple research and science organisations. While the vast majority of prospective decommissioning activity, and oil and gas industry focussed science capability is off Western Australia's coast, other science institutions around Australia should be explored to ensure the best capacity available responds to this issue. This must be delivered with in-built end-user (balanced between industry and public interests as per the Dredging Science Node) leadership of scope and quality to ensure a focus on applicable outcomes. Independent oversight of the science is required to ensure there is no perception of bias towards any particular end-user.
Detailed and resourced science planning	Care should be taken in the detailed design of research projects because of the highly interdependent nature of uncertainties and the need to ensure multiple science activities across disciplines are integrated to deliver applicable outcomes. Proper resourcing of the planning stage, with independent oversight, should be done to ensure appropriate care is taken and expensive re-design mid-program is avoided. Experimental design will be particularly important in this program due to the low numbers of decommissioning projects completed in Australian waters and the resulting paucity of data and site replicates. Planning should also properly consider other opportunities and priorities that emerge in ongoing discussions that are not included in this report, provided there is agreement by end-users. Where possible the scope of works in this report should be considered alongside other engineering and social research (not fully explored in this report) where cost-efficiencies can be made through integration, shared sites and shared data.
Supported with data and access	The major breakthroughs in the Dredging Science Node came about because of the voluntary sharing of data by Chevron, Woodside and Rio Tinto Iron Ore. Access to this existing confidential data (through careful data management arrangements) allowed

	WAMSI to test international assumptions and prove or disprove them in the Australian context, to identify where international and local research had been incorrect due to considering laboratory instead of real-world processes, and underpin experimental design to ensure it filled knowledge gaps.
Access and trial sites	A barrier in the WAMSI Dredging Science Node was that access was not made available to site during dredging activities. If detailed design indicates it is necessary, trial sites should be identified in shallow shelf environments and deep sub-tropical environments (North West Shelf / Timor Sea) and deep cold water environments (Bass Strait and Great Australian Bight) to examine the effects of decommissioning activities as they occur, and alternative sites to examine reefing effects.
Strategic investment	The quantum of research required, the cost of marine science in general and the future decades of decommissioning requires a strategic response which will require strategic investment. It is likely that the science program will require a large investment of funds given the scale of potential benefits resulting from the certainty this baseline science will provide. This will require a strategic and shared response to deliver this level of investment.
Australian focus and linkage with global efforts	Any response needs to be applicable in the oil and gas regions in Australia and to understand the level of applicability across the different regions around Australia. Further, decommissioning is a global issue with parallel international efforts underway to understand the effects. Industry, research and government participants should attempt to integrate any Australian response in this global effort, where appropriate and relevant.

6.2 Concept for a science program

The Project Steering Group has provided some guidance for the development of a science plan to address decommissioning. Figure 8 and the supporting Table 6 below, provides a conceptual map of how an integrated program could be constructed to maximise the efficiency of science expenditure, the potential for innovation through multi-disciplinary approaches, as well as ensure work is keenly targeted on applicable outcomes.

The full range of interdependencies are not able to be shown on the map, but the complexity of multi-disciplinary programs are indicated.

It is noteworthy that throughout the stakeholder engagement, other issues were raised including policy and management as well as structural engineering and engineering processes to reduce the cost burden of decommissioning to industry. Although beyond the scope of this project, it may be of value to consider a comprehensive program to explore innovation and targeted knowledge in all of science, economics, policy frameworks and engineering processes.

In exploring a complete program of decommissioning solutions, economies of scale and a collaborative focus of expertise could enable a focused highly cost effective outcome with benefits to the State, Commonwealth, industries and community.

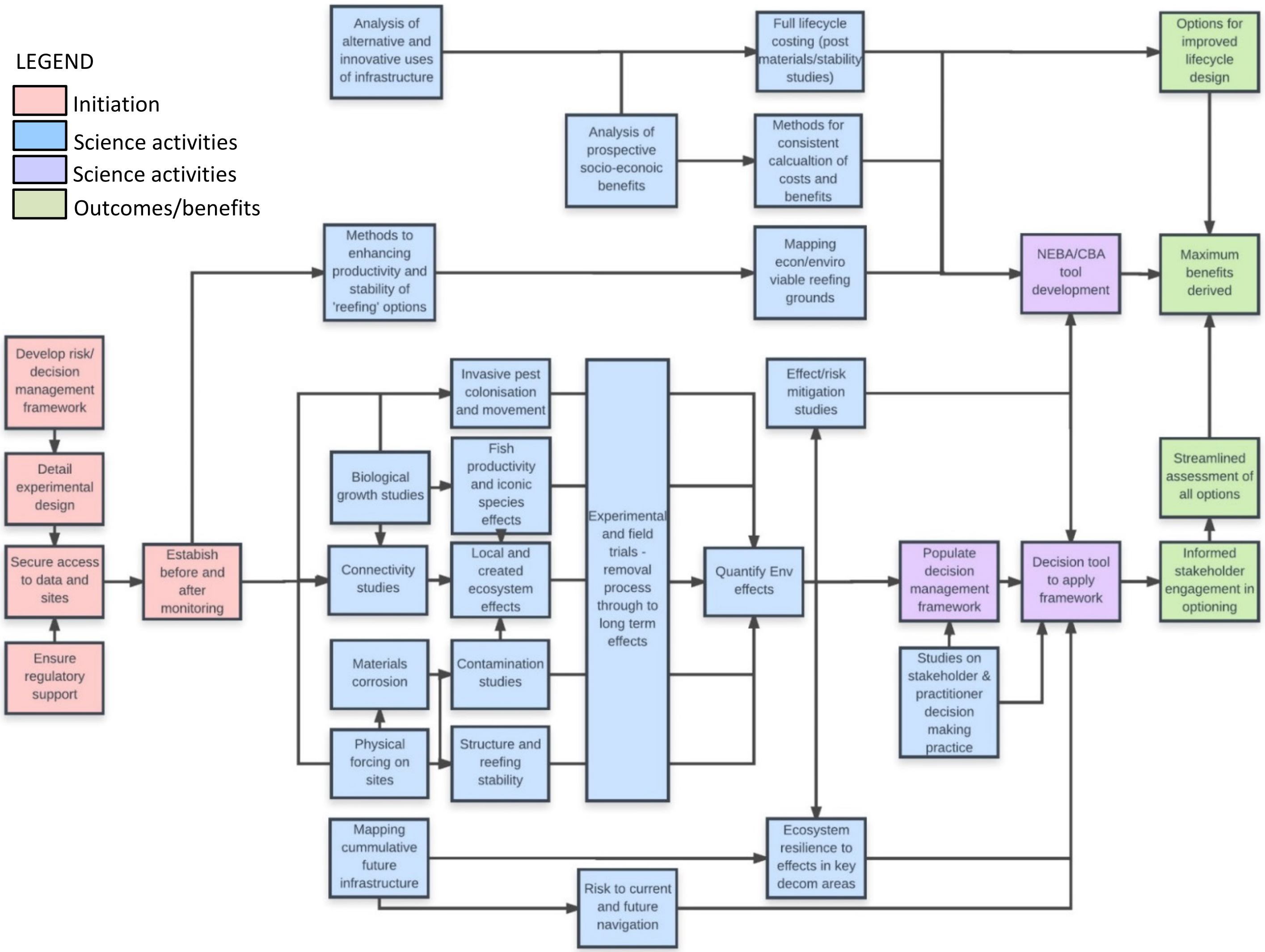


Figure 8. Flow chart describing the interrelated science and other packages of work that delivered outcomes and benefits. Explanation provided in Table 6

