2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
Decarbonising the Queensland Economy	Emerging decarbonisation industries: *Synthetic Biology*	Knowledge-driven seed industries that have the potential to generate sizeable decarbonisation and climate resilience benefits if supportive ecosystems can be established.	Regional jobs: What opportunities are there for synthetic biology to provide ecologically sustainable growth in Queensland's regional communities?	Industry blueprint: Many of Queensland's attributes such as proximity to markets and availability of feedstock, make it an ideal location for investment. Despite the suitability of Queensland for synthetic biology, investors and companies are yet to make the leap to on-the-ground development. What barriers and opportunities will see the synthetic biology industry develop within timeframes that allow Queensland to be first or early movers in the sector?	Sustainability accounting: How can the sustainability of products derived from synthetic biology be understood and compared to other means of productions?		
Decarbonising the Queensland Economy	Emerging decarbonisation industries: *Microalgal and macroalgal resources*	Knowledge-driven seed industries that have the potential to generate sizeable decarbonisation and climate resilience benefits if supportive ecosystems can be established.	Sustainable foods: What potential does algae have for meeting the community's requirements for sustainable foods development? In this context, what are the co-benefits that may be available from the development of the sector and the barriers faced in embedding them in the Queensland economy.	Climate action: What opportunities are there for the algae industry to support the Queensland Government's target of net zero carbon emissions by 2050?			
Building climate resilience	Climate resilience in world heritage estate		Closing the gap between carbon credit issuance and emissions reduction under land sector carbon projects: - likelihood of achieving project portfolio outcomes under various climate projections, carbon methods - contribution of sequestration in achieving net zero policy outcomes.	Identification of the weeds currently (or likely to become) of greatest threat to ecosystems in protected areas - preventative measures and control options in a changing climate.	Changes to protected area visitation, use and community expectations due to climate change – what will we need to do differently?	Fire management challenges in a changing climate – conservation, life and property and community expectations.	
Building climate resilience	Climate resilience in world heritage estate: *Southern Region*		Monitoring of changing rainfall patterns and storm intensity to understand impacts on the K'gari (Fraser Island) World Heritage Area's outstanding universal value and, in particular, the relationship between annual rainfall and groundwater table levels in the dune field.	Ongoing monitoring of the impacts of increase fire intensity on K'gari (Fraser Island) World Heritage Area's outstanding universal value and dune disruption.	Monitor climate change related trends in flora and fauna distribution, recruitment and phenology in the Gondwana Rainforests of Australia World Heritage Area (Queensland Section).		
Building climate resilience	Climate resilience in world heritage estate: *Wet Tropics*		Exploring potential for science-based interventions, restoration and management works that facilitate ecosystems transition that allow	Supporting research and monitoring led by Rainforest Aboriginal Peoples, including approaches based on Traditional Ecological Knowledge and	Integrating invasive species management and modelling under changing environmental and climatic conditions, and	Implementation of appropriate fire regimes, including traditional fire	

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

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			novel changes in composition while maintaining ecosystem functions.	experience of adaptation to historic climate risk		management, in response to a variable and changing climate to fire sensitive ecosystems such as rainforests.	
Building climate resilience	Climate resilience in world heritage estate: *Central Region*		Identification of the weeds currently (or likely to become) of greatest threat to ecosystems in protected areas - preventative measures and control options in a changing climate.	Changes to protected area visitation, use and community expectations due to climate change – what will we need to do differently?	Fire management challenges in a changing climate – conservation, life and property and community expectations.		
Building climate resilience	Climate resilience in world heritage estate: *Northern Region*		Identify forward trends and propose management actions for increased visitation to Cape York Peninsula protected areas associated with improvement to road access and community response to COVID and increased domestic travel.	Identify management actions to address the vertical retreat of fauna associated with climate change in the Wet Tropics World Heritage Area	Identify management actions to ameliorate the effect of increased bushfire frequency and intensity associated with climate change in the Wet Tropics World Heritage Area.		
Building climate resilience	Climate resilience in world heritage estate		Can we better integrate environmental models (e.g. water, soil, biodiversity, agriculture, climate) to estimate the cumulative impact of landscape interventions (both natural and artificial) under future climate projections?				
Advancing the circular economy	Resource Recovery Technology	Technology is needed to recover and transform existing waste streams into higher-value products, divert waste from landfills, and reduce demand for scarce materials. Demand for recycled materials and products needs to be stimulated to support targets for recycling and waste minimisation.	Recovering resources: Technologies are needed to recover valuable resources from complex waste such as e-waste (batteries, solar panels, digital devices), as well as high volume problematic waste such as mattresses and textiles. Queensland's large landmass and distribution of regional centres present difficulties for the economic viability of resource recovery. - Identify waste generated in regional areas, and suitable resource recovery options - Research use cases that demonstrate the scalability and viability of resource recovery	Transforming recovered resources: What technologies currently exist to transform recovered resources into high-value products for manufacturing, particularly for SMEs in regional areas?	Demand for recycled content: Procurement decisions by government and industry rely on confidence in product quality and performance. To stimulate demand in large scale purchasing decisions (e.g. for road and rail infrastructure; packaging; building construction, etc) for products with recycled content, research is needed to: - identify a set of use cases where products incorporated recycled content and maintain performance needs in the Queensland context - support the development of procurement standards and specifications for these products.		

