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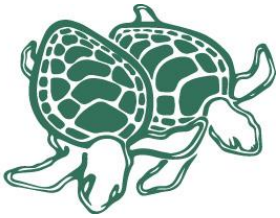

I. SUMMARY

1. ECNT provides this submission in response to Santos's Darwin Pipeline Duplication Project: Supplementary Environmental Report, May 2023 (**SER**)[1] on Santos' application for an environmental approval for the Darwin Pipeline Duplication (**DPD**), a key component of the Barossa Gas Project (**Barossa Development**).
2. Santos seeks environmental approval to construct a pipeline from the Barossa Gas Export Pipeline to the Darwin Liquified Natural Gas (**DLNG**) facility. It will duplicate a portion of the Bayu-Undan pipeline and use the new pipeline to transport gas. Santos states that it intends to build the DPD in order to preserve the existing Bayu-Undan pipeline so that it can be used for carbon capture and storage (**CCS**) in the soon-to-be depleted Bayu-Undan gas fields in Timor Leste (**Bayu-Undan CCS Project**).
3. This submission deals with:
    a. The relevant legislative framework (**Section II.**);
    b. Questions concerning the necessity of the DPD and lack of certainty concerning CCS activities described in Santos's DPD Project NT EPA Referral (**Referral**),[2] the Referral form[3] and Referral Appendices[4] (**Referral documents**) and SER (**Section III.**);
    c. The direct and indirect climate impacts of the DPD project and how they are dealt with in the SER (**Section IV.**);
    d. The marine impacts of the DPD project how they are dealt with in the SER (**Section V.**);
    e. Cultural impacts of the DPD project (**Section VI.**); and
    f. Further information that the NT Environment Protection Agency (**EPA**) should request (**Section VII.**)
4. In summary, ECNT submits that:
    a. Insufficient information has been provided in the SER to enable the EPA and Minister to undertake their functions under the *Environment Protection Act 2019* (NT) (**EP Act**).

       Recommendation 1: The NT EPA should direct Santos to provide the further information set out Section VII. pursuant to r 124 of the *Environment Protection Regulations 2020* (NT) (**EP Regs**).

    b. There is significant uncertainty about the economic and technical viability of the Bayu-Undan CCS Project, upon which the DPD is contingent. Furthermore, Santos has no regulatory approvals in place for the Bayu Undan CCS Project.

[1] Santos, *Darwin Pipeline Duplication Project: Supplementary Environmental Report* (Report, May 2023) weblink (**SER**).
[22] Santos 'Darwin Pipeline Duplication (DPD) Project NT EPA Referral', 8 December 2021 weblink.
[3] Santos 'Referral Form', weblink.
[4] Santos, 'Appendix A-I' weblink.

Recommendation 2: Noo approval should be given for the DPD until Santos has obtained all relevant regulatory approvals for the Bayu Undan CCS Project, including under the *Offshore Petroleum and Greenhouse Gas Storage Act, the Environment Protection (Sea Dumping) Act* and the *Environment Protection and Biodiversity Conservation Act* and associated regulations.

c. Santos has failed to show why construction of the DPD is justified in circumstances where the SER make it clear that there is significant uncertainty about whether the Bayu-Undan CCS Project will proceed, and that the construction of the DPD will have significantly greater environmental impacts than available alternatives.

Recommendation 3: The NT EPA