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7 May 2025

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Chair Environmental Protection Authority
By email: registrar@dwer.wa.gov.au

Dear [redacted]

REFERRAL FOR ASSESSMENT

Browse Carbon Dumping Project

Conservation Council of WA
Greenpeace Australia Pacific

The Conservation Council of WA (CCWA) and Greenpeace Australia Pacific (GPAP) write to formally refer for assessment under Section 38 of the *Environmental Protection Act 1986* (WA) (**EP Act**) the Browse Carbon Dumping Project (the **EP Referral**). This project is a proposal by Woodside Energy Ltd (**the Proponent**) to attempt to transport, inject and sequester up to ~14,200 tonnes of carbon dioxide (CO_2) per day into the Calliance Storage Formation off the coast of Western Australia (the **Proposed Action**).

The project was originally referred to the Commonwealth government for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (**EPBC Act**) and is mostly described in EPBC referral 2024/10028 titled Browse Carbon Capture and Storage Project (**the EPBC Referral**).[1]

The scope of work in the Proposed Action in the EP Referral varies from that described in the EPBC Referral. In the EPBC Referral, the Proponent included up to 5 years of post-operation monitoring of the CO_2 plume. The EP Referral includes 1,000 years of post-operation monitoring of the CO_2 plume and reservoir management.

The timeframe of the Proposed Action in the EP Referral varies from that described in the EPBC Referral. In the EPBC Referral, the Proponent indicated that the Proposed Action would continue until about 31 December 2065. This proposed timing consisted of a period for construction, drilling and completion activities, followed by 31 years of operation, then 5 years of ongoing plume monitoring and decommissioning. In contrast, the Proposed Action in this EP Referral continues until at least 31 December 3060. This proposed timing consists of a period for construction, drilling and completion activities, 31 years of operation, 5 years for decommissioning and 1,000 years post-operation of ongoing plume monitoring and reservoir management.

The Proposed Action will involve impacts to Scott Reef and marine fauna from the activities involved in the installing, servicing, operation and monitoring of the carbon dioxide sequestration. CCWA and GPAP believe that assessment under the EP Act is required in order to control and mitigate impacts to the WA environment including impacts to state listed species and ecological systems of conservation significance.

The Proposed Action also presents a cumulative risk, being tied to the Proponent's proposed Browse to North West Shelf Development which was referred to the EPA in 2018 for assessment under the EP Act.

The Proposed Action is an assessable 'proposal' as defined by section 3 of the EP Act. CCWA and GPAP believe the Proposed Action is likely to produce significant direct and indirect impacts on the environment which require assessment under Part IV of the EP Act.

To our understanding, the Proposed Action has not been referred to the EPA by any other party.

About the Conservation Council of WA

CCWA is Western Australia's foremost non-profit, non-government conservation organisation representing close to 100 environmental organisations across Western Australia, with tens of thousands of engaged individuals state-wide. This broad collective of like-minded groups and

[1] Browse Carbon Capture and Storage Project https://epbcpublicportal.environment.gov.au/all-referrals/project-referral-summary/project-decision/?id=cd879297-8cc8-ef11-b8e8-0022481295e6

individuals creates a vibrant and passionate community, dedicated to the conservation of our unique and diverse state.

CCWA has been a prominent and forthright voice for conservation for more than 50 years working directly with the government, media, industry, community groups, and political parties to promote a more sustainable WA and to protect our natural environment.

About Greenpeace Australia Pacific

Greenpeace is a global environmental network dedicated to the mission of securing a world capable of nurturing life in all of its magnificent diversity. We are fully independent, accepting no funding from any government, business or political party anywhere in the world. Greenpeace Australia Pacific is an autonomous entity headquartered in Sydney with more than 1.2 million people participating in our network.

Summary of Proposed Action

The Proposed Action was described in documents submitted to the Commonwealth Department of Climate Change, Energy, the Environment and Water (**DCCEEW**) as part of the Proponent's EPBC Referral.

The Proponent provides the following project description:

> *The purpose of the proposed Browse Carbon Capture and Storage ("CCS") Project is to develop the infrastructure to transport, inject and permanently sequester up to 270 mmscfd (~14,200 tonnes of Carbon Dioxide (CO2) per day) into the Calliance Storage Formation at an expected annual average injection rate of 3 - 4 million tonnes per annum (mtpa). The CO2 will originate from the proposed Browse to NWS Project 1. About the project Browse Carbon Capture and Storage Project Application Number: 02625 Commencement Date: 08/10/2024 Status: Locked (EPBC 2018/8319), which is expected to produce approximately 80 million tonnes (this is the middle case of the range of expected outcomes) of reservoir CO2 over the life of that proposal. The Browse CCS Project will be designed to capture and permanently sequester, at a minimum, 85% of the CO2 removed from reservoir fluids ("reservoir CO2") by the Browse to NWS Project. On this basis, the Browse CCS Project is expected to enable a net reduction of greenhouse gas (GHG) emissions from the Browse to NWS Project by approximately 53 million tonnes (47%). It will also enable an additional 9 mt of CO2 that would otherwise be sent to onshore processing facilities, to be captured and sequestered.*
>
> *Key subsea infrastructure enabling operation of the proposal includes a subsea CO2 flowline connected to the Browse FPSOs and the injection sites, as well as operation of between 2 and 6 gas injection wells. A total of up to 7 wells would be drilled as part of the proposal. The CO2 stream, once separated from reservoir hydrocarbons, will be dehydrated and compressed to enable injection at the well sites by equipment that will be located on board the Browse to NWS Project Floating, Production, Storage and Offtake (FPSOs) vessels .*
>
> *The proposed Browse to NWS project initially included provisions to vent the CO2 to atmosphere, however, the Browse CCS Project is proposed to be utilised to avoid the need to vent these emissions by injecting them into an underground storage formation.*
>
> *A detailed description of the Browse CCS Project is provided within Att 1 Proposed Browse CCS Project Referral Supporting Information Document (Section 2, pg. 32).*

Scope and Battery Limits
The scope of the Browse CCS Project is limited to the following physical components:

- *Drilling and completion activities of up to seven wells, of which between two and six would be operated as part of the CO2 injection system.*
- *Installation and commissioning of a subsea CO2 injection flowline up to 130km in length, to be installed along one of two possible routes.*
- *Installation and commissioning of supporting subsea infrastructure such as communication and control umbilicals and well control infrastructure (i.e. x-mas trees).*
- *Monitoring of the CO2 plume within the Calliance Storage Formation via periodic geophysical and/or seismic surveys.*
- *Operation and maintenance of the subsea infrastructure.*
- *Capture of the CO2 stream at the outlet of the Acid Gas Removal Unit, dehydration of the CO2 stream and injection into subsea infrastructure via use of an electrically driven export compressor. This equipment will be installed and operated from the two Floating, Production, Storage and Offtake vessels (FPSO), which form part of the Browse to NWS project infrastructure.*
- *Decommissioning and removal of all infrastructure installed as part of the Browse CCS Project.*

The 'battery limits' the Browse CCS Project commences at the point at which the CO2 is separated from the Browse reservoir fluids via the Acid Gas Removal Unit (AGRU) on each of the two Browse FPSO. Operation of the AGRU and associated activities, as well as generation of electricity (and other incidental utilities) that will be used by the CCS Project are within the scope of the Browse to NWS Project.

The management and impact assessment associated with the risk of an unplanned release of concentrated CO2 stream to the Commonwealth Marine Environment is contained solely within the scope of the Browse CCS Project. Further details regarding the potential impacts, including changes to marine water composition, resulting from a highly unlikely release of CO2 from the storage formation are described in Att 7 CO2 Release and Hydrocarbon Spill Modelling Report (Appendix C). A Protected Matters Search Tool was conducted for the environment that may be affected (EMBA) for the worst case, highly unlikely spill event that may occur as a result of the proposal (See Att 8 Hydrocarbon Spill EMBA Protected Matters Search Tool Report (Appendix D)).

All other activities required for the proposed Browse CCS Project (equipment on each FPSO including product extraction from reservoirs, separation of CO2 from other reservoir fluids, generation of electricity and operation of the overall system including utilities such as cooling water) are outside the scope of this referral. These activities are all included within the scope of the activities described as part of the previously referred proposed Browse to NWS Project.

Development Envelope
The spatial extent of physical infrastructure associated with the Browse CCS Project is shown in Figure 11 of Att 1 Proposed Browse CCS Project Referral Supporting Information Document (Section 1.3.3, pg. 23). The boundary of this project area aligns with the boundary of each GHG or pipeline graticular block boundaries that either infrastructure will be installed in, or which may be affected by, the movement of the CO2 plume within the geological formation.

A second Project Area boundary is shown in Figure 12 of Att 1 Proposed Browse CCS Project Supporting Information Document (Section 1.3.3, pg. 24), to show the boundary of the area in which seismic surveys would be conducted as part of periodic surveys conducted to monitor the migration of the CO2 plume. The is no physical disturbance to the seabed associated with this activity.

The Browse CCS Project does not involve any activities in WA State Waters or within 3 nautical miles of Scott Reef above the mean high tide mark. There may be temporary and localised impact to State Waters due to noise from vessels installing or maintaining the CO2 flowline when it is in proximity to the State Waters boundary. Given the short term nature of these activities, there are no planned impacts from this activity that would have a significant effect on the environment within WA State waters and as such the proposed Browse CCS Project is not being referred under the WA Environment Protection Act 1986.

Disturbance footprint
Seabed disturbance is associated with the temporary or permanent installation, placement and decommissioning of facilities, infrastructure, and equipment, including:

- *A subsea CO2 Injection Flowline of up to 130km in total length*
- *7 injection wells (up to 6 wells will be operated, 7 will be drilled). All wells will be located along the final 10km of either the primary or alternative injection flowline route.*
- *MODU or support vessel anchors / moorings*
- *Subsea control infrastructure such as electrical and hydraulic cables (umbilicals)*
- *Associated subsea structures such as manifolds, in line tees (ILT) and end terminations (FLET)*

Other activities that may cause seabed disturbance include seabed intervention & preparation and secondary stabilisation for the CO2 Injection Flowline or subsea infrastructure and temporary wet parking of project infrastructure during construction prior to installation at the final design location.

Seabed disturbance associated with the CCS infrastructure is estimated at approximately 2.5 km2 and will only occur in deep, offshore waters (>200m deep). All disturbance due to the presence of infrastructure on the seabed is completely reversible as infrastructure will be removed as part of project decommissioning.

Drilling and completion of injection wells will generate drill cuttings, require cementing of the casing, and require the use of a range of fluids, that may be discharged to the marine environment, typically at the seabed and at or near the sea surface depending on the hole section.