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

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			applications for these priority waste streams applicable in Queensland's context.				
Developing robust and effective natural capital markets	Developing robust and effective natural capital markets	Emerging natural capital markets present an opportunity to contribute to measures to address habitat loss, species decline and climate change, support biodiversity conservation and help investors meet their Environmental, Social and Governance (ESG) commitments at a time when consumers and shareholders are driving more responsible investment. The department values research that investigates measures that would facilitate public-private co-investment in establishing robust and effective natural capital markets.	International review of standards, data systems, tools and frameworks used for recording, verification and reporting in environmental markets.	Review of the attributes of environmental markets, recommendations for what types of markets might work in Queensland to deliver high-priority outcomes and recommendations for what role the government could play in bringing them to fruition.	Development of further methodologies for the valuation and verification of the co-benefits of carbon farming projects.	Identification of options to reduce barriers to the uptake of emerging carbon methods, including streamlining of regulatory approval processes (e.g. blue carbon method).	Re-examination of approaches to the quantification of additionality, counter-factuals and 'business-as-usual'.
Managing Queensland's biodiversity and threatened species	Automation of biodiversity monitoring	New and emerging technologies are being used around the globe to monitor natural environments, including their extent, condition, and biological composition. This information can be used for a vast array of research, planning and management and environmental market purposes such as monitoring changes in vegetation, tracking animal migrations, mapping fire risk, protected area planning, assessing the health and resilience of ecosystems and informing adaptive management, including the reduction of human-wildlife conflict. The technologies being employed include remote sensors on satellites, aircraft and unmanned aerial vehicles, data loggers and gauges,	Can the spread of ecosystem dominating weeds, particularly exotic pasture grasses, be automatically mapped through the classification of remotely sensed imagery?	Are there opportunities for improving/standardising the use of automated cameras and/or microphones for wildlife detection to enhance the suite of detectable species and the efficiency of data collection?			

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

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		cameras, and acoustic recorders.					
Managing Queensland's biodiversity and threatened species	Threatened Species and Ecosystems: improving our knowledge and understanding	Queensland's flora, fauna and ecosystems are a valuable part of Queensland's rich biodiversity. Research is vital to addressing key knowledge gaps to achieve best outcomes for biodiversity. Applied research will contribute to improved policies, programs and management actions by enabling decisions to be based on the best available scientific evidence, benefit from innovative new approaches and harnessing new technologies, and incorporating an adaptive management approach.	Identify and apply innovative technologies to help us improve our knowledge and understanding of threatened species biology and ecology, in particular threatened species that are difficult to detect and monitor, and those that generate high public interest (iconic, human-conflict species).	Develop practical methods for reliably and efficiently capturing the ecological data required to detect change in ecosystems and threatened species abundance in timeframes that enable an effective response and for the purposes of environmental accounting. Identify and trial innovative technologies to improve effective and efficient capture of information on species assemblages and ecosystem health to determine management effectiveness and inform management and decision-making.	Develop systems to better capture, process, analyse, and present data in a format that can inform and communicate knowledge to promote effective conservation of species and ecosystems. Build effective data-sharing platforms to securely store and share threatened species information in a timely manner.	Provide innovative and cost-effective solutions to the management needs of significant species and those that generate high public interest (iconic, human-conflict species).	
Managing Queensland's biodiversity and threatened species			Improved understanding of the nature, distribution and impact of threats on threatened species and communities to identify threat abatement hotspots for targeted mitigation.	Apply innovative methods to monitor impacts of threats on species and ecosystems. Identify innovative technologies that could provide opportunities to improve threat management and protect key values most at risk. Develop methods to measure rates of decline in biodiversity values as a result of threats, identify limits of acceptable change within management timeframes and determine the effectiveness of threat mitigation actions.	Improve understanding of introduced pest species and pathogens, their impacts and control options. Develop cost-effective control methods and deliver effective management actions to reduce impacts and promote threatened species and ecosystem recovery. Quantify impacts of pest species on Queensland's threatened values.	Improve understanding of threatened species and ecosystem responses to fire regimes (including savannah burning and cultural burning methodologies) and identify effective planned burn practices to achieve biodiversity conservation in a changing climate, and methods/metrics to evaluate success.	
Managing Queensland's biodiversity and threatened species	Managing threats to Queensland's biodiversity	Queensland would benefit from a body of research to develop State-wide indicators and targets that can be used to measure biodiversity outcomes	How could existing biodiversity data be integrated to evaluate effectiveness of achieving biodiversity outcomes for the state?	Which indicators for different components of biodiversity could be measured and how could they be amalgamated to provide a state level evaluation of effectiveness?			