Table 6. Description of considerations underpinning the 4 stages in Figure 8

Initiation stage	Stage gate	Review and key experimental stage	Stage gate	Knowledge transfer	Benefits realisation
Risk management framework Understand the management framework to identify the specific thresholds, protocols/tools and cause-effect pathways that require evidence. This is a critical step to ensuring a targeted program and appropriate experimental design as it provides the 'boxes' of protocols, thresholds or advice that the science program needs to 'fill'.		**Main themes of science** Analysis of data, monitoring results and global evidence base to define relevance to the Australian context: a) cause effect pathways b) impacts of likely pressures c) thresholds for key impacts These projects will be against the priorities outlined in 5.2 and delivered in a staged manner (e.g. corrosion studies done prior to, and informing, stability and contamination studies): • Environmental ○ ecosystem and species ○ fish productivity and aggregation ○ marine pests • Materials ○ corrosion and its management ○ material deterioration ○ toxicity of contaminants • Stability ○ physical forcing on structures and reefing ○ sediment dynamics ○ stability enhancement for reefing.		**Populate management framework** Utilising expert, stakeholder and end-user working groups, populate elements of the management framework with the agreed outcomes of the scientific program. **Toolkits** Hand-over and train users on tools kits for decision making from the decision support projects.	Stakeholders able to make informed judgements on the full range of decommissioning options should enable regulators and companies to engage with stakeholders in these options as 'normal' practice.
Trial site selection Agreement on pending projects that can be used as real time study sites and agreement on access and liability cancellation/deferral to support scientific activity.				**Encourage adoption** Work with policy, regulatory and industry groups (around Australia) to encourage the formal adoption of the outcomes of the project to streamline expectation.	Both stakeholders' capacity to engage, and confidence about the environmental effects, social and economic benefits of decommissioning options in a range of situations, should allow streamlined negotiation and consideration of decommissioning plans.
Monitoring plan Develop before-after monitoring plan to provide baseline and change information.	Have these requirements been met? If yes, progress to a science program.	**Decision support projects** Social and economic projects to inform decision making through definition of: • relative cumulative pressures • value of secondary uses of infrastructure (e.g. reefing) • methods to inform cost and benefit analysis • areas and depths around Australia where certain recommendations developed through both, this the main themes of science and decision projects, apply.	Has the review of local data and global science allowed conclusions to be drawn? Is further experimental work required?	**Data provision** Ensure all data developed through this program is publicly available and readily accessible (embargoed to contributing partners for a period if necessary).	
Data access Formal data sharing agreements and protocols signed (use WAMSI DSN protocols as default) to allow scientists rapid access to baseline information in review stage.		**Contemporary and relevant reference list** Provide a 'library' of references that have been shown as valid in the Australian context and useful for immediate application.		**Legacy** Consider the establishment of an ongoing partnership on decommissioning science as innovation creates new questions, and to assist Indian Ocean / South East Asian neighbours in decommissioning activities.	Companies should be able to maximise the benefits of decommissioning to meet stakeholder and commercial expectations by understanding innovative approaches to designing and decommissioning infrastructure.
Funding for science activity Detailed planning and costing to support strategic investment by participants or through major grant program.		**Constant engagement with stakeholders** The need for constant engagement on progress and findings with stakeholders to build familiarity and trust with final outputs.			
Establish end-user oversight Utilise group similar to the Dredging Science Advisory Committee (potentially adapt the Decommissioning Blueprint Project Steering Group).		**Peer review** Ensure peer review and independent quality assurance of outputs to ensure credibility. Link technical report products to peer reviewed literature.			

6.3 Models for resourcing and delivering this program

There are a range of options available for future studies that are required to resolve the uncertainty surrounding decommissioning processes and to investigate the fundamental science required to underpin decommissioning into the future. Three of these options are listed below.

It is recommended that the Blueprint Steering Committee consider these and other options in more detail, but consider a strategic program of work as a necessary activity for improving decommissioning practice in Australia.

Individual project approach – individual projects run independently by industry, universities, or government agencies etc., on a case by case or as needs basis. Projects are specific to the site under consideration. This approach lacks any sophisticated integration of studies to build a collective understanding that can input directly into management processes and inform policy development. It lacks collaboration and can result in duplication and additional unnecessary costs.

WAMSI or similar organised collaboration – WAMSI is an unincorporated joint venture that represents a collaboration of State, Commonwealth, industry and academic entities collaborating to create benchmark research and independent, quality scientific information. WAMSI delivers public good marine research that informs the social and economic development and marine environmental management off Australia's western coast.

WAMSI delivers at-scale projects with direct applicability to Government and other end-users such as industry through the joint capability of its eight research partners as well as other research organisations across Australia where required. Examples include the recently completed $20million Dredging Science Node and $30million Kimberly Marine Research Program.

The WAMSI model enables tailored but independent governance to ensure a keen focus on delivering applicable outcomes as well as confidence of independence and credibility. WAMSI nodes are generally funded by a 1:1 sharing of the costs between the State Government and/or industry end-users, and the research sector. WAMSI normally delivers Western Australian centric activities and special arrangements would need to be made to address a national issue and include key capabilities from expert non-partner research groups.

The Cooperative Research Centre (CRC) approach - CRCs are an Australian Government program to enhance Australia's industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-industry research centres.

A CRC is an industry, government and research collaboration to address a particular issue and create an economic outcome for Australia. Rather than utilise an existing similar organisation such as WAMSI, a CRC requires that an incorporated entity is established to allow the financial governance required for a major partnership between many companies, SMEs, and government with the purpose of developing and managing intellectual property and commercialisation that provides participants with a competitive advantage.

While this often comes with an increased governance and administration of an incorporated entity, and noting CRCs are a nationally competitive process and not certain to receive approval, the CRC program does allow for a major Commonwealth cash funding investment to be made to match the other partners. This contribution can be in the 10s $Millions over the life of a CRC.

A recent CRC bid on the Decommissioning of Offshore Oil and Gas Infrastructure was put up by UWA, (Engineering and legal considerations for decommissioning of offshore oil and gas infrastructure in Australia) Decommissioning Offshore Infrastructure CRC (DOI-CRC), and supported by industry and the State Government. The bid was unsuccessful, however may be pursued at a later date.

7 References

Abbott, A. (1996). Brent Spar: When science is not to blame. Nature 380.6569: 13-14.

APPEA, 2017. Scientific Literature Review: Environmental Impacts of Decommissioning Options. https://www.appea.com.au/wp-content/uploads/2017/08/Final-Advisian-Decommissioning-Report.pdf

Bryman, A. (2008). Social research methods (3rd Ed.). Oxford: Oxford University Press.