The modelling undertaken in relation to the development of the Browse resource indicates that sediment deposition from well drilling would potentially occur to a distance in the order of a couple of hundred metres from each well location (in the direction of the prevailing current). This assessment aligns with several studies which indicate that the spread of cuttings can be expected to be up to about 150 m from the discharge location. Drill cuttings and retained non-water based fluid (below the surface after treatment on the drilling centre for the bottom-hole (reservoir) well sections are generally dispersed and settle within a seabed area confined to a maximum of 500 m distance of the discharge point.

Documents comprising the full EPBC Referral are available online.[2]

The scope of work in the EP Referral varies from the above EPBC Referral in that after operations have ceased, there is a need for the CO_2 plume to be monitored for at least 1,000 years. Should CO_2 leaks or reservoir instabilities be detected over that 1,000 year period, then reservoir management activities would need to be conducted to ensure the CO_2 plume is permanently and securely sequestered.

There are considerations further to the Proponent's documents that have potential to produce and exacerbate impacts, including:

- The potential for expansion and storing of carbon pollution from elsewhere, including construction of additional pipelines and injection wells.
- The long-term efficacy and operational integrity storage formation and associated infrastructure for the duration required to have enduring impact on emissions reduction.
- Public statements by the Proponent that Browse carbon capture and storage (**carbon dumping**) would be "high risk" and that the process is "unproven".

CCWA and GPAP believe the Proposed Action will produce significant environmental impacts that are both residual and cumulative.

Grounds for referral

CCWA and GPAP submit the following grounds for referral of the Proposed Action:

CCWA and GPAP believe the Proposed Action will have a significant effect on the WA environment. In particular, CCWA and GPAP are concerned that the Proposed Action will have unacceptable, residual, and cumulative environmental impacts to Scott Reef and marine fauna that are reliant on state waters in the area for migration, foraging and reproductive purposes. CCWA and GPAP submit that the relevant effects on the environment include effects on the following environmental factors:

- Marine fauna;
- Marine environmental quality;
- Coastal processes;
- Benthic communities and habitats; and
- Landforms

In particular, CCWA and GPAP wish to draw to your attention to our collective concerns (set out in further detail below in this letter) as to the following significant effects of the Proposed Action on the WA environment and key environmental factors listed above:

1. The Proposed Action is likely to have significant effects on the environmental values of Scott Reef.
2. The Proposed Action is likely to have significant effects on marine fauna, including marine fauna listed as threatened and or migratory under the *Environment Protection*

[2] Browse Carbon Capture and Storage Project https://epbcpublicportal.environment.gov.au/all-referrals/project-referral-summary/?id=13333817-2d90-ef11-8a69-0022481295e6
https://epbcpublicportal.environment.gov.au/all-referrals/project-referral-summary/project-decision/?id=cd879297-8cc8-ef11-b8e8-0022481295e6

and Biodiversity Conservation Act 1999 (Cth), and species that are listed as threatened by the Department of Biodiversity, Conservation and Attractions (DBCA); such as green sea turtles and their habitat; pygmy blue whales and their habitat; short-nosed, leaf-scaled and dusky sea snakes and their habitat.

The Proposed Action requires careful evaluation, through environmental impact assessment in accordance with the EPA's guidance documents which include:

Technical Guidance - Protection of Benthic Communities and Habitats
Technical Guidance - Protecting the Quality of Western Australia's Marine Environment

1. The Proposed Action is likely to have significant effects on the environmental values of Scott Reef

1.1 Scott Reef

Scott Reef is located in Western Australian state waters, approximately 270km off Australia's north west coast and forms part of a broader chain of reefs that includes Ashmore Reef, Seringapatam Reef, and the Rowley Shoals.[3] Scott Reef constitutes a significant and biodiverse coral reef system, with the region supporting a highly diverse ecosystem, including 1,500 species of invertebrates and nearly 900 species of fish, many of which are endemic to the area.[4]
High levels of water clarity and low levels of nutrient content allow corals to thrive in the area.[5]
Scott Reef provides a crucial habitat for a wide array of endemic and migratory species, including pelagic and plankton communities, marine invertebrates, fish, sharks, rays, marine reptiles, and marine mammals.[6]

Endangered species that use Scott Reef as critical habitat include the dusky sea snake, and the Scott-Browse genetic stock of green turtle, which utilities Sandy Islet (an important Landform) as a crucial nesting site[7] (designated as a Biologically Important Area (BIA) and Habitat Critical for Survival of a Species). The reef and its surrounds form part of the migratory route for pygmy blue whales, which utilise the area for food.[8] Scott Reef also provides foraging and resting habitats for migratory seabirds and shorebirds. Although isolated, Scott Reef is already subject to multiple environmental pressures including marine heatwaves, coral bleaching and cyclone activity.

The Proponent notes that Scott Reef hosts the largest diversity of hard corals within WA, with fourteen distinct benthic habitat types described and mapped, including extensive deep lagoonal coral habitats, of which, the scleractinian corals are the keystone species of the coral communities within the Scott Reef system and are considered to be of high conservation and ecological value.

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[3] Oceanwise, 2024. Scott Reef Review of Environmental Values and proposed Browse to North West Shelf Project Environmental Impact Statement/ Environmental Review Document

[4] Gilmour J, Smith L, Cook K, Pincock S (2013a) Discovering Scott Reef.

[5] Rayson M (2006) A Three Dimensional Hydrodynamic Model of Scott Reef, Western Australia. Bachelor of Engineering (Applied Ocean Science) with Honours , University of Western Australia

[6] Commonwealth of Australia (2012b) Protected places report card - Supporting the marine bioregional plan for the North-west Marine Region. {Department of Sustainability, Environment, Water, Population and Communities (DOSEWPC)

[7] Guinea ML (2010) Long Term Monitoring of the Marine Turtles of Scott Reef. Charles Darwin University

[8] Jenner C, Jenner M, Pirzl R (2008) A study of Cetacean Distribution and Oceanography in the Scott Reef/ Browse Basin Development Areas During the Austral Winter of 2008. Centre for Whale Research (WA) Inc

The Proponent also notes that Scott Reef is located just 5km from the project area.

1.2 Carbon dumping consists of technological and process uncertainties

Offshore carbon dumping is a technology that is unproven at scale, has never been attempted in Australian Commonwealth waters and presents numerous risks. It is also largely untested in Australia's offshore environment.

In the 2019 EIS for the Browse to North West Shelf Development[9], the Proponent gives brief consideration to carbon dumping, noting that "geosequestration" was "high risk" and "unproven":

> *"significant technical, operational and safety risks … technical feasibility as offshore geosequestration at the required scale is unproven. … Geosequestration is, therefore, a high risk, high cost mitigation option for Browse reservoir CO_2"*

The Proponent's supplementary report to the draft EIS for the Browse to North West Shelf Development dated 2022 repeats the same concerns.[10]

Documents[11] obtained under the *Freedom of Information Act 1982* (Cth) show that the Commonwealth government raised numerous concerns about carbon dumping with the Proponent, including:

- *"CO_2 toxicity in general and localised ocean acidification may arise if a loss of well control event occurs"*
- *"a new environmental risk of reinjected CO_2 escaping from the Calliance reservoir via a number of pathways, such as failed well barriers, induced fracturing of capping rocks when reinjection occurs, or escape through faults."*
- *"successful CCS programs in offshore environments are complex to execute because the technology is in its infancy, and residual uncertainty would remain"*
- *"CCS will likely require long-term monitoring of… will likely require seismic surveys over the >40-year life of the project, which would generate noise that can injure and adversely affect biologically important behaviours of marine fauna, including cetaceans that are listed as threatened under the EPBC Act."*
- *"additional drilling activities and installation of flowlines, resulting in direct and indirect impacts"*

As the delegate noted in these released documents, carbon dumping is a technology in its infancy. The delegate also noted that the action referred for assessment under the EPBC Act is a decades-long project requiring viable technologies; long-term commitment; an interdisciplinary scientific team to monitor the stability of the storage formation; statutory safeguards to protect the environment from untested or unreliable technological processes; and the capacity to provide the necessary level of expertise, monitoring, and rapid remedial actions. As per our EP Referral, the Proposed Action is actually a millenium-long project.

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[9] Woodside, 2019. PROPOSED BROWSE TO NWS PROJECT DRAFT EIS/ERD

[10] Woodside, 2022. PROPOSED BROWSE TO NORTH WEST SHELF PROJECT Supplement Report to the Draft EIS

[11] https://www.dcceew.gov.au/sites/default/files/documents/75951.pdf

It is not appropriate to 'learn by doing' in circumstances where there are significant technological and process uncertainties or incapacity, and where sensitive ecosystems are at risk of residual impact.

CCWA and GPAP highlight the need to assess the Proposed Action thoroughly and ensure management of environmental risks in:

- the exploration for 'suitable' storage formations;
- the development of extra infrastructure, for example, should the Proponent incorporate additional sources of carbon to be dumped;
- the compression of gases to liquids;
- the transportation of captured greenhouse gas substances via pipeline or vessel;
- the monitoring for migration or escape of greenhouse gas substances from storage formations;
- the management of any such migration or escape;
- the monitoring and early detection of environmental change;
- the inducing of local seismic activity; and
- the integrity of the pipelines in all conditions.

The Proponent has not clarified how the high risks and unproven nature of the Proposed Action were addressed to make the proposal feasible.

1.3 Ongoing compliance and monitoring

Carbon dumping is purportedly intended to mitigate climate change by reducing CO_2 from industrial processes entering the atmosphere. In order to achieve the Paris Agreement climate goals, CO_2 storage periods of less than 1,000 years are insufficient for neutralising remaining fossil CO_2 emissions under net zero emissions.[12]
To fulfill its intended purpose, the Proposed Action will have to include monitoring for leakage (from the storage formation and initially from flowlines), subsidence, uplift, caprock failure, reactivation of faults and well integrity loss[13] for a period of at least 1,000 years. This monitoring will involve ongoing seismic blasting and other activities.

The efficacy of long or even near-term CO_2 sequestration is not guaranteed. Issues with compliance, viability and monitoring include:

- Unexpected rapid CO_2 migration within the designated reservoir;
- CO_2 escape from the designated reservoir into previously unknown geological layers;
- changes in pressure in the storage formation;
- changes in subsurface geology;
- seismic activity; and
- difficulties in ascertaining accurate capacities of targeted formations.