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
		and trends (including declines or recovery) in Queensland. Indicators and targets are required to evaluate the effectiveness of conservation measures across the State, including threat mitigation and recovery programs, climate adaptation, habitat restoration, citizen science, and biodiversity legislation. Having indicators and targets would enable Queensland to meet national and international reporting requirements including reporting on international targets under the Post-2020 Global Biodiversity Framework. Indicators and targets could provide a foundation for ESG reporting, natural capital accounting and provide a guiding basis and certainty for investors in the development of investment markets. Consideration is required as to how the range and nature of data collected for biodiversity can be utilised in a coordinated and integrated fashion to evaluate the effectiveness of current collective investments into biodiversity conservation across government and the private sector, appropriateness of legislative frameworks and impact of current efforts and initiatives.	What are relevant and adequate samples for some of the biodiversity components?	What are suitable biodiversity indicators for ESG reporting?			
Managing Queensland's biodiversity and threatened species	Managing human wildlife conflicts and the sustainable use of wildlife to ensure they	Human-wildlife conflicts are becoming more frequent, serious and widespread because of human population growth, agricultural expansion, infrastructure development,	Develop innovative approaches and measures that can be taken to assess and reduce the damage or impacts of human wildlife conflicts, de-escalate tensions, address risks to human safety, wellbeing, income, and	Develop new technologies to assist in monitoring wildlife populations in order to identify and proactively respond to predicted increases in human wildlife conflicts arising from	Improve understanding of the intrinsic biological characteristics of species and ecosystems subject to harvesting, including productivity, resilience, and stability and the impacts of extrinsic environmental change to ensure the	Examine and review institutional structures of management and control to	Improve understanding of the cultural, ethical, ecological, and economic values attributed to

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
	don't negatively impact the conservation of wildlife populations.	climate change and other drivers of habitat loss. Human-wildlife conflicts can occur wherever wildlife and human populations overlap, so any factor that forces wildlife and people into closer contact makes conflicts more likely. Human-wildlife conflicts can have severe implications for communities' livelihoods, safety and wellbeing, and risk undermining conservation efforts by eroding support for protected areas, wildlife protection and biodiversity. Action to manage human wildlife conflicts can pose a serious threat to a species' survival, and reverse previous conservation progress. A range of wildlife species (including plants, animals, and other organisms) are also harvested to supply commodities including foods, fibres, medicines, forage, and a means of earning income. The way in which these wildlife species are used has implications for the long-term sustainability of the species and the ecosystems they inhabit.	develop sustainable solutions which integrate ecology, social psychology, economics, conflict resolution, human behavioural change and conservation laws.	nature and human induced changes in environments. Develop new approaches to human behavioural change to proactively respond to predicted increases in human wildlife conflicts.	management and use of native wildlife species is sustainable.	ensure they include appropriate incentives and sanctions, good governance, are implemented at an appropriate scale and include participation of relevant stake-holders, take account of land tenure, access rights, regulatory systems, traditional knowledge, and customary laws.	wildlife and how these can provide incentives for conservation.
Managing Queensland's biodiversity and threatened species	Citizen Science, Biodiversity, and Threatened Species	Citizen Science is gaining support across the science field and presents opportunities to expand data collection, sampling, engagement, and community appreciation of science.	What opportunities exist within Queensland to improve the utilisation of citizen science data in managing Queensland's biodiversity and threatened species?	What barriers exist within the science community that restrict further uptake, use and sharing of citizen science sourced data?	How can citizen science methodology be better standardised to improve the transferability and comparability of data across locations, environments, communities, and states.	What opportunities exist, or are emerging, for the utilisation of mobile devices, and apps to improve data collections and application by citizen scientists.	How can we better support and upskill park rangers to act as a contact point, and community leaders on citizen science?
First Nations data, sovereignty and	Return on investment from Caring for Country in	First Nations people contribute significant levels of cultural 'goods and services' to the management of Queensland's	Can a First Nations cultural monitoring and evaluation framework/indicators for both natural, cultural and visitor values	How can we measure the intangible benefits from Caring for Country within the Queensland protected area estate?	How does this relate to existing co-benefit frameworks for measuring outcomes for First Nations peoples?	Where and how does the State generate indirect saving from	How can traditional ecological knowledge improve