Cash, D. W., Borck, J. C., & Patt, A. G. (2006). Countering the Loading-Dock Approach to Linking Science and Decision Making. Science, technology, & human values, 31 (4), 29. http://dx.doi.org/10.1177/0162243906287547

Clarke, B., Stocker, L., Coffey, B., Leith, P., Harvey, N., Baldwin, C., . . . Cannard, T. (2013). Enhancing the knowledge–governance interface: Coasts, climate and collaboration. Ocean & Coastal Management, 86, 88-99. http://dx.doi.org/10.1016/j.ocecoaman.2013.02.009

Cvitanovic C., Hobday A.J., van Kerkhoff L., Wilson S.K., Dobbs K., Marshall N.A. (2015). Improving knowledge exchange among scientists and decision-makers to facilitate adaptive governance of marine resources: a review of knowledge and research needs. Ocean and Coastal Management 112:25-35

Department of Mines, Industry Regulation and Safety (2017). Petroleum Decommissioning Guidelines. Pp 12. http://www.dmp.wa.gov.au/Documents/Petroleum/PET-DecommissioningGuideline.pdf

Western Australian Government Department of Mines & Petroleum. Regulating oil & gas. http://www.dmp.wa.gov.au/Documents/Petroleum/PD-PTLA-NT-192D.pdfFisheries Research Services (1995). Case Study: Brent Spar. FRS Marine Laboratory, PO Box 101, 375 Victoria Road, Aberdeen. AB11 9DB UK

Global CCS Institute. (2009). Well plugging and abandonment techniques. https://hub.globalccsinstitute.com/publications/long-term-integrity-co2-storage-%E2%80%93-well-abandonment/2-well-plugging-and-abandonment

Goodman, L.A. (1961). Snowball sampling. The annals of mathematical statistics, pp.148-170.

Guston, D. H. (2001). Boundary Organizations in Environmental Policy and Science: An Introduction. Science Technology Human Values, 26. http://dx.doi.org/10.1177/016224390102600401

Nelson, E.B. & Guillot, D. (2006). Oil well cementing. Schlumberger (pp773).

NOPSEMA (2016). Decommissioning offshore petroleum facilities in Commonwealth waters https://www.nopsema.gov.au/assets/Publications/A495492.pdf

Nursey-Bray, M., Pecl, G. T., Frusher, S., Gardner, C., Haward, M., Hobday, A. J., . . . van Putten, I. (2012). Communicating climate change: Climate change risk perceptions and rock lobster fishers, Tasmania. Marine Policy, 36(3), 753-759. http://dx.doi.org/10.1016/j.marpol.2011.10.015

Patton, M. Q. (1990). Evaluation and Research Methods (2nd ed.). Newbury Park, USA: Sage.

Pecl, G., Frusher, S., Gardner, C., Haward, M., Hobday, A., Jennings, S., . . . van Putten, I. (2009). The east coast Tasmanian rock lobster fishery – vulnerability to climate change impacts and adaptation response options. Department of Climate Change, Australia.

Rigzone, (2016). How does decommissioning work? http://www.rigzone.com/training/insight.asp?insight_id=354

Shervin Setareh. (1995). Brent Spar Case Study.

http://pixbox.co.uk/ct/downloads/Shervin_Setareh-Brent_Spar_Case_Study-1995-Questions.pdf

Shaw, J. (2014). Climate Change Adaptation: Building Community and Industry Knowledge (978-0-9872761-1-7). Perth WA: WAMSI FRDC.

Shaw, J., Danese, C., & Stocker, L. (2013). Spanning the boundary between climate science and coastal communities: opportunities and challenges. Ocean & Coastal Management, 86, 80-87. http://dx.doi.org/10.1016/j.ocecoaman.2012.11.008

Stocker, L., & Shaw, J. (2016). Cultural models on the Western Australian coast: improving sustainability outcomes. In T. Kerr & J. Stephens (Eds.), Indian Ocean Futures: Communities, Sustainability and Security: Cambridge Scholars. Retrieved from http://www.cambridgescholars.com/indian-ocean-futures

Tacchi, J. A., Slater, D., & Hearn, G. N. (2003). Ethnographic action research: A user's handbook. http://dx.doi.org/http://eprints.qut.edu.au/4399/

Techera E.J. and Chandler J. (2015). Offshore installations, decommissioning and artificial reefs: Do current legal frameworks best serve the marine environment? Marine Policy, 59:53-60

Walter, M. (2010). The Politics of the data: How statistical Indigene is constructed. International Journal of Critical Indigenous Studies 3(2):45-56.

Walter, M. (2013). Social Research Methods. 528 pp. OUP Australia & New Zealand, 2013

WAMSI (2015). The Blueprint for Marine Science 2050. Research Directions to enhance industry competitiveness and government effectiveness in the marine environment in Western Australia. pp 105. ISBN 978-0-9872761-2-4

8 Acknowledgements

This project was made possible by the large number of stakeholders, both individuals and others representing agencies and organisations, who freely gave of their time, opinions and expert knowledge in this engagement process. Their inclusion in the project is gratefully acknowledged and very much appreciated. Their continued input into the project will complete the process and be highly valued.

The project had a number of partners who contributed financially to the project and also provided oversight via a Project Steering Committee. All partners are gratefully acknowledged.

9 Appendices

Appendix 1. Decommissioning Project Steering Group

Name	Organisation
Patrick Seares	WAMSI (Chair)
Jenny Shaw	WAMSI (Project lead)
Alex Ogg	WAFIC
Andrew Rowland	Recfishwest
Christine Lamont / Tim Carter	NOPSEMA
Damien Hills / Andrew Taylor	APPEA
Darren Foster / Mark Pagano	Department of Fisheries
Ian Briggs	Department of Mines and Petroleum
Jill Stajduhar	NERA
Mhairi Glover	APPEA Decommissioning Policy Group
Ray Masini	OEPA
Anneke Van der Weyde (Observer)	Department of Industry, Innovation and Science
Stephen Newman	WAMSI Blueprint

Appendix 2. Examples of decommissioned oil and gas assets in Australia

Activity Details	**Location**	**Dates**
Activity Name: Balnaves Operations Cessation Activity Type: Decommissioning, dismantling or removing a facility, Any other petroleum-related activity Submitted by: Woodside Energy Julimar Pty Ltd	Regions: Pilbara Adjacent to: Western Australia	Submitted: 30/06/2016 Decision: 20/07/2016
Activity Name: Puffin Field Decommissioning Activities Activity Type: Decommissioning, dismantling or removing a facility Submitted by: Sinopec Oil and Gas Australia (Puffin) Pty Ltd	Regions: North West Adjacent to: Western Australia	Submitted: 15/09/2015 Decision: 27/11/2015
Activity Name: Jabiru and Challis Fields (Decommissioned State) Environment Plan Activity Type: Decommissioning, dismantling or removing a facility Submitted by: PTTEP Australasia (Ashmore Cartier) Pty Ltd	Regions: Northern Territory Adjacent to: Northern Territory	Submitted: 30/01/2014 Decision: 15/05/2014
Activity Name: Woollybutt Decommissioning Phase 1 and 2 Activity Type: Decommissioning, dismantling or removing a facility, Any other petroleum-related activity Submitted by: ENI Australia Limited	Regions: North West, Pilbara Adjacent to: Western Australia	Submitted: 25/09/2012 Decision: 28/11/2013