[12] Brunner et al, 2024. Durability of carbon dioxide removal is critical for Paris climate goals. https://www.nature.com/articles/s43247-024-01808-7

[13] Sont. et al. 2023. Geomechanical challenges during geological CO2 storage: A review. https://www.sciencedirect.com/science/article/pii/S138589472206449X

Issues of intergenerational equity also require consideration under these lengthy monitoring timescales. Future generations should not be responsible for ongoing monitoring or remedial actions, and should not bear the responsibility for the environmental risks or actual impacts of offshore carbon dumping.

While trailing liability for these processes is said to be enduring, the risk of government liability for compliance monitoring and environmental impact assessment exists where monitoring is required on geological timescales.

Additionally, CCWA and GPAP believe there should be regulatory evaluation of the risks in operating at the specified location. How will compliance for the transport, injection, storage, and monitoring of greenhouse gas substances be managed at such a remote offshore location and/or over a large area?

The long timeframes required for storage make the risks of unplanned leakage and potential consequences even more significant.

1.4 Induced Seismicity

Carbon dumping carries the risk of inducing seismic activity, including earthquakes, when large volumes of gas are injected underground.[14] Fault systems are difficult to detect and have complex activation mechanisms. Injection-induced seismic activity in the proposed area will compromise storage integrity and has potential to cause ground deformation (subsidence or uplift)[15] via fracture or reactivation of faults, leading to ground offset or the compaction and settling of unconsolidated sediments.

Subsidence and uplift can occur over a broad region around faults, which is pertinent in the context of Sandy Islet, a landform that provides a critical nesting rookery for green sea turtles that sits just above sea level.

Scott Reef and Sandy islet are already at risk of subsidence as a consequence of the proposed Browse to North West Shelf Development if it were to proceed. Further subsidence from the Proposed Action could accelerate the decline of reef health and threaten the existence of Sandy Islet by way of relative sea level rise, reduced reef accretion, increased erosion and increased frequency of saltwater overtopping.[16]

The potential for subsidence from gas extraction is poorly understood, with limited research available on its long-term effects in this region. The evaluation, prediction and control of CO_2 injection-induced seismicity is difficult and adds further risk and uncertainty to the Proposed Action.

1.5 Carbon dioxide leakage and ocean acidification

[14] Cheng et al, 2023. Seismicity induced by geological CO2 storage: A review. https://www.sciencedirect.com/science/article/abs/pii/S0012825223000582

[15] Styron, Coseismic Uplift and Subsidence: An underappreciated seismic threat. https://blogs.openquake.org/hazard/2019/11/19/coseismic-uplift-subsidence/

[16] Oceanwise, 2024. Scott Reef Review of Environmental Values and proposed Browse to North West Shelf Project Environmental Impact Statement/ Environmental Review Document

As noted by a Commonwealth government delegate considering the Proposed Action, "CO_2 toxicity in general and localised ocean acidification may arise if a loss of well control event occurs".[17]

CO_2 leakage from carbon dumping can occur via various mechanisms, including injection well failure, flowline rupture, injection-induced seismic activity, undetected faults, sealing failures, fractures, and poor site selection.

The impacts of unplanned CO_2 release in the marine environment are not well understood but could be significant. Large leaks may cause widespread water acidification and asphyxiation of marine life[18], while long-term leaks may lead to species being unable to adapt to the change in environmental conditions and alter the diversity, composition and function of nearby ecosystems.[19] Plumes can also be pulled by currents and continue to lower ocean pH as they move.[20] CO_2 leakage is also of consequence for marine benthic ecosystems, due to the dissolution of sedimentary carbonate.[21]

Upon exposure to water, carbon dioxide can form carbonic acid, which is corrosive and may further compromise well and pipeline integrity.[22] Common acid-forming impurities like sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) in CO_2 streams also contribute to a much greater corrosion potential than natural gas.[23] Because of the limitations of capture technologies, CO_2 transported through pipelines is likely to contain impurities, threatening pipeline integrity.[24]

Severe weather also increases the risks of straining CO_2 pipelines by eroding their support structures or subjecting them to heavy water flows that can cause them to rupture.

Proponent documents included with the EPBC Referral[25] note that the Proposed Action will involve the "operation of between 2 and 6 gas injection wells. A total of up to 7 wells would be drilled as part of the proposal."

The documents model the outcomes of two subsea CO_2 release outcomes:

- Scenario 1 is described as a 'Subsea uncontrolled release, full bore CO_2 injection well "blowout" for 77 days at the worst-case volume. The release was assumed to be coming from a subsea injection well location.' The Proponent notes that 'the larger capacity of the reservoir would maintain the pressure and flow that would be generated by a full-bore

[17] https://www.dcceew.gov.au/sites/default/files/documents/75951.pdf

[18] Pham et al. 2016. Consequence Study of CO2 Leakage from Ocean Storage. https://www.sciencedirect.com/science/article/pii/S1877705816310669#:~:text=A%20leakage%20of%20this%20stored,influence%20on%20the%20marine%20life

[19] Molari et al, 2018. CO2 leakage alters biogeochemical and ecological functions of submarine sands. https://www.science.org/doi/10.1126/sciadv.aao2040

[20] *Potential impacts of CO 2 leakage in the ocean*. (n.d.). Strategies for Environmental Monitoring of Marine Carbon Capture and Storage.

[21] James et al, 2021. Assessing Sedimentary Boundary Layer Calcium Carbonate Precipitation and Dissolution Using the Calcium Isotopic Composition of Pore Fluids https://www.frontiersin.org/journals/earth-science/articles/10.3389/feart.2021.601194/full

[22] Gregory Cooney et al., *Evaluating the Climate Benefits of CO2-Enhanced Oil Recovery Using Life Cycle Analysis*, 49, Environ. Sci. Techfebnol., 7491–7500 (2015).

[23] Steven Jansto, *Risks and Potential Impacts from Carbon Steel Pipelines in Louisiana Transporting and Processing Variable Produced Gases such as Carbon Dioxide (CO2), Hydrogen (H2), Methane (CH4)* (2022)

[24] V. E. Onyebuchi et al., *A systematic review of key challenges of CO2 transport via pipelines*, 81, Renew. Sustain. Energy Rev., 2563–2583 (2018).

[25] WEL CO2 Modelling for Offshore CCS Project Report, 2023.

blowout until intervention', which could take multiple months.

- Scenario 2 is described as a 'Short-term (17-hour) CO_2 release from a subsea flowline rupture.' In this scenario, 'if the pipeline were to rupture, higher rates of discharge of CO_2 would occur resulting in release of the entire CO_2 inventory of the pipeline in a short period.'

Despite the Proposed Action comprising up to 7 wells, 6 of which may be CO_2 injection wells, and up to 130km of CO_2 injection flowline along two possible routes, only two release points were modelled, as shown in Figure 1. Proponent documents model CO_2 release locations within close proximity to Scott Reef and the state waters surrounding Scott Reef, with one being on the boundary of the State and Commonwealth waters that surround Scott Reef.

REPORT

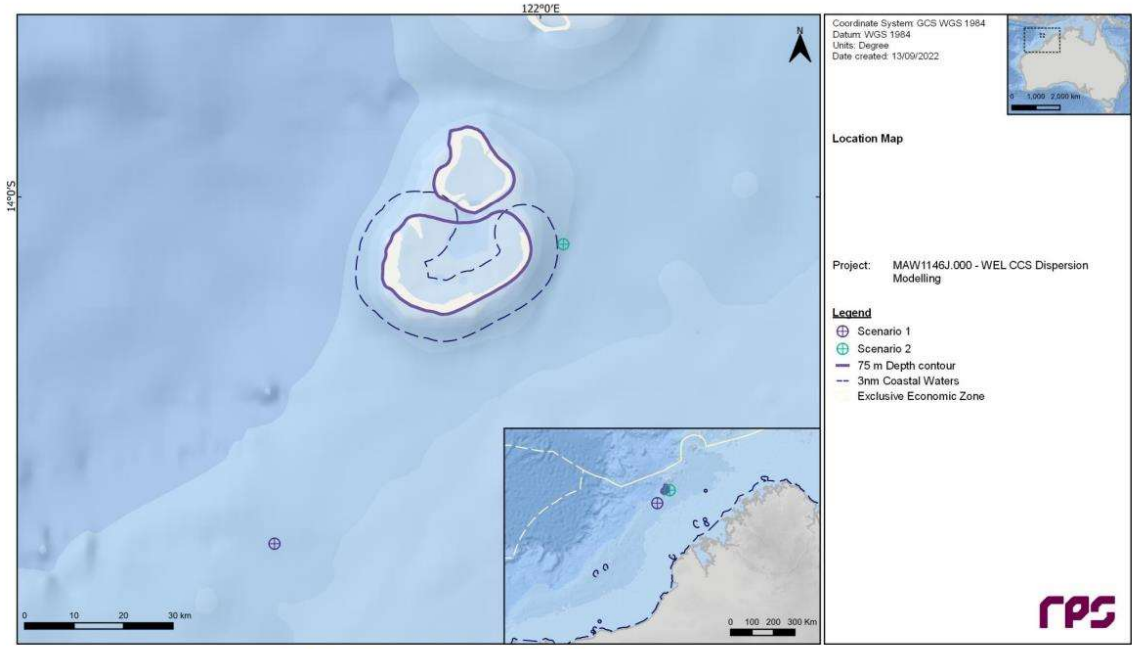

Figure 1-1 CO_2 release locations, near Scott Reef, off the Kimberley Coast Western Australia.

Figure 1: Two modelled CO_2 release locations.

Both release outcomes have the potential to release significant amounts of CO_2 and other particulates into the marine environment. Figure 2 shows that average CO_2 mass flowrate resulting from a pipeline rupture could be over 4,900kg/s. Given the scenario 2 CO_2 release location, a flowline rupture would immediately impact state waters at Scott Reef.

REPORT

Table 2-5 Average CO_2 mass flowrates and mass flux velocities assumed for the blowout scenario over 11 weeks of discharge.

Property	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
Average CO_2 blowout mass flowrate (kg/s)	82.87	75.90	63.19	48.00	39.07	32.95	29.85	28.22	26.90	25.90	25.03
Mass-flux-based velocity (m/s)	46.82	43.39	38.53	28.91	23.24	19.21	16.83	15.79	15.00	14.40	13.89

Table 2-6 Average CO_2 mass flowrates and mass flux velocities assumed for the pipeline rupture scenario over 17 hours of discharge.

Property	Hour 1	Hour 2	Hour 5	Hour 8	Hour 11	Hour 17
Average CO_2 blowout mass flowrate (kg/s)	4905.1	1043.9	464.4	229.1	135.9	49.8
Mass-flux-based velocity (m/s)	108.8	23.2	10.3	5.1	3.0	1.1

Figure 2: Average CO_2 mass flowrates for blowout and pipeline rupture scenarios.

Scenario 1 modelling shown in Figure 3, shows a CO_2 plume with significant geographic spread. Given this is one of up to 7 wells, 6 of which could be CO_2 injection wells, outcomes such as scenario 1 pose a risk to marine fauna that move between the state waters surrounding Scott Reef and Commonwealth waters to the south of Scott Reef for migratory or foraging purposes, such as the pygmy blue whale.

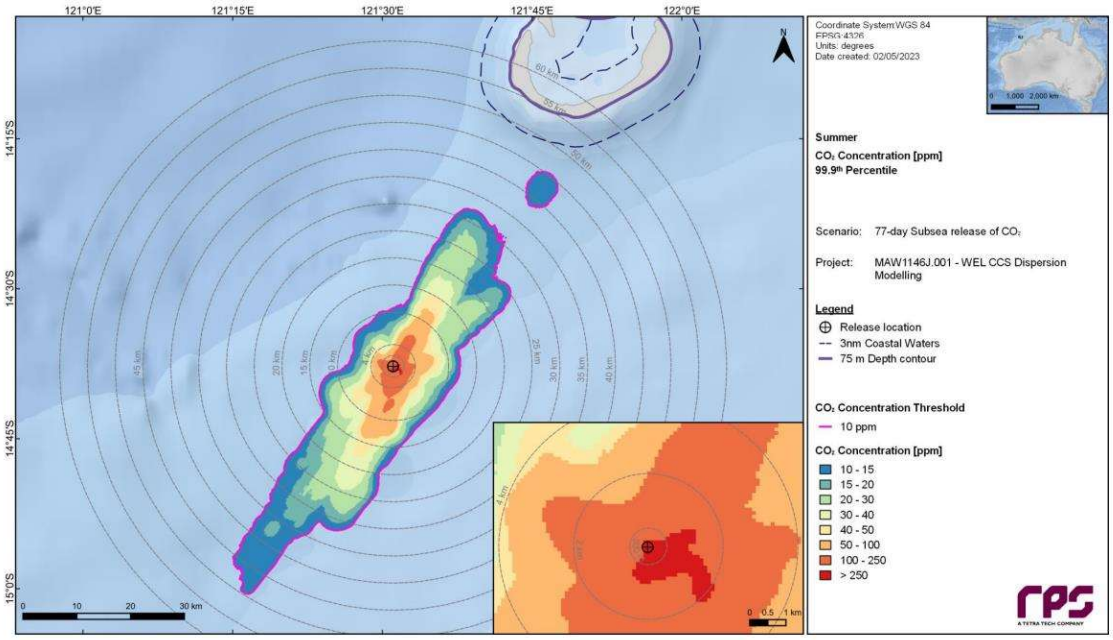

Figure 4-10 Predicted CO_2 concentration at the 99.9th percentile resulting from a 77-day Subsea release of CO_2 under summer conditions.

Figure 3: Modelled CO_2 concentrations at the 99.9th percentile resulting from a 77-day subsea release of CO_2.

The Proponent plans to conduct seismic blasting survey monitoring of CO_2 plumes once every five years during operations. This suggests that containment leaks may go undetected for years and that the 77-day time period modelled for subsea release of CO_2 is insufficient.

The EPBC Referral[26] purportedly shows that a subsea flowline rupture beside Scott Reef could temporarily reduce the pH of the localised waters by up to 0.2 pH units. This acidification could extend 4.9km from the source of the rupture over the duration of the blowout event, demonstrating a clear impact on state waters.

Scott Reef lies just 5km from the proposed flowline. At best, the results seem to indicate that Scott Reef would be on the brink of being impacted by a change of 0.2 pH units. However, modelling is inherently uncertain. Modelling the novel risk of a CO_2 release carries a high level of uncertainty given that carbon dumping technology is still in its infancy with few historical examples of CO_2 release events.

The Proponent has inappropriately drawn from modelling to purportedly demonstrate that a sudden acidification event would not be toxic to the marine fauna and benthic communities at Scott Reef. Gradual acidification over decades or centuries is not comparable to a sudden and

[26] WEL CO2 Modelling for Offshore CCS Project Report, 2023.

abrupt change in pH and it cannot be assumed that conclusions drawn from studies of gradual acidification translate to situations involving sudden pH changes.

1.6 Proximity to State Waters

The Proposed Action is in very close proximity to state waters and will impact WA environmental factors in multiple ways.

Figure 4 shows the proposed development area boundary for the Proposed Action. CCWA and GPAP note that the development area boundary is inconsistent in relation to the berth given to the east and the west of the flowline. The Proponent shows that the easterly boundary lies approximately 7km away from the primary CO_2 injection flowline, however the westerly boundary skirts or even touches the 3nm boundary of the state waters of Scott Reef.

The location of the Proposed Action risks resulting in various impacts on state waters and WA environmental factors due to:

- Noise and disturbance from installation and operation of flowline in close proximity to Scott Reef and Scott Reef state waters.
- Variability in construction and flowline movement over the course of construction and operation.
- Marine fauna that would normally migrate through or feed at Scott Reef instead avoiding the area due to noise and disturbance.
- The development area boundary enveloping Scott Reef and WA state waters for 180-degrees to the south-east side of Scott Reef.
- Interaction with infrastructure in state waters - the Proposed Action is directly linked to, and reliant upon, the Browse to North West Shelf Development, which proposes to cross into Scott Reef state waters.
- The flowline immediately bordering the Scott Reef state waters boundary. Any CO_2 release from a subsea flowline will immediately enter state waters and impact the state marine environment.
- Large CO_2 release or hydrocarbon release from any of the injection wells or subsea flowlines will impact state waters or marine fauna that are dependent on nearby state waters.

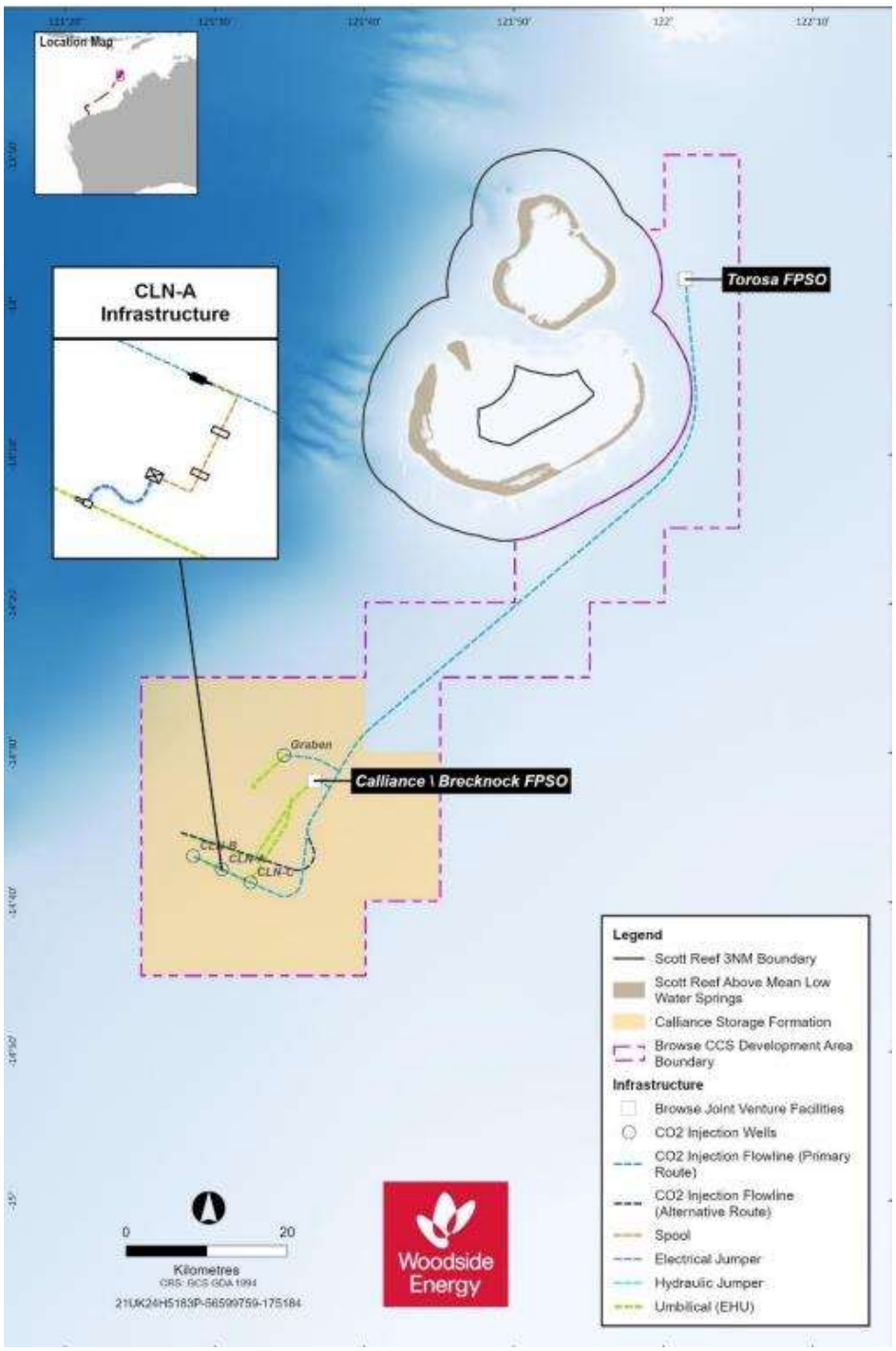

Figure 4: Browse Carbon Dumping Area Boundary in relation to Scott Reef and WA state waters.

Scenario 2 outcomes can occur at any point along the subsea flowline. Figures 1 and 4 demonstrate that CO_2 release points along the flowline would be located in close proximity to the boundary of state and Commonwealth waters, and will have a direct impact on environmental factors under state consideration.

1.7 Installation

The installation of 130 kilometres of flowline along the outer boundary of Scott Reef state waters has the potential to impact water quality, marine fauna and benthic communities. Underwater

industrial activity has the potential to suspend solids and contaminate sediment through the discharge of untreated wastewater, heavy metals, chemical fluids and other toxic substances, posing long term risks to marine life.