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
cultural heritage	protected area management	protected area estate. Anecdotal evidence suggests Caring for Country investment provides numerous broader benefits than only economic returns, including contributing to First Nations peoples' wellbeing.	strengthen the Department's Values-Based Management Framework?			investing in First Nations protected area management?	conservation outcomes?
First Nations data, sovereignty and cultural heritage	First Nations data and sovereignty	As the use of big data and open data and our participation in the global on-going efforts to inform policy and practices grows, the rights and interests of First Nations people to their cultural and proprietary information is becoming increasingly important to the Department. First Nations data sovereignty refers to the right of First Nations people to exercise ownership over First Nations data from and about their Country, and communities, as well as individual and collective access and privacy.	How can DES develop data collection practices that ensure data about First Nations partners working in protected area management and environmental markets reflects their priorities, values, and diversity?	Identify, through consultation, First Nations partners' needs and requirements for data collection and use.	How can DES accurately express First Nations partners stories?	How can traditional ecological knowledge improve conservation outcomes?	
First Nations data, sovereignty and cultural heritage	First Nations and historic cultural heritage, social and economic biodiversity values	The Queensland community is the guardian of a globally and nationally significant proportion of Australia's biodiversity which are facing a future of ongoing declines, in part due to human-induced changes in climate. With a vision that 'Queenslanders support threatened species to prosper in self-sustaining populations, now and into the future', the Queensland Government is committed to managing, recovering and conserving threatened species and ecosystems. It depends on building a shared sense of responsibility within the DES and across the broader community.	Identifying and mapping areas of cultural heritage significance to build shared understanding and knowledge exchange and improve management of cultural values.	Estimating the social and economic value of Qld conservation estate and biodiversity values – environmental economic accounting including for threatened species and their habitats. Increased understanding and monitoring of community expectations and satisfaction in conservation and management of Queensland's natural areas.	Building long term, enduring citizen science engagement in biodiversity conservation and environmental markets.	Improved understanding and codification of traditional ecological knowledge, beliefs and values, and incorporation into ongoing biodiversity and conservation research and management and environmental markets.	

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
		This recovery involves a variety of stewards and stakeholders with differing perspectives and priorities, including Australian, state and local governments, First Nations people, Natural Resource Management (NRM) groups, conservation organisations, community groups, corporations, industry and private individuals. This makes it challenging for threatened species recovery efforts in Queensland to be coordinated, targeted and communicated.					
First Nations data, sovereignty and cultural heritage	Engaging First Nations communities through citizen science	First Nations science has a unique place in Queensland, Australia, and the world. First Nations citizen science presents a unique opportunity for Queensland to boost participation in citizen science, help to increase science literacy as well as leveraging traditional knowledge	What cultural perceptions of Queensland science exist within Queensland's First Nations communities, and how can these be addressed to increase citizen science engagement?	What cultural capability improvements are required across Queensland's science community to better engage First Nations communities?	What opportunities exist for the establishment of a First Nations citizen science network or advisory panel to promote future engagement?	How can we harness existing partnerships with First Nations communities, such as park rangers, to better engage communities.	
Best practice mine rehabilitation	Best practice mine rehabilitation	The Office of the Queensland Mine Rehabilitation Commissioner (QMRC) in DES is undertaking research to inform best practice mine rehabilitation in Queensland. Priority research areas include mine waste cover systems, topsoil deficits, residual voids and post-mining land uses. Research opportunities may be technical in nature or may incorporate social aspects.	Reducing risk through supporting robust research trials to rehabilitate mine waste structures. <u>Mine waste cover systems</u> - Mine waste cover performance, including comparison of various cover design components in full-scale cover systems, across different climatic ranges in Queensland - Best practice approaches for covers over waste rock dumps, heap leach pads and tailings storage facilities for various commodities <u>Geomorphic landform evolution modelling</u>: - its application to Queensland mine waste structures.	<u>Addressing Topsoil Deficits</u>. - Effective approaches for mine rehabilitation in the absence of topsoil - Biological amendments as a reality for mine rehabilitation in regional and remote areas –addressing technical and practical challenges across Queensland	<u>Completion criteria for post-mining land uses</u>. - Maximising economic, social and environmental outcomes from mine rehabilitation in peri-urban mining regions in Queensland - Maximising economic, social and environmental outcomes from mine rehabilitation via enduring energy precincts in Queensland	<u>Rehabilitation failure – causes and corrective actions</u>. A research program to create a more definitive inventory of rehabilitation and its effectiveness – what works and what doesn't. <u>Grazing on rehabilitated mine lands</u>. Working with	

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
			- how it can be best incorporated into the regulatory regime for rehabilitation.			the Department of Agriculture and Fisheries to better understand land capability and how to best ensure rehabilitated lands returned to grazing can best be managed. Research in technical aspects of categories 1-5 and relationship to EA conditions, as well as regulatory policy regarding management of the grazing type and intensity post-mining. This work would also consider application of co-production of renewables and livestock grazing.	
New approaches and technologies for environmental monitoring, detection and analytics	Improving GBR catchments and estuaries water quality monitoring and reporting	Application of new tools such as robotics, sensor networks and machine learning to provide better data to support decision making regarding GBR water quality	What is the feasibility of deploying fleets of drones to collect samples and deliver to a mobile lab(s)?	What are the cost / benefits of increasing sensor networks by a factor of 10?	How can the revolutionary new environmental DNA (eDNA) survey method help to monitor ecosystem health? Eg. monitoring native and exotic fauna diversity in the GBR catchments.	Can we automate real-time water quality data processing, prediction and reporting using recent advancements in machine learning?	
New approaches and technologies for environmental monitoring,	Investigating and responding to Emerging Contaminants	The department will need to investigate and develop new monitoring capabilities to rapidly detect and respond to emerging contaminants	How much do septic systems contribute emerging contaminants (including PFAS) into the environment?	What are the contaminants of emerging concern in QLD waterways? Can we use emerging technologies to assess the risk from these contaminants?	What are the risks associated with tyre particles and microplastics and related chemicals on Moreton Bay fauna and what are new ways of assessing any risk?	What are the levels of contaminants of emerging concern in urban waterways and	

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
detection and analytics		including PFAS, tyre particles and microplastics.				how much do sewage system overflows and aging sewage and stormwater infrastructure add to contamination?	
Built heritage	Digital heritage and Queensland's historical heritage	Digital technologies are increasingly being employed to record and model Queensland's historical heritage places (including archaeological and underwater cultural heritage sites), to integrate information available about those places, to manage them as assets and aid regulation of physical changes to them, and to connect the community with why those places are valued. Reflective of the increased adoption of digital technologies and methods by the planning, development and construction industries, the Department regularly receives data produced from digitisation of the State's heritage places, which has been used as the basis for archival recordings of places. A growing body of digitised historical records (photographs, architectural drawings, and newspapers) complements the Department's own ever-increasing collection of records about heritage places. There is widespread access to personal technologies that enable anyone to record and broadcast details about what they value about Queensland's historical heritage landscape. The department values research that investigates the future	How might an organisation like the Department address the challenges inherent in shifting its heritage business towards adoption of the latest digital technologies, but also towards digital thinking and the culture and processes of a digital age?	How might the Department navigate the role of statutory authority and custodian of heritage place knowledge to engage with complementary digital heritage initiatives and platforms, and facilitate broader access to the layered values and meanings associated with Queensland's historical heritage places and artefacts?	What are the key factors to consider in establishing standards for acquiring, sharing, and managing digital heritage place data for sustainability, accessibility over the long-term, and risk management?	How might the Department leverage existing and emerging digital technologies and media to demonstrate and promote best practice conservation, interpretation, and development at Queensland's historical heritage places? How might the Department implement a Building Information Modelling approach to the recording, management and promotion of Queensland's historical heritage places and its important archaeological and underwater cultural heritage artefacts?	How does an integrated digital heritage approach to Queensland's historical heritage places relate to a curatorial, materialistic view of heritage conservation practice as compared to emerging views that preference the importance of enabling an evolution of heritage values at places through community participation?

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
		potential of digital heritage to improve the recording, management and promotion of the historical heritage places and important archaeological and underwater cultural heritage artefacts it regulates under the Queensland Heritage Act 1992. It values research that proposes future-proofed solutions to synthesising the multiple strands of digital heritage to the benefit of Queensland's cultural heritage for the community and future generations.					
Built heritage	Innovative approaches to encouraging private investment in the conservation of Queensland's historical heritage places	There exists an unrealised potential for the historical heritage places of Queensland to be part of driving a sustainable social and economic future for this state. It can be argued that this potential is dormant because a view predominates that heritage conservation is burdensome without realising real value and is superfluous to more pressing human needs. This thinking ignores the prospect of our heritage places being invested in as long-term assets for a future that must adapt to climate change. Public commitment to historical heritage conservation through the actions of government is part of the picture, but its capacity to harness the full benefits of heritage places could be greatly augmented by partnerships with the private and community sectors. Recent financial innovations have delivered access to diverse new markets by combining public and private capital, but also an emergent, socially responsible investor class.	What are exemplars of public/private partnerships being used to deliver adaptive reuse of historical heritage places or areas and how would success be measured?	What public/private partnerships or other models being used in areas allied to heritage place conservation might offer useful lessons?	What are the optimal funding mechanisms for delivering sustainable conservation of Queensland's historical heritage places and areas over the long-term?		

2023 DES R&D Linkage Opportunities program: DES priority research themes and questions

DES nominated research theme	Topic	Description	Question 1	Question 2	Question 3	Question 4	Question 5
		The department values research that investigates tools or instruments that would facilitate public-private co-investment in heritage-led conservation at the level of individual places but also across districts or areas to harness the community and tourism benefits associated with meaningful and characterful urban centres.					
What Works? – translating and commercialising research	Translating and commercialising research	Consultation undertaken for the development of the Trailblazer Universities Program highlighted the importance of strengthening capability at the institutional level, emphasised the barriers to collaboration and commercialisation, and proposed solutions such as more effective IP arrangements and greater incentives for academics and institutions to translate and commercialise research.	What are the best practice, with evidence of better commercialisation outcomes, IP and commercialisation arrangements within research and innovation ecosystems that support researcher involvement in taking research to commercialisation success? In the context of supporting all of Queensland's research commercialisation efforts (noting Qld's regionality), not only a single research organisation.	What are the optimal incentives from governments and research organisations that have proven to be effective to encourage researchers and research organisations to commercialise research that leads to greater impact via commercialisation? In the context of supporting all of Queensland's research commercialisation efforts (noting Qld's regionality), not only a single research organisation.	What are the optimal collaboration mechanisms to strengthen collaboration within research and innovation ecosystems to reduce barriers to and achieve improved commercialisation rates? In the context of supporting all of Queensland's research commercialisation efforts (noting Queensland's regionality), not only a single research organisation		
What Works? – translating and commercialising research	Leading the research enterprise	This is a major learning curve – often unknown and often not pursued – when transitioning from leading your own research and research team through to being a leader of multidisciplinary teams of groups of researchers (Early, Mid, Esteemed), research infrastructure and research support services professionals (systems, services, policy) that are jointly delivering research outcomes across discovery, application, demonstration, and delivery of research. (Very senior research leaders being the focus)	What are the key attributes of high performing leaders who have made the transition from research leader to being a leader of a research enterprise?	What training and mentoring systems are optimal to assist enhanced performance of researchers considering and/or understanding the transition to being a leader of a research enterprise?	What program of activities could be provided to Queensland based researchers to support their development as leaders of research enterprises?		