Source: NOPSEMA

Appendix 3. Decommissioning Information paper

Link to report: "**Independent review of the effects of decommissioning offshore infrastructure**"

Appendix 4. Stakeholders and sectors represented in the engagement process

Interviews and workshops were held with the following groups / participants:

- Fishers-Recreational (EGFC, KBGFC, NBSFC, WAGFA)
  - and including Recfishwest
- Fishers -Commercial (Trawl [fish/prawn], Trap, Line, Mackerel, Marine Aquarium Fish)
  - and including WAFIC, Pearl Producers Association
- Fishers - Charter (FTOL)
- Yacht Club -Dampier
- Tourism - general visitor and accommodation
- Tourism - dive charter and whale shark operators
- Conservation members
- Indigenous (Murujuga Land and Sea Unit)
- Marine Service Providers
- Small business owners
- Oil and Gas employees
- Chamber of Commerce and Industry (ECCI and KDCCI)
- Regional Development Commission (PDC and GDC)
- Government – Local (Exmouth, Dampier)
- Government – State (Departments of Fisheries, Transport, Environment, Parks and Wildlife, Ports WA, OEPA)
- Government – Commonwealth (DoIIS, DoIRD, Dept. Env, Agri and Water, AFMA, AMSA, Geoscience Australia)
- Research (UWA, CU, AIMS, Centre for Whale Research)

Appendix 5. Summary of stakeholder issues

(taken from over 900 issues in raw data that is not supplied as it is attributable and sensitive)

Topic	Stakeholder issues / questions
ENVIRONMENT	
Environment	Is there a correlation between hydrocarbon seepage / discoveries and increased biodiversity or environmental productivity?
Environment	What are the noise issues associated with removing infrastructure?
Environment Baselines	Does good baseline data exist for all oil and gas developments and is this accessible?
Environment Baselines	Is there enough information to undertake a BACI (Before-After-Control-impact) analysis of benefits from decommissioning projects
Environment Biodiversity/Aggregation	Does oil and gas infrastructure increase productivity or aggregate species?
Environment Biodiversity Composition	Does the community composition on oil and gas infrastructure differ from that in the natural environment?
Environment Biodiversity Migratory Shifts	What ecological changes have occurred as a consequence of the infrastructure being in place, and what is the likely consequence of removal? (E.g. bird migration, mammal haul out, altered feeding grounds). Including from a species level to an ecosystem level

Topic	Stakeholder issues / questions
Environment Biodiversity Productivity increase	Does oil and gas structure increase environmental productivity/ biodiversity?
Environment Biodiversity Refugium	Does infrastructure act as a type of refugium?
Environment Biodiversity Structure	Does biodiversity vary depending on the nature of the structure (components, type)?
Environment Biodiversity Structure	What structures maximise biodiversity?
Environment Connectivity	Is there connectivity between structures and the surrounding habitat?
Environment Contamination	What are the main contaminants following decommissioning, will they be released into the environment, and will they be toxic?
Environment Ecosystem value	Can the environmental value of the ecosystems built up around the oil and gas infrastructure be estimated?
Environmental Premium	Is 'environment' the most important issue when considering decommissioning options?
Environment Future impacts	What are the major issues and their environmental impacts over time (e.g. corrosion, contamination and seepage, cyclones and resulting instability, deterioration)?

Topic	Stakeholder issues / questions
Environment Future impacts	Is there long-term environmental monitoring in place?
Environment Future impacts	Is habitat restoration possible?
Environment Habitat removal and restoration/rehabilitation	What are the environmental costs and benefits of infrastructure removal?
Environment Habitat removal and restoration/rehabilitation	Is habitat restoration possible?
Environment Introduced Marine Species	Do invasive species colonise oil and gas infrastructure more readily than natural structures?
Environment Introduced Marine Species	Are these structures used as stepping stones for introduced marine species?
Environment Location	What are the environmental impacts of decommissioning with respect to depth, temperature and other biophysical parameters, bioregion, asset clusters?
Environment Removal Risk	What is the level of environmental risk for the removal of infrastructure?
Water Quality Ecotoxicology	What are the ecotoxicology risks when decommissioning?

Topic	Stakeholder issues / questions
DEPTH	
Depth	Is depth the most important variable (*cf* distance from shore, temperature, bioregion latitude etc) when considering environmental and structural issues?
ECONOMIC	
Economic Cost benefit scenarios	What are the social and economic costs and benefits of leaving in-situ, partial or complete removal (including for local communities)? [see below also]
Economic Flow of benefits	Is there a mechanism or appetite for 'flow of benefits' from 'cost savings'?
Economic Future use	What is the potential for 'future use' (e.g. commercial fishing prospectively, tourist operations)?
Economic Local cost benefit	What are the social and economic costs and benefits of leaving in-situ, partial or complete removal (including for local communities)?
FISHING	
Fishing Artificial Reefs	What are the environmental, social and economic benefits of artificial reefs in shallow and deep waters?
Fishing Catches existing structures	What are the estimated commercial and recreational fishing catches from existing infrastructure?

Topic	Stakeholder issues / questions
Fishing Enhancement	Do oil and gas assets enhance or aggregate productivity / biodiversity?
Fishing Impacts	What are the significant fishing impacts and benefits from oil and gas infrastructure?
Fishing Location	Are there environmental, social or economic advantages in re-locating infrastructure when decommissioning?
Fishing Structure	What types of structure maximise the benefits for commercial and recreational fishing?
NAVIGATION	
Navigation Charts	Why are all components of oil and gas infrastructure not located on charts and available on live sites?
Navigation Depth	At what distance from the sea surface can structure remain without being a navigation hazard?
Navigation Depth	Is the depth of infrastructure a determinant in full or partial removal? (e.g. IMO 1989/98 guidelines. Structures built post 1998 should be designed for full removal. How many structures do we have in those depth categories?)
Navigation Interference	If structure left in place – what exclusion zones remain?
Navigation Interference	What can be left at sea that does not create a navigation hazard?

Topic	Stakeholder issues / questions
Navigation Maintenance	If structure is left in place – how would it be maintained so not a navigation hazard??
Navigational Premium	Is ‘navigation’ the most important issue when considering decommissioning options?
Navigation Visibility	If structure is left in place – how would it be maintained and made visible?
RESEARCH & EDUCATION	
Consultation and engagement	What level of consultation will there be in any decommissioning phase?
R&E Future Monitoring	Will there be future monitoring and further research required for decommissioned sites?
SAFETY	
Safety ALARP	Are all decommissioning options designed into the lifecycle of the project?
Safety Cyclones	In cyclone prone areas, how stable are structures if remaining in situ – or moved to other locations?
Safety Location	In high current and cyclone areas, can infrastructure be left in place without long term safety issues?

Topic	Stakeholder issues / questions
Safety Maintenance	What is the minimum maintenance required for structures to be left in-situ and remain stable for 100 years?
Safety oil and gas, fishers (R&C)	How can the safety of staff, fishers and others using structures be managed?
Safety Structure	If left in-situ, what parts could be left in place for other purposes, such as Tourism, without significant dangers?
Safety	What are main safety issues for all decommissioning options: leave in situ, partial or full removal?
SOCIAL	
Social and cultural attitudes	What are the key social costs and benefits for leaving infrastructure *c.f* removal ?
Social and cultural	Are the strong inter-relationships and connectivity between all aspects of decommissioning considered in the decision making process (including environmental, social, cultural and economic)?
STRUCTURES, TECHNIQUES and FEASIBILITY	
Contaminant Removal feasibility	Can contaminants be completely removed (e.g. sludges, sands, NORMS, hydrocarbons)?

Topic	Stakeholder issues / questions
Corrosion Timeframe	What is the timeframe and breakdown of components of different oil and gas structures?
Cyclones	Would the risk of cyclones and shallow water (e.g. Dampier) exclude leaving structures in –situ?
Location Move	Is there a greater cost benefit if bringing the structure in closer for increased access?
Monitoring long term	Is there technology available to monitor long term impacts e.g. leakage and seepage?
Plug and Abandon (P&A)	What incidents have occurred post plugging and abandonment of wells?
P&A	What structure remains after a well is P&A?
Removal feasibility	Is it feasible to completely remove all infrastructures?
Removal feasibility Dumping	How much material currently falls off or is dumped from assets/barges?
Technical challenges	What are the main technical, environmental and social challenges when decommissioning (all options)?

Topic	Stakeholder issues / questions
TOURISM	
Tourism Aesthetics	Are the aesthetics of oil and gas infrastructure considered e.g. in broad expectations of Marine Park visitors?
Alternative ideas	Are there opportunities for alternative uses of oil and gas assets? Cost benefit?
Increased opportunities	What are the costs and benefits for local communities and visitors for decommissioning (all options)?
Location and Access	What are main issues in moving structures closer to shore for increased access?
WASTE	
Waste Disintegration	What are the rates of disintegration / corrosion of the different structures and what are their breakdown contaminants (see previous)?
Waste Recycling	Can any components be re-used or recycled? In Australia?
Waste Recycling	What are the costs and benefits of disposing of infrastructure components on land or in the ocean?
Waste Residual	After full removal – what waste components remain (e.g. tailings, spoil, and other deposits)?

Appendix 6. Expert panel attendees for prioritisation workshop

Name	**Organisation**
Patrick Seares	WAMSI (Chair)
Jenny Shaw	WAMSI (Project lead)
Allison Sellman	Atteris
Chris Jones	Chevron
Karen Cooper	AIMS
Luke Smith	Woodside
Mannie Shea	WAFIC
Mark Bailey	Oceanica
Peter Landman	Chevron
Stan Bowes	DMP
Steve Newman	DoF
Susan Gourvenec	UWA
Tim Carter	NOPSEMA
Walter Law	DMP

The workshop was held over two days with Day 1 outcomes reviewed by Decommissioning Project Steering Group and attendees before the commencement of Day 2.

Appendix 7. Summary of issues raised by stakeholders and considered by prioritisation panel

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
	High/ Mod				
	Baseline data and access to data	Q: Does baseline data exist for all oil and gas developments and is it accessible?	Baseline data is the initial data collected which serves as a basis for comparison with subsequently acquired data.	Limited data available and variable between oil and gas developments. Quality may not be useful for habitat/ biodiversity assessment.	Meta-analysis or trial required.
	High				
	Ecosystem benefit	Q: Does oil and gas infrastructure **increase productivity**, provide a source of recruitment or **aggregate**/ attract species? Q: Can the **environmental value** of the ecosystems built up around the oil and gas infrastructure be estimated? Q: What are the environmental costs and benefits of infrastructure removal?	The environmental costs or benefits of all decommissioning options are a primary factor in decision making. Environmental premium was ranked the highest for stakeholders in this project.	Some data and literature available on oil and gas impacts on biodiversity (Australia and overseas). Variable depending on depth, size, and location of structure however limited data and some anecdotal evidence for recruitment and increased productivity. Regional effect unknown.	Meta-analysis and research required. Calculation of benefit including biodiversity, social and economic. By infrastructure type and position. Links into all issues of

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
		Q: Does biodiversity vary depending on the nature of the **structure: components** and **type**? Q: Is 'environment' the most important issue when considering decommissioning options? Q: What ecological changes have occurred as a consequence of the infrastructure being in place, and what are the likely consequences **of removal?** (*E.g.* bird migration, mammal haul out, altered feeding grounds). Including from species level to ecosystem level. Q: What are the environmental impacts of decommissioning with respect to depth, temperature, and other biophysical parameters, bioregion, asset clusters etc? Q: What are the significant fishing impacts and benefits from oil and gas infrastructure?		Variable anecdotal information for fish mammals and birds using as refugia. Structural complexity and composition appears important when considering aggregating devices.	productivity, biodiversity, value. What is threshold for determining community willingness for environmental impact?

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
	High				
	Connectivity	Q: Is there connectivity between structures and the surrounding habitat? Q: Are oil and gas assets used as stepping stones for IMS?	Connectivity refers to the movement of plants and animals between habitats. It is difficult to evaluate in the marine environment.	Limited information available on connectivity.	Research. Connectivity study to provide information to inform the value and benefit to the whole region.
	High				
	Corrosion	Q: What is the timeframe and breakdown of the different oil and gas Structures?	Corrosion is the deterioration of a metal as a result of chemical reactions between it and the surrounding environment.	Limited information available except on specific components.	Communication through to research. Accepted breakdown characteristics for 'industry standard' steel, plastic liners and concrete.
	High				
	Contamination	Q: What are the main contaminants following decommissioning, will they be released into the environment, and will they be toxic?	Sources of contaminants are from produced formation water (PFW) and drill cuttings. PFW mainly hydrocarbons, heavy	Limited data in Australia as few decommissioned assets. Depends on the type of infrastructure plus stability	Communication through to research (ecotoxicology study).

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
		Q: Can contaminants be completely removed e.g. sludges, sands, NORMS, mercury, hydrocarbons? Q: Is there technology available to **monitor long term impacts** e.g. leakage and seepage (low).	metals and NORMS. Drill cuttings mainly hydrocarbons but may contain traces of heavy metals and NORMS.	and corrosion. Contaminants can include: hydrocarbons, plastics, mercury, NORMS, rust inhibitors, arsenic, asbestos, steel, concrete. Risk of re-suspension could be an issue during removal.	Development of a Monitoring Guideline.
	High				
	Stability	Q: In cyclone prone areas, how stable are structures if remain or moved to another location? Q: What is the minimum maintenance required for structure to be left in-situ and remain stable for 100 years?	The ability of the structure to remain unchanged and unmoving over time.	Good engineering data on stability of functioning asset. Stability affected by physical forcing and degradation.	Trial Use artificial reef sites to check stability over time.
	High				
	Cost benefit analysis	Q: What are the economic and social costs and benefits of the decommissioning options, measured	Cost benefit analysis is a process which systematically compares the costs and	Required for decision support tool in NEBA and EP.	Meta-analysis.

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
		against the size, type, and depth of asset? Including local and regional employment scenarios, recycling options. Q: Are there environmental, social or economic advantages in re-locating infrastructure when decommissioning?	benefits of a process or decision. This issue is key to the decision making process. Required for all options.		
	High				
	Navigation: Charts, depth, interference, maintenance, premium	Q: Why are all components of oil and gas infrastructure not **located on charts** and available on live sites? Q: At what **distance from the sea surface** can structures remain without being a navigation hazard? Q: What can be left at sea that does not create a navigation hazard? Q: If structure left in place – what **exclusion zones** remain? What determines the size of zones? Q: Is the depth of infrastructure a	Navigation issues are handled by the Department of Transport.	The Resources Data Initiative is being delivered by the COAG Energy Council's Upstream Petroleum Resources Working Group. It will improve access to resources-related environmental and geo-technical open data, integrate resources-related data with emerging technologies; and enhance data discovery, access and analysis through	Communication - Meta-analysis and short mapping exercise. Including: current and future fishing areas, transport and mooring areas, key tidal and water level changes, future vessel sizes and where protections are required. Live website required for accurate up to date information, including current

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
		determinant in full or partial removal? Q: If structure left in place – how would it be **maintained** so not a navigation hazard?		agreed standards for terminology, formats and the provision of clean data to users. This Initiative is expected to enhance access to and information available on the location of some components of oil and gas infrastructure, such as pipelines.	Notice to Mariners.
	Medium				
	Migratory shifts / refugium	Q: Is infrastructure acting as **refugium**? Q: What ecological changes have occurred as a consequence of the infrastructure being in place, and what are the likely consequences **of removal?** (*E.g.* bird migration, mammal haul out, altered feeding grounds). Including from species level to ecosystem level.	A place (e.g. platforms, rigs) where animals can live and, in effect, seek refuge. Examples include seals hauling out on infrastructure in the Bass Strait. Birds changing migratory routes to rest. Fish using as protected habitat.	Fish: Infrastructure may provide refugia. NW Shelf ‘exclusions’ protect species. Act like a marine park. Gulf of Mexico Red Snapper. Rigs provide protection. Sharks: anecdotal evidence that sharks aggregate around platforms. Mammals: Bass Strait seals	Communication – trials. See also ‘Ecosystem benefit’

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
				probably using as haul out Birds: likely limited to non-operational rigs. Offshore platforms noisy and busy, birds unlikely to settle except when facility not operating. NW Shelf – do not get big flocks of birds. State waters: non-operational platforms – get a lot of birds, usually non migratory nearshore birds. Areas where infrastructure left may add value.	
	Invasive marine species/ pests	Q: Do invasive species colonise oil and gas Infrastructure more readily than natural structures?	IMSs are thought to colonise 'man-made' structures more readily than natural structures. Specific materials are also understood to colonise species more readily.	Anecdotal evidence that invasive species do colonise 'man-made' infrastructure more readily. Genetic work required re: connectivity. Biosecurity monitoring frameworks required. Surveys for IMS = project by	Research. See also 'Connectivity'.

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
				project for evidence. Most platforms clean off marine growth regularly. NW Shelf vessels moving back and forth every day. If was a high risk – would be IMS in Dampier Harbour FPSOs removed from area. Research more important if any reefing or relocation in shallow water.	
	Ecotoxicology	Q: What are the ecotoxicology implications following corrosion of infrastructure?	The impact of toxic chemicals on biological organisms.	Some data available, although limited.	See also 'Contamination'.
	Artificial reefs (cost benefit including relocation)	Q: What are the environmental, social and economic benefits of artificial reefs in shallow and deep waters? Q: What types of structures maximise the benefits for	Currently research (overseas) on reef modules to maximise productivity and fishing opportunities. Oil and gas infrastructure may not be best structure for reef creation – possibility to combine two	Limited data is available. More quantitative analysis required. Recommendation of ideal site characteristics of benefit. Site selection is asset specific	Trial and research. See also 'Ecosystem benefit' and 'Cost benefit analysis'.

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
		commercial and recreational fishing?	structures. Multipurpose –covering pipelines with mats so not unstable especially in shallow waters. Deep water not such an issue.	as distance is critical financial driver.	
	Cumulative impacts (sub-regional)	Q: What are the impacts of decommissioning across a region?	Cumulative environmental effects can be defined as effects on the environment which are caused by the combined results of past, current and future activities. What are the issues when one or multiple assets are decommissioned in a region?	Scale of prospective infrastructure (versus North Sea etc) low in WA. Consider likely impact versus other pressures and identify 'hotspots.' Research into how to practicably determine cumulative impact of decommissioning. Pressure mapping required.	Communication research. Practical framework for consideration of sub-regional impact of decommissioning. See also 'Ecosystem benefit' and 'Cost benefit analysis'
	Existing benefit (fish catches)	Q: What are the estimated commercial and recreational fishing catches from existing infrastructure?	The DoF collects commercial catch data. DoF also undertake surveys of recreational fishers to estimate catches. The	Critical to assessment of total benefit. Likely have commercial	Meta-analysis. See also 'Ecosystem benefit' -fish loss and gain.

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
			geographic scale of the data can make it difficult to refine the catch area.	fishery assistance, use VMS. Some data may be available from WAFIC also Recfishwest. Also DoF recreational phone surveys. Could also compare pipeline infrastructure and natural reef structures.	
	Low				
	Noise	Q: What noise issues are associated with removing infrastructure?	Underwater noise can lead to area avoidance or harm depending on a range of variables.	Short term noise necessary for removal or leaving in place (except some pipelines). Current regulation of noise is on a Case by case basis.	Communications – trial Understanding of impacts: if harmful or fauna avoidance. Topic links into Blueprint Noise project and cumulative noise profile.
	Habitat restoration	Q: Is it possible to restore the habitat?	The restoration of degraded, damaged, or destroyed ecosystems and habitats.	Limited decommissioning and data in Australia. Could look at other work to determine if necessary. Argument from terrestrial	Communication - trial. Natural rate of restoration and guidance on approaches

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
				environment and remediation. In marine environment often get increase in habitat. Mostly can remove all. Difficult to remove some things, e.g. gravity based platforms, pipelines with rock casements, 200m pylons.	to accelerate restoration.
	Future uses	Q: Are there alternative opportunities for decommissioned infrastructure? (tourism, recycling, reefing elsewhere).	Alternative uses for the oil and gas infrastructure. Suggestions have included: research facilities, weather stations, tourist accommodation for divers, fishers and photographers.	There are multiple alternative scenarios, however it is very expensive to maintain an operating platform.	Communication See also 'Cost benefit analysis'.
	Consultation	Q: What consultation will occur prior to any decommissioning decisions?	Discussing an issue with someone to seek advice or better understand their opinion.	Environment Plans open for public comment.	Communication.
	Hydrocarbon	Q: Do natural hydrocarbon seeps	Hydrocarbon seepage is	No available data to link	Communication.

Rank High Med Low	Issue	Summary of stakeholder questions	Description	Information (summarised from Prioritisation Workshop)	Options to address issue i Communication - Research synthesis & communication ii Meta-analysis -research synthesis iii Trials- applied research iv Research – pure research
	seepage and productivity	increase fishing productivity and the likelihood of wells being placed on productive fishing grounds?	common on continental margins around the world. It is often associated with increased productivity.	discoveries with productivity. Some data linking seepage with productivity. E.g. Halimeda mounds in Timor Sea started from hydrocarbon seeps. Long geological time frame.	
	Lifecycle design	Q: Are all decommissioning options designed into the lifecycle of the project?	The process of designing the infrastructure for the entire lifecycle. From inception, through engineering design and production, removal and disposal.	Not much thought given for all projects, especially earlier assets. E.g. North Rankin 1982. Modules now created for easy removal AND designed for decommissioning considerations.	Communication. Input to cost models that determine reefing or export approaches and NEBA.
	Monitoring	Q: Is there long term monitoring in place – post decommissioning?	To observe and review over a period of time.		Communication.

Appendix 8. Policy and Management Issues raised by Stakeholders

Issue	Summary of stakeholder views
Acceptable risk	What level of risk is considered acceptable?
Acceptable risk	What are the levels of disclosure for contaminants and what is considered acceptable?
Acceptable risk	Will maintenance be ongoing?
Alternative uses	What are the alternatives to full removal decommissioning? Examples included: tourist accommodation, wind turbines, aquaculture, weather stations, research stations, diving tourism, Climate Change sentinel areas, and research opportunities for future decommissioning.
Alternative uses	Would State and Commonwealth legislation (excluding DMP and NOPSEMA) currently permit reefing e.g. Department of Fisheries (DoF) and Environmental Legislation?
Alternative uses	Would the infrastructure be for sale e.g. rigs be for sale for other purposes e.g. tourism accommodation, diving, fishing boats?
Capacity to remove	What is the Government position on Company's selling assets to others (e.g. Companies) who do not have the funds for full removal / decommissioning and remediation?
Consultation	What level of consultation is proposed prior to decommissioning?
Consultation	There was much engagement when the infrastructure and development was being proposed, how much engagement is likely when it is being pulled out? E.g. Removing lines and pipes creates huge plumes and environmental damage. Fishers want to know what is happening, when and where. Especially in their fishing grounds.
Consultation	The WAMSI consultation was considered timely and effective.
Consultation and engagement	All stakeholders need to be represented and most would like to be involved in the process.
Exclusion zones	When an asset is plugged and abandoned does the exclusion zone remain?

Exclusion zones	Exclusion zones are often in the most productive parts of the fishery. For example, the Pluto and Wheatstone rigs were put in place over the most productive ridge in the fishery. The Exclusion zones also overlap resulting in a $32km^2$ exclusion. Fishers indicated they were not spoken to prior to the rigs turning up.
Exclusions	What are the current Exclusion zone laws as fishers get moved beyond 500m? (e.g. Griffin well on the maps says 5km, DMP says 500m. What is correct? Oil and gas bring very large boats (200m long), do not touch them but bully fishers out of the way).
Exclusions	Fishers buy their fishing licence to fish a certain area. Fishers lose a lot of ground in total with all the exclusion zones, especially when there are other subsea structures (e.g. 500m becomes 5nmiles). Why can't fishers have the exact coordinates they could fish around as could fish at the back of the footprint?
Expectation	Has DMP/ NOPSEMA agreed they may change the regulatory framework to partially remove or leave some infrastructure?
Expectation	How will the information generated in this project be used in management decision making / decision support?
Expectation	In Exmouth there was lots of consultation at the outset – and oil and gas infrastructure was going to be removed? Is this still the case?
Expectation	In the initial stakeholder consultation, much of this activity was started on the premise that all infrastructures would be removed. If this changes, how will community expectation be managed?
Expectation	When the infrastructure was put in place community had an understanding that all would be removed. Over the past 25 years the infrastructure has grown valuable ecosystems, particularly pipelines on muddy bottoms. As recreational fishers in Onslow, Exmouth and Dampier head out to the pipe lines to fish – how would the community expectation be managed if they were pulled up?
Expectation	In the absence of clear knowledge, would not the structure still need to be removed?
Flow of benefits	Does WA/ Australia have the legal framework or precedence to distribute any benefits resulting from Industry cost savings?
Flow of benefits	If there was a flow of benefit from the cost savings, how would agreement be reached on the benefit and management of the fund?
Flow of benefits	Concern that benefit and exclusion zones would go to recreational fishers and divers, who were previously not stakeholders in the deep water space.

Greenhouse Gas	What are the Greenhouse gas implications of decommissioning?
Liability	If a well is P&A and fishers hook up – who is liable for damage? For existing wells and following decommissioning.
Liability	If infrastructure remains, who is liable for navigation and maintenance in the long term?
Liability	What is the liability precedence in other jurisdictions? What options exist for the transference of liability, including funds to manage ongoing liability, research and monitoring?
Liability & title	Following decommissioning, who holds the liability and title?
Monitoring	Is there current monitoring of the wells that have been P&A, would there be long term monitoring of any structures left in place?
Navigation & safety	Why is there limited public information on the whereabouts of the infrastructure? Not enough transparency from the oil and gas companies including high resolution locations of well heads.
Navigation & safety	Current 'Notice to Mariners' is not sufficient for safe navigation and fishing. Is there any proposal for a live document, showing all structures, wells etc.?
Policy precedence	Are there any Australian guidelines or precedents for protocols and guidelines depending on the bioregional setting?
Policy precedence	How many approvals have been granted (State & Commonwealth) in Australia for any infrastructure to be left in place?
Policy precedence	What are the precedents in other jurisdictions for all options of decommissioning?
Process	Is it likely that decisions made regarding decommissioning will be made on a case by case basis?
Process	Are decommissioning and infrastructure removal options incorporated into the initial design phase? Are they part of the approval process before the development starts?
Process	What process do regulators use for making decommissioning decisions? Is there a decision support framework for all options of decommissioning?
Process	Is the connectivity between the environmental, social, cultural and economic implications understood? Are they taken into

	consideration in the decision –making process?
Remediation	Does the State / Commonwealth have a rehabilitation fund similar to that for terrestrial mining remediation?
Resource sharing	Will management for fisheries be put into place before decommissioning, rather than after the event?
Resource sharing	How will the existing entitlements of commercial fishers be protected following decommissioning? Have already lost considerable ground with oil and gas exclusions (without compensation). If fishing grounds are opened up again, would access be retained by commercial fishers?
Resource sharing	Will there be a resource allocation process instigated prior to decommissioning, based on existing catch rates of commercial and recreational fishers?
Resource sharing	Marine Aquarium Fishers (MAF) indicated that when there is increased tourism, dive charters or artificial reefs generating more recreational fishers they (MAF) often lose water that they have fished for years.
Resource sharing	Currently in the Dampier NW shelf area there is a strategic separation of commercial and recreational fishing at 30miles or the 30m contour (whichever comes first). In the nearshore area recreational fishers operate, as well as limited commercial Specimen Shell and Marine Aquarium fishers. Offshore, the other commercial fishers including Pilbara Trap and Pilbara Trawl operate. There are concerns from commercial fishers that if Exclusion zones are removed, particularly from where they previously fished, the recreational fishers will travel out to the deeper water and access these sites.
Resource sharing	Will resource sharing issues be considered as part of decommissioning options? Including between commercial fishers, recreational fishers, divers, spear fishers, no take tourists and conservation groups.
Sea Dumping	Under existing Sea Dumping legislation, where does NOPSEMA’s role end and Parks Australia start when assessing decommissioning plans?
Sea Dumping	If dumping infrastructure in other countries (land and sea), does this relate back to Australian legislation?
Situation	A number of agencies (State and Commonwealth) indicated they do not currently have enough knowledge to give a view or make decisions regarding decommissioning.

Situation	What is the approximate decommissioning time line for the current oil and gas infrastructure in WA?
Taxation	What are the benefits of all decommissioning options including tax flows under Australian laws?
Views	Varied from: All man-made structures that have been constructed in the marine environment should be taken out. Especially as the economic gains to the Companies have been high, there has been little community give-back and the time frames (50years) compared with the time for a reef system to evolve. To other view: Anything constructed in the water should be left in for the benefit of the recreational diving, recreational fishing, spearfishing, underwater observing, It is also good for tourists and locals.

Appendix 9. Scientific Literature Review: Environmental Impacts of Decommissioning Options

Link to report: www.appea.com.au/safety-environment/environment-publications/

Scientific Literature Review

Environmental Impacts of Decommissioning Options

Level 4, 600 Murray St
West Perth WA 6005
Australia

401320-13274-401320-13274-001

www.advisian.com

Advisian
WorleyParsons Group

Appendix 10. Decommissioning options

OPTIONS	DESCRIPTION
Disposing at land	Bringing the installation onshore, cleaning it, breaking it up into scrap for recycling in the steel industry, or disposal at licensed sites.
Toppling on site	Cleaning the installation, placing or toppling the cut section on the seabed.
Placing in deep water	Cleaning the installation, and then towing it and placing it a deep water site.
Leaving on site	Making the installation safe and leaving in-situ.
Artificial reef	Cleaning the installation and using it to form an artificial reef to improve local marine life.
Re-use in another location	Cleaning the installation, carrying out non-destructive tests, removing and transporting it to another site suitable for the platform's characteristics, then installing it at the new site.
Re-use for another scope	Making the installation safe and transferring use/purpose and potential ownership.

Taken from: APPEA 2016 Offshore Oil and Gas Decommissioning Decision-making guidelines

Appendix 11. Plug and Abandon (P&A) explained

During the Stakeholder workshops there were considerable questions on the process for plugging and abandoning wells. There are a number of ways this is achieved. Below is a summary of the most common practises. The sources are listed below.

Plugging and Abandonment (P&A) is the process by which a well is closed permanently, usually after either there is insufficient hydrocarbon potential to develop the well, or after production has ceased. Legislation requires all wells to be plugged and abandoned once they are no longer in use and /or their connecting platform is being decommissioned.

There are a number of ways that wells can be plugged and abandoned, however key stages in well abandonment are:

- Filling the well with fluid
- Removal of downhole equipment
- Cleaning out the wellbore
- Plugging open-hole and perforated intervals(s) at the bottom of the well
- Plugging casing stubs
- Plugging of annular space
- Placement of a surface plug
- Placement of fluid between plugs (Rigzone, 2016).

The removal of downhole equipment can be undertaken using an existing drilling or conventional workover rig. This process aims to remove all equipment used by the operator, including packers, downhole pumps and production tubing (Global CCS Institute, 2009).

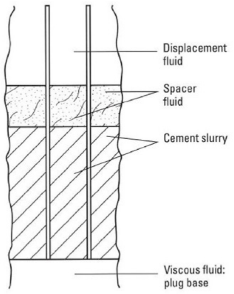
Cleaning out the wellbore is done through flushing the bore with a circulation fluid. The fluid selected should have physical properties that enable pressure to be easily controlled to enable the removal of unwanted materials such as fill and debris. In some circumstances other tools or additives may need to be used to ensure the wellbore is properly cleaned (Global CCS Institute, 2009).

Plugging of the well is undertaken to ensure that hydrocarbons will not leach into the environment and that the resource is protected. Therefore, an impermeable barrier must be installed. Whilst plugs may be made from various materials, Portland cement is the most commonly used within the oil and gas industry, as it hardens in place due to local pressure and temperature. Cement plugs are required to be of a certain length depending on the regulatory authority governing well abandonment in a region. Cast iron bridge plugs are also common in North America.

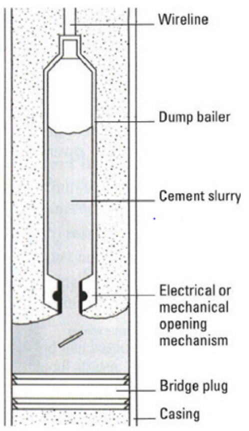
Typically, no less than three plugs are placed during well decommissioning activities. These consist of the following:

- A cement squeeze at the level of the perforations
- A plug located close to the middle of the wellbore
- A surface plug.

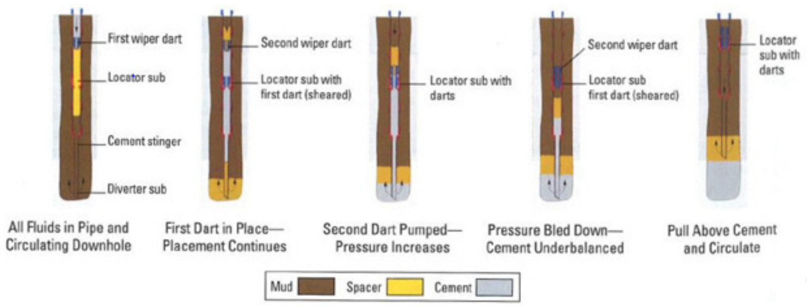
There are three major methods currently used for well plug placements (see diagrams below). These are the balanced plug method (Diagram i), the dump bailer method (Diagram ii) and the two-plug method (Diagram iii). Once a well has been plugged, testing must be undertaken to verify that the plug has been placed at a proper level and is providing zonal isolation. Testing methods include pump pressure testing and swab testing (Global CCS Institute, 2009).



(i) Balanced plug method (Nelson and Guillot, 2006).



(ii) Dump bailer method (Nelson and Guillot, 2006)



(iii) Two-plug method (Nelson and Guillot, 2006)

10 Information Boxes within text

Information Box 1: Legislation informing the process of decommissioning in Australia

Information Box 2: Decommissioning terms used in this report

Information Box 3: What can happen in the absence of collaboration, consultation and effective engagement?