1.8 Hydrocarbon Release

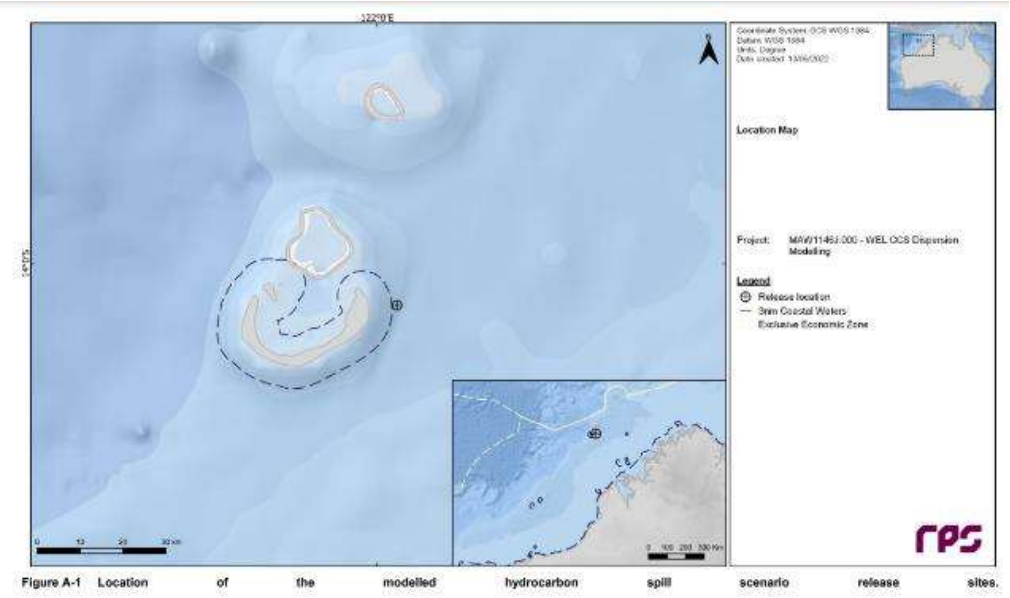

Figure 5: Location of the modelled hydrocarbon spill scenario.

In the EPBC Referral[27], the Proponent modelled various scenarios of short-term (instantaneous) surface release of 2,000 m3 of marine diesel. The location of the modelled hydrocarbon spill scenario is displayed in figure 5.

Predicted annualised probability of floating oil, shoreline oil, entrained oil, and dissolved aromatic hydrocarbon concentrations all show impact to state waters and to Scott Reef. In all modelled scenarios, the hydrocarbons breach state waters; in many cases the hydrocarbons completely engulf Scott Reef and in some cases the hydrocarbons spread all the way to state waters off the Kimberley coast (see figure 6).

[27] WEL CO2 Modelling for Offshore CCS Project Report, 2023.

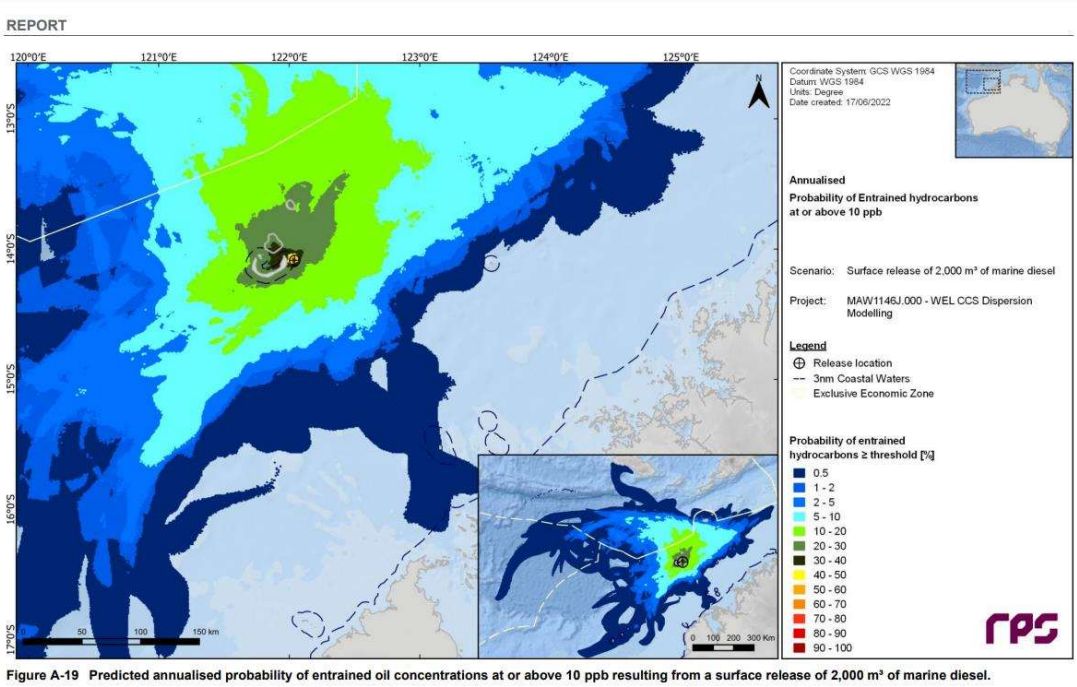

Figure A-19 Predicted annualised probability of entrained oil concentrations at or above 10 ppb resulting from a surface release of 2,000 m³ of marine diesel.

Figure 6: An example of predicted entrained oil concentrations resulting from a marine diesel spill.

Hydrocarbon spills present a risk to emergent reefs, coastal systems, intertidal zones, shoreline habitats, and marine fauna that interact with the ocean surface. Any hydrocarbon release from the Proposed Action will have great likelihood of impacting coastal processes at Sandy Islet.

The modelling submitted by the Proponent[28] found that if a major marine diesel spill were to occur:

- There would be a 46.5% probability of impactful (i.e. above defined threshold limits) floating oil concentrations contacting Scott Reef (3.5% probability of contacting Sandy Islet).
- There would be a 10.5% probability of impactful (i.e. above defined threshold limits) shoreline oil concentrations contacting Scott Reef and Sandy Islet.
- Accumulated concentrations of floating and shoreline oil could reach 10,161 g/m2 at Scott Reef and Sandy Islet.
- There would be a 54.5% probability of impactful (i.e. above defined threshold limits) entrained oil concentrations contacting Scott Reef.
- Oil exposure would occur, at a minimum, 153 km from the source of the release in the case of a worst case spill, and entrained oil concentrations equal to or greater than the 10 ppb and 100 ppb thresholds are predicted to be found up to 908 km and 589 km from the spill site, respectively.
- Low-volatility components of the oil are expected to persist for an extended period as residual oil.

Unplanned hydrocarbon release from the Proposed Project may impact Scott Reef and Seringapatam Reef and result in coral mortality. Scott Reef hosts the largest diversity of hard corals in WA and has fourteen distinct benthic habitat types. The southern portion of Scott Reef is home to deep lagoonal coral habitats that are unique to this part of the reef and are "the keystone

[28] WEL CO2 MODELLING FOR OFFSHORE CCS Project Report, 2023.

species of coral communities within the Scott Reef System which are considered to be of high conservation and ecological value"[29].

Scott Reef supports a variety of life-sustaining corals, including an abundance of the threatened *Acropora tenuis* coral[30], a calcium carbonate-secreting hard coral that is essential to the longevity and strength of coal reef habitats.[31] Scientific findings have demonstrated that exposure to oil condensate at high concentrations can be detrimental to coral larvae growth.[32] Given the proximity of the project area to Scott and Seringapatam Reefs, the impacts a hydrocarbon release could have on the corals and coral reef-dependent marine life at Scott and Seringapatam Reefs are of high risk.

These types of impacts would severely, and perhaps irreversibly, damage Scott Reef and Sandy Islet.

1.9 Summary

Scott Reef and its surrounds contain a diverse assemblage of marine species and ecosystems with high biodiversity values. CCWA and GPAP submit that the Proposed Action risks having a significant impact on state environmental factors pertinent to Scott Reef, including marine environmental quality, benthic communities and habitats, coastal processes and landforms.

Injecting CO_2 under the seabed presents uncalculated risks and untested monitoring challenges, with potential for induced seismicity, mass CO_2 release, and hydrocarbon release.

These risks have never been confronted at scale, and the magnitude of offshore injection contemplated by the Proponent would create unprecedented challenges in managing reservoir pressure and monitoring CO_2 plumes in the depths of the ocean. Scaling offshore carbon dumping would also require a massive buildout in onshore and offshore infrastructure, pipelines, and other CO_2 transport vessels, like ships and railcars, which pose additional environmental, human rights, health, and safety risks from displacement, leaks, ruptures, and other disturbances.

Proposed CO_2 dumping locations are concentrated in two areas most prone to leaks. The single biggest risk of CO_2 leakage comes from the interaction of injected CO_2 with legacy oil and gas wells. And yet the sites being heavily targeted for offshore carbon dumping are zones of long-standing, intensive oil and gas drilling, where old wells abound.

The failure of industry and regulators to manage this existing offshore infrastructure calls into question their ability to safely manage the entirely new network of undersea equipment required for offshore carbon dumping. Failures, leaks and accidents could pose major hazards to sensitive marine organisms and make the surrounding seawater more acidic, compounding ongoing ocean acidification.

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[29] Referral ATT 1: Proposed Browse CCS Project Referral Supporting Information Document, p 71.

[30] Woodside (December, 2019), 'Benthic Habitats - Change in Water Quality - Coral", Proposed Browse to NWS Project Draft EIS/ERD, p 652 https://www.woodside.com.au/docs/ default-source/current-consultation-activities/australianactivties/propsed-browse-to-north-west-shelf-project---drafteis-erd.pdf

[31] Coral Reef Alliance, 'How Reefs Are Made', Coral Reef Alliance, https://coral.org/en/coral-reefs-101/howreefs-are-made/#:~:text=Coral%20reefs%20are%20built%20 by,whips%2C%20do%20not%20produce%20reefs

[32] Andre P. Negri et al (February 19th, 2016), 'Acute ecotoxicology of natural oil and gas condensate to coral reef larvae - Effects of condensate and UV on coral and sponge larvae', Nature - Scientific Reports - Articles, https://www.nature.com/articles/srep21153#Sec2

Injecting CO_2 into areas where leaks from oil and gas wells go undetected, unreported or unresolved[33] would not guarantee "permanent" storage.

The Proponent has inadequately demonstrated that the carbon dumping activities will not impact ecologically important benthic communities outside of the proposal footprint in state waters, and has failed to account for the direct and indirect impact to marine species reliant on these communities.

The scale and nature of the impacts of the Proposed Action are significant, complex and will require substantial analysis and assessment. In particular, the project:

- engages with a novel and untried method of carbon dumping in Australia;
- is located in a remote area with complex marine, meteorological and climatological conditions;
- is predicted to impact multiple environmental factors in multiple ways, varying from acute short-term impacts to long-term changes to the local environment;
- and will contribute to cumulative impacts and interact with other complex developments in the area, namely, the Browse to North West Shelf Development.

CCWA and GPAP submit that the health of Scott Reef should be prioritised for protection and that the potential effects on the environmental values of Scott Reef, including marine environmental quality, coastal processes, benthic communities and habitats, and landforms require proper assessment under Part IV of the EP Act.

2. The Proposed Action is likely to have significant effects on marine fauna

Scott Reef and its surrounding waters, both state and Commonwealth, support approximately 1,500 species of invertebrates; at least 898 species of fish; a diverse and abundant assemblage of sharks and rays; at least nine reef-dwelling species of sea snake; the Scott-Browse genetic stock of green turtle; and at least eight marine mammal species, with an additional 21 species likely to occur. "Incomplete knowledge of taxa present in these habitats means the number of species is likely an underestimate"[34].

Scott Reef is also critical habitat for threatened species, including the Dusky Sea Snake, the genetically distinct Scott-Browse Green Turtle and Hawksbill Turtle. A list of EPBC listed Threatened and Migratory species within the Proposed Action's boundary as identified by the Proponent is provided in Proponent's EPBC Referral. The area is also a critical habitat for species listed as threatened by the Department of Biodiversity, Conservation and Attractions.[35]

There is a lack of data on the spatio-temporal habitat use of many of these species and their resultant interactions with the Proposed Action, making it difficult to predict the potential impact of noise, light, pollution and geologic disturbance on these populations.

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[33] https://www.watoday.com.au/national/western-australia/santos-wells-have-been-leaking-gas-into-the-ocean-off-wa-for-a-decade-20230612-p5dg0d.html

[34] Scott Reef Review of Environmental Values and proposed Browse to North West Shelf Project Environmental Impact Statement/ Environmental Review Document. OceanWise 2024.

[35] Threatened species and communities https://www.dbca.wa.gov.au/management/threatened-species-and-communities

As illustrated in figure 7 and figure 8, the EPBC Referral[36] shows a clear interaction and or overlap between state waters, the development area boundary and species dispersal - in this case pygmy blue whales and green turtles. These areas of overlap and interaction are critical to species survival, with impacts of the Proposed Action present both in state waters and while traversing between state waters and the project area boundary.

Faunal species that will be impacted by the Proposed Action have foraging and migration distribution patterns that span large spatial scales and are of a varying nature in terms of both horizontal (east-west) and vertical (north-south) movement on the surficial plane, and movement through varying depths.

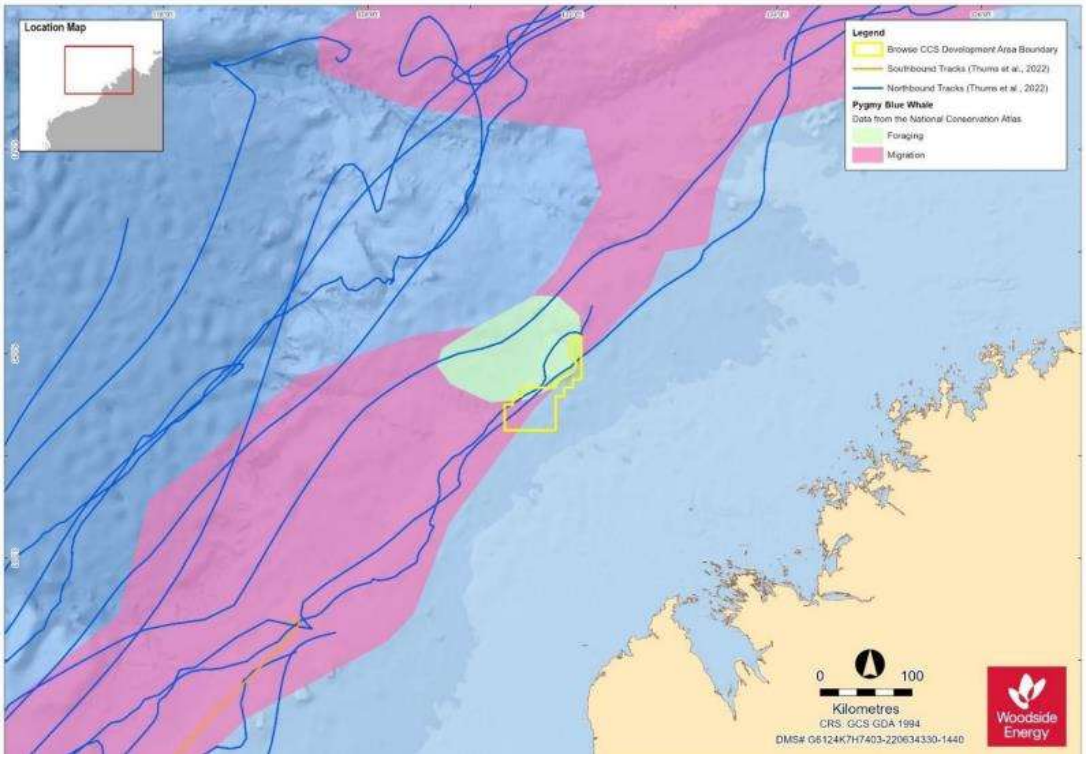

Figure 7: Biologically important areas (migration and foraging) for pygmy blue whales relevant to the project area, as provided by the Proponent.

[36] Referral ATT 1: Proposed Browse CCS Project Referral Supporting Information Document.

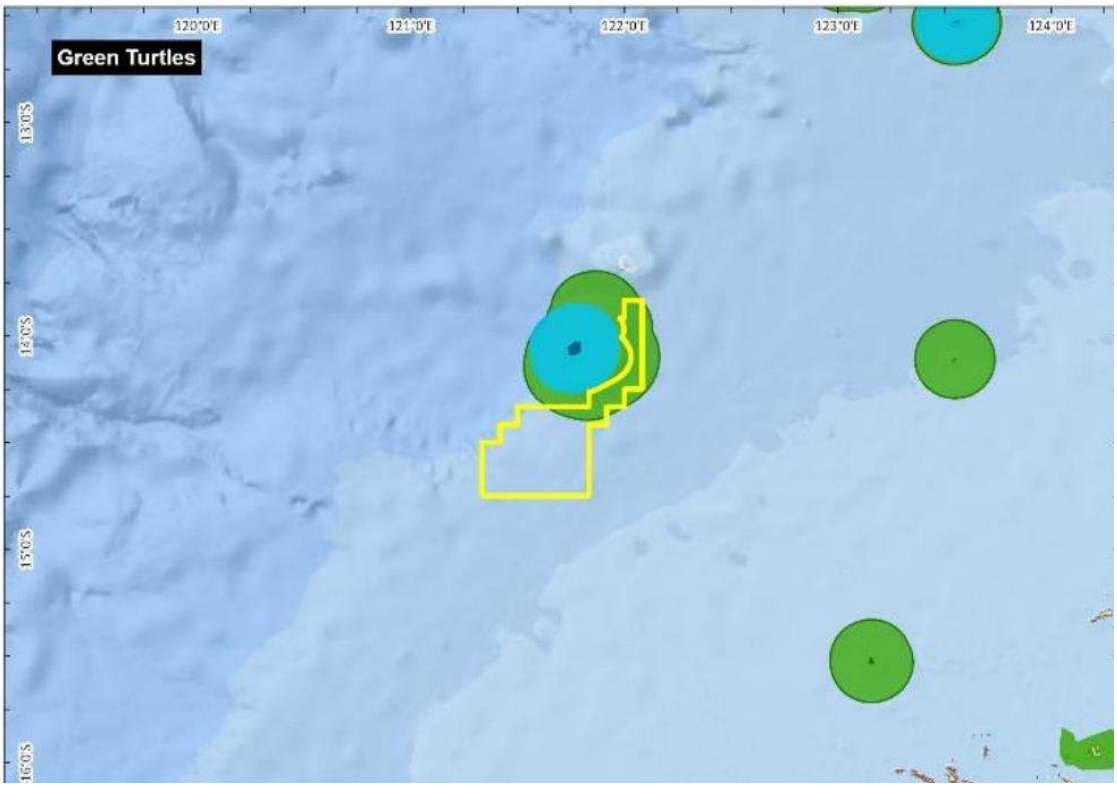

Figure 8: Biologically important areas (internesting and foraging) for green turtles relevant to the project area, as provided by the Proponent.

2.1 Risks from ongoing seismic blasting used for monitoring

The monitoring program for the Proposed Action will be at a remote offshore location and will require ongoing seismic blasting and other monitoring methods to ensure storage compliance, in perpetuity.

Direct impacts of underwater noise on marine fauna, particularly cetaceans, can lead to severe outcomes such as mortality, physical injury, auditory impairments (both permanent and temporary), auditory fatigue (a reduction in sound perception), auditory masking (where anthropogenic noise obscures biologically important sounds), and behavioural disturbances.[37,38]

A diverse array of marine organisms depend on natural soundscapes for critical life processes. For instance, noise interference has been identified as a threat in the Recovery Plan for Marine Turtles in Australia.

The Proponent did not provide its Measurement, Monitoring and Verification (**MMV**) Program with its EPBC Referral. Neither the time frame for the MMV, nor the precise processes that will be involved, are clear.

The Proponent notes that the MMV will be adopted with additional aspects to include monitoring of the injection plume beyond cessation of injection and including seabed/seawater chemical

[37] C. Peng et al., 'Noise in the sea and its impacts on marine organisms', International Journal of Environmental Research and Public Health, vol. 12, 2015, p. 2, https://www.ncbi.nlm.nih.gov/ pmc/articles/PMC4626970/

[38] Erbe et al. 2019. Managing the Effects of Noise From Ship Traffic, Seismic Surveying and Construction on Marine Mammals in Antarctica https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2019.00647/full

composition monitoring in response to any leakage of CO_2, and periodic seismic blasting to monitor migration of the plume. The Proponent's EPBC Referral states that it will "…decrease the monitoring activities if the plume migration behaviour is as expected during the injection period".

The back-up plans set out in the EPBC Referral for addressing a leak or catastrophic storage formation breach (beyond further monitoring obligations) are not clearly defined.

2.2 Risks to marine fauna from the Proposed Action

Marine fauna are at risk from direct, indirect, and cumulative impacts from the Proposed Action, including:

- Seabed subsidence (or expansion) from ongoing oil and gas extraction/storage activities, which can cause environmental impact and lead to infrastructure damage, such as to flowlines.
- Ongoing seismic blasting for direct carbon dumping activities but also for containment monitoring purposes.
- Noise and light pollution leading to behavioural disturbances and communication masking.
- Drilling activities.
- Discharge of putrescible and sewage waste.
- Discharge of other hazardous wastes affecting water quality.
- Increased vessel movements, vessel strikes and interactions between marine fauna and equipment.
- CO_2 leakage producing CO_2 toxicity.
- Unplanned catastrophic loss of containment producing CO_2 toxicity.
- Impacts from climate change and rising sea levels, exacerbated by continued fossil fuel extraction and use, and including from the significant contribution to greenhouse gas emissions from the facilitation of the Browse to North West Shelf Development.
- Changing the characteristics of the marine environment.

These risks are amplified where there is little available knowledge on the ecological needs of species or of the specific risks from climate impacts; the risks from seismic blasting; the risks from pollution exposure and CO_2 toxicity; and cumulative risk.

2.3 Risks to marine turtles

The Proponent has identified four species of threatened marine turtle in the footprint of the Proposed Action. However, all six species of marine turtle found in Western Australian waters are likely to use the area around Scott Reef. The Green Turtle is of particular concern, due its genetic isolation and requirement for critical breeding sites and foraging habitat at Scott Reef (Sandy Islet). Some of these turtles stay at Scott Reef all year round, but some migrate to and from these habitats through deepwater development areas within the footprint of the Proposed Action,[39] where they will be exposed to the full range of threats, as listed above. The especially vulnerable time when hatchling turtles disperse, requires closer consideration in any risk assessment.

The main risks to marine turtles from the Proposed Action include: light pollution; underwater noise and ongoing seismic blasting programs directly affecting turtle behaviours or indirectly by

[39] Ferreira et. al. (2020). Multiple satellite tracking datasets inform green turtle conservation at a regional scale. https://doi.org/10.1111/ddi.13197

affecting food resources or prey behaviours; unplanned and/or uncontrolled pollution events directly affecting turtle breeding areas or indirectly by affecting food resources; vessel strike; and introduction of invasive species.

Noise and other emissions do not have to impact directly on Scott Reef to affect marine turtles, if the turtles rely on their internesting migratory pathway to be free of impacts. For example, pollutants such as noise can induce alarm responses at 2km from seismic blasting operations and behaviour indicative of avoidance at 1km, which may cause turtles to avoid their traditional feeding and breeding grounds.

Marine animals like the Green Turtle are highly sensitive to exposure to oil spills, with research showing that sea turtles that become heavily coated in oil are unlikely to survive without human intervention.[40] Turtles must regularly come to the ocean surface to breathe and, in doing so, would in the instance of an oil spill be exposed to the physical (smothering) and toxic effects of chemical and vapour exposure. Oil from spills does not just collect on the ocean surface but can be present in water columns that Green Turtles migrate through.[41] Harm or mortality can also be caused if oil is ingested, contaminates food sources, or reduces food availability. Sea turtles are particularly vulnerable to population-level impacts due to their highly migratory nature and reliance on multiple different habitat areas that could be impacted by an oil spill (e.g. beach, nearshore habitats, foraging grounds, open ocean). Oil exposure is also highly toxic to turtle eggs, hatchlings, and nesting sites.[42]

Artificial light pollution associated with the construction and operation of offshore oil and gas facilities can interfere with natural behaviour of green turtle hatchlings, which utilise moonlight for orientation and navigation.

2.4 Risks to sea snakes

Sea snakes, such as the dusky sea snake, the short-nosed sea snake and the leaf-scaled sea snake are at risk from construction operations, ongoing seismic blasting monitoring operations, and unplanned pollution events, including from loss of CO_2 containment. Sea snakes are also particularly sensitive to low frequency sounds. More research is required to further assess the vulnerability of sea snakes to anthropogenic noise.[43]

There have been "sustained declines in the abundance and diversity of sea snakes at Ashmore Reef…"[44] since 2005, with the reef being devoid of snakes since 2012.[45] The causes of these declines have been hypothesised[46] as:

[40] Milton et. al. (2003). Oil and Sea Turtles: Biology, Planning, and Response. https://www.reefrelief.org/wp-content/uploads/oil-turtle1.pdf

[41] National Oceanic and Atmospheric Administration (NOAA). (2016). How Do Oil Spills Affect Sea Turtles?

[42] Recovery Plan for Marine Turtles in Australia.

[43] Chapuis, L.; Kerr, C.C.; Collin; Hart, N.S.; Sanders, K.L. (2019), Underwater hearing in sea snakes (Hydrophiinae): First evidence of auditory evoked potential thresholds. J. Exp. Biol. 222.

[44] Lukoschek, V., Beger, M., Ceccarelli, D., Richards, Z., & Pratchett, M. (2013). Enigmatic declines of Australia's sea snakes from a biodiversity hotspot. Biological Conservation, 166, 191–202. https://doi.org/10.1016/J.BIOCON.2013.07.004

[45] Lukoschek, V. (2018). Population declines, genetic bottlenecks and potential hybridization in sea snakes on Australia's Timor Sea reefs. Biological Conservation, 225, 66–79. https://doi.org/10.1016/j.biocon.2018.06.018

[46] Somaweera, R., Udyawer, V., Guinea, M. L., Ceccarelli, D. M., Clarke, R. H., Glover, M., Hourston, M., Keesing, J., Rasmussen, A. R., Sanders, K., Shine, R., Thomson, D. P., & Webber, B. L. (2021). Pinpointing Drivers of Extirpation in Sea Snakes: A Synthesis of Evidence

- Environmental events increasing susceptibility to pathogens.
- Increases in predator abundance causing changes in trophic structure.
- Increases in vessel traffic.
- Other unidentified factors.

However, the key threatening processes for sea snakes in WA are yet to be conclusively defined.[47] These data gaps are significant and thus restrict the development of comprehensive conservation strategies to protect sea snakes at Scott Reef.

Importantly, Scott Reef "supports the largest known population of the dusky sea snake and is the remaining stronghold for this species"[48]. The Dusky Sea Snake is listed as Endangered under the EPBC Act due to:

> "…a severe, possibly very severe, reduction in numbers over the last three generations, a restricted distribution, and a continuing decline in the area, extent and quality of habitat, area of occupancy, and number of mature individuals…primarily due to climate change, oil pollution, and excessive marine noise[49]….[E]xcessive marine noise that are inferred – in the absence of adequate monitoring data – to have had a direct, significant, and ongoing impact on the dusky sea snake…[and] [c]ritical reef habitat continues to be at risk from oil spill and other pollutants".[50]

Accordingly, noise (from vessels, drilling and ongoing seismic blasting activities), and pollution (waste, chemical discharges, unplanned pollution events) from the Proposed Action will create a significant, albeit undefined, risk to the sea snakes. Without clear data on the explicit causes of sea snake decline, but in the understanding that it is likely a result of impacts from fossil fuel extraction, marine heatwaves, and increasing ocean acidification, new fossil fuel projects (including carbon dumping operations) must be properly assessed.

Sea snakes are prone to mortality from seismic blasting through "fatal barotrauma from intense sound".[51] These reptiles have a lung that extends through a third of their body, allowing them to store oxygen for long dives. The air-filled cavity in their lung can be damaged by intense underwater shock waves from seismic blasting, potentially resulting in severe trauma or death.

2.5 Risks to marine mammals

Marine mammals are at risk from impacts to food resources due to pollution (including ocean acidification events and noise from seismic blasting), from direct exposure to chemical pollutants, from vessel strike, and from exclusion to areas subject to seismic blasting.[52] Risk assessments by the Proponent, concluding low ("not significant") risk to whale species of conservation significance, are not clearly substantiated in the EPBC Referral.

From Ashmore Reef. Frontiers in Marine Science, 8, 559. https://doi.org/10.3389/FMARS.2021.658756/BIBTEX Pinpointing_Drivers_of_Extirpation_in_Sea_Snakes_A.pdf

[47] D'Anastasi, B. R., van Herwerden, L., Hobbs, J. A., Simpfendorfer, C. A., & Lukoschek, V. (2016). New range and habitat records for threatened Australian sea snakes raise challenges for conservation. Biological Conservation, 194, 66–70. https://doi.org/10.1016/J.BIOCON.2015.11.032

[48] Conservation advice for dusky sea snake p13

[49] Conservation advice for dusky sea snake p1

[50] Conservation advice for dusky sea snake p13

[51] DECCEEW 2024 Conservation Advice for Aipysurus fuscus dusky sea snake pg.20

[52] Sound that propagates through the water column may create barriers that inhibit whales ability to navigate or see (hear) through the wall of noise. s40462-024-00458-w (1).pdf p7

Risks to threatened species of whales, directly attributable to the activities of the fossil fuel industry, are noted in the DCCEEW Conservation Management Plan for the Blue Whale. For some species, including Fin and Sei Whales, their rarity and the limited knowledge of their ecology, introduces uncertainties into the risk assessment.

Blue whales, including the pygmy blue whale subspecies, are listed as endangered under the EPBC Act, and their conservation under the Act is outlined by the recovery plan "Conservation Management Plan for the Blue Whale". The plan lists noise interference (including seismic blasting) as one of the main threats to blue whales and includes "assessing and addressing anthropogenic noise" as a "very high priority" action area for the pygmy blue whale. The recovery plan also lists priority actions, including "demonstrably minimise recognised anthropogenic threats to blue whales" and "maintain and improve current levels of legal and management protection". It is clear that, based on the best available scientific evidence, the Department considers the blue whale population to be under threat from anthropogenic noise disturbance. Allowing the Proposed Action and its associated seismic activities to proceed would then be clearly counter to the objectives in the blue whale recovery plan.

In the recovery plan, impacts from seismic blasting and industrial noise are ranked as 'very high' and 'moderate', respectively - that is, they are 'almost certain' to occur, with their consequences being 'moderate' and 'minor', respectively. This is because excessive and constant noise displaces blue whales and causes other behavioural changes in offshore waters.[53] By contrast, the Proponent evaluates the potential for noise impacts from the Proposed Action to be 'slight' and 'minor',[54] concluding that only "slight temporary, behavioural impacts may occur"[55]. The evaluation provided to support this conclusion is similar to that provided in the Browse to North West Shelf Development documentation, to which the former Department of Agriculture, Water, and the Environment (DAWE) assessed that "it does not appear that Woodside's environmental impact assessment has taken into consideration important context from the recovery plan for Blue Whales, or the importance of the Scott Reef area as a migratory and foraging biologically important area (BIA) for pygmy blue whales"[56]. This is also consistent with the WA EPA's assessment of the proposal that was "unacceptable", in part due to threats to pygmy blue whales.[57] The threat of the Proposed Action compared to the Browse to NWS Development is only compounded by the persistent seismic blasting that must take place to monitor the CO_2 plume after injection.

To comply with the recovery plan, the Proponent states that in the EPBC Referral that it will avoid conducting seismic blasting from October to December and mid-April to early August, which it identifies as migratory periods for pygmy blue whales. However, there is limited data on the presence and distribution of pygmy blue whales at Scott Reef. This is compounded by climate

[53] Conservation Management Plan for the Blue Whale. 2015. https://www.dcceew.gov.au/sites/default/files/documents/blue-whale-conservation-management-plan.pdf

[54] Proposed Browse Carbon Capture & Storage Project EPBC Act Referral Supporting Information Document

[55] Browse Carbon Capture and Storage Project - EPBC referral document

[56] FOI 200801, Department of Agriculture, Fisheries and Forestry,https://www.agriculture.gov.au/sites/default/files/documents/200801.pdf, p. 68-69

[57] Milne, P. (2024, August 4). "Unacceptable": Red flag for Woodside's Browse gas project poses problemfor federal government. WAtoday; WAtoday. https://www.watoday.com.au/national/western-australia/unacceptable-red-flag-for-woodside-s-browse-gas-project-poses-problem-for-federal-government-20240725-p5jwjm.html

change[58] and increased ocean noise[59] (to which seismic surveys contribute), which may be causing delays to whale migratory patterns, but requires further research. The Proponent's analysis ignores these changes and uncertainties, and instead cites a singular study that it commissioned itself that is fourteen years out of date. Even this cited report identifies wider migratory periods from October to January, and early April to mid-August.[60]

While the Proponent expects the impact of seismic blasting on pygmy blue whales to be slight and temporary, the Department's recovery plan casts doubt on this assertion, stating, "Anthropogenic disturbances along migratory routes may have unanticipated consequences as overcoming such disturbances depends on whether blue whales have the ability to adapt their migratory routes"; and "it is unknown whether the ability to adapt migratory routes is individual, species, subspecies, or population specific"[61]. Furthermore, the CSIRO states, "Anthropogenic sounds can mask vocal communication, disrupt normal behaviours, and cause temporary or permanent threshold shifts in hearing ... Such impacts, if persistent and chronic enough, may ultimately have adverse impacts on foraging and reproduction and individual health and fitness which can manifest in population effect...In extreme cases, there is physical damage to tissues and organs when individuals are close to the high point source sounds created by geophysical surveys"[62]. This shows that impacts to pygmy blue whales would not be limited to just migration displacement, but could have impacts on the survival of the population.

2.6 Risks to plankton communities

Plankton communities, both phyto and zooplankton, provide an important role in the marine food chain and in the support of fisheries. Plankton communities can be impacted by organic waste disposal, chemical pollution (including ocean acidification), light pollution, and noise from seismic blasting. Events causing increases in plankton levels (e.g., increases to nutrient levels; attraction to light) can result in a higher demand on oxygen, thus affecting the survival of other species locally. Events causing decreases in plankton (e.g., chemical pollution; seismic blasting) can affect food chains or fish stocks. Attraction of zooplankton to light can result in predatory species being attracted to industrial operational areas.

The EPBC Referral states that there will be only temporary, highly localised impacts to plankton, with no lasting effects. The length of these 'temporary' impacts is not specified.

While past studies have shown a limited impact to plankton from seismic blasting, the CSIRO identified substantial impact to zooplankton biomass from seismic blasting within the area of activities and 15km from it.[63] The time zooplankton populations took to recover to 95%, from these seismic events in the survey area and in the surrounding 15km, was up to 100 days.[64]

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[58] Fitzgerald, R. (2023, November 11). Blue whales pass by Timor-Leste like clockwork each year. Now,scientists are "alarmed" at their late arrival. ABC News.

[59] Piltz, J. (2024, April 9). Avoidance, confusion, solitude: whales react to rising noise pollution. University of Melbourne, Faculty of Science.

[60] McCauley, R.D., 2011. Woodside Kimberley sea noise logger program, September 2006 to June 2009:whales, fish and man made noise (Report). Curtin University, Perth.

[61] Conservation Management Plan for the Blue Whale, p.25

[62] Commonwealth Scientific and Industrial Research Organisation submission, as quoted in Makingwaves: the impact of seismic testing on fisheries and the marine environment, Chapter 2

[63] SeismicPlankton_FinalReport_v2

[64] How this period of impact affected other species is not detailed in the study, nor the effect on meroplankton (fish eggs and invertebrate larvae).

In addition to the impacts from seismic blasting, effects on krill from the industrial activities or pollution events that produce ocean acidification, have been identified. Laboratory experiments have shown that ocean acidification can be detrimental to Antarctic krill embryo development, which would consequently affect krill predators such as blue whales.[65] The acidification of the ocean can also impact embryos of oviparous fish by increasing the mineralisation of their skeletons,[66] and can also have profound consequences for ocean biogeochemistry. Biogeochemical effects of ocean acidification include changes to the nitrogen, phosphorus and iron cycles, calcification and silicification, and the occurrence of low O_2 zones.

CCWA and GPAP submit that there are risks to plankton communities from a range of industrial inputs directly associated with the Proposed Action, and, more broadly, from the impacts of oil and gas operations. Being the base of the marine food chain, impacts to plankton communities can have profound impacts on marine fauna populations and must be carefully assessed for impact.

2.7 Risks from other vessel discharges

The discharge of sewage, putrescible, and chemical wastes from the Proposed Action will be within three nautical miles of Scott Reef, producing additional risks to the sensitive ecological systems of Scott Reef and to marine wildlife. The main control in the EPBC Referral for any overburden on biological oxygen demand (BOD) or increased phytoplankton levels is the "assimilative capacity of the open ocean"[67]. The proximity of Scott Reef and the migratory paths and foraging areas of marine fauna to these discharges requires careful consideration in view of the Proponent's reliance on natural ocean processes to dilute waste and other pollutants.

The Proponent states in the EPBC Referral that "it is not considered credible that toxic affects to marine fauna will occur"[68] from the discharge of chemical or biohazardous waste. No evidence has been presented for this claim of 'no risk'. Similarly, claims of 'no risk' to marine wildlife (e.g., whales, turtles, and fish) from the unplanned discharge of other solid wastes, is not well substantiated.

CCWA and GPAP submit that these potential effects on marine fauna from the Proposed Action require proper assessment under Part IV of the EP Act.

Cumulative risks

The Proposed Action is over a large area and includes a range of different operations. The Proposed Action will also be operating in proximity to other oil and gas operations. The cumulative impacts from the range of activities that form the Proposed Action (including air emissions from the terrestrial projects linked to the Proposed Action) and its interaction with other offshore projects (e.g., from seismic blasting, drilling operations, spills, emissions, etc.) must be properly assessed.

Furthermore, synergistic, additive, or antagonistic interactions between seismic sound impacts and other stressors have not been studied. Single stressors related to sound exposure may show

[65] Conservation Management Plan for the Blue Whale

[66] Ocean acidification and warming affect skeletal mineralization in a marine fish

[67] Proposed Browse Carbon Capture & Storage Project EPBC Act Referral Supporting Information Document

[68] ibid

no effects in isolation but when combined with other stressors (e.g., temperature or food competition), effects may become pronounced.[69]
Additional pressures to reef and other ocean ecological systems, including from sea level rises, changes in sea temperature, and ocean acidification, resulting from climate change; marine debris; physical habitat modification; oil production; and introduction of invasive species, should also be considered in proper environmental assessments of the Proposed Action.

The activities of the Proposed Action, combined with those of other industrial operations and other ecological stressors could push Scott Reef's coral ecosystems past their resilience threshold, risking functional extinction of the reef system.

Conclusions on the use of carbon dumping in an area of conservation significance
The Proposed Action presents a range of uncertainties in regard to:

- its capacity to meet sequestration targets;
- its safety in regards to permanent containment;
- its capacity to be monitored over long time spans and in remote locations; and
- its capacity to be managed for leakage or catastrophic storage failure.

CCWA and GPAP submit that the proximity of sensitive environmental receptors, including habitat for numerous threatened species, means the Proposed Action presents high risks for several environmental factors in this offshore area.

The Proposed Action is likely to have a significant impact on the environment and listed threatened species, and it has not been established that the risks from carbon dumping operations can be managed, the impacts rectified, or monitoring and compliance maintained in perpetuity.

The Proposed Action will have clear and significant impacts on WA environmental factors and must therefore be fully assessed by the WA EPA. The EPA's environmental impact assessment (EIA) process is designed to evaluate the potential environmental impacts of proposals, including both direct and indirect (secondary) effects. The WA EPA are required to assess the environmental acceptability of any proposal likely to have a significant environmental effect on the WA environment.

The Proposed Action requires careful evaluation, through environmental impact assessment in accordance with the EPA's processes.

Outcomes sought

CCWA and GPAP believe that the Proposed Action will have both direct and indirect impacts on WA environmental factors, including marine environmental quality, marine fauna, coastal processes, benthic communities and habitats, and landforms.

The Proposed Action is high-risk and unproven, and poses a distinct threat to the functional survival of one of WA's ecologically significant areas.

[69] Carroll, A. G., Przeslawski, R., Duncan, A., Gunning, M., & Bruce, B. (2017). A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Marine Pollution Bulletin, 114(1), 9–24. https://doi.org/10.1016/J.MARPOLBUL.2016.11.038

CO_2 toxicity, seismic blasting, induced seismicity, ocean acidification and hydrocarbon release, combined with ongoing compliance and monitoring issues threaten the habitat, foraging areas, migration routes, and vital reproductive areas of numerous threatened species, as well as the viability of Scott Reef as a functional habitat.

CCWA and GPAP believe that in view of the above points the Proposed Action is likely to have a significant effect on the WA environment, in particular the environmental values of Scott Reef and the marine fauna that rely on it.

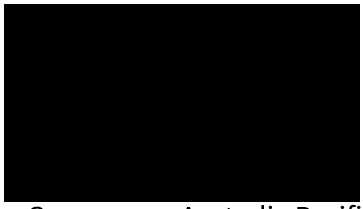
The EPA's objective in s 15 of the EP Act is to use its best endeavours to protect the environment, and prevent, control, abate and mitigate pollution and environmental harm. One of the EPA's key functions, under s 16(a) of the EP Act, enabling it to discharge its statutory objective, is to conduct environmental impact assessments. It is critical that, when presented with information as set out in this EP Referral, the EPA acts in accordance with its objective and functions to ensure the Proposed Action is subject to proper assessment, including through public participation in that assessment.

Based on the information set out in this letter, CCWA and GPAP respectfully request that the EPA accept this EP Referral and conduct a comprehensive environmental impact assessment under Part IV of the EP Act.

Thank you for your attention to this matter.

Yours sincerely,

Conservation Council of Western Australia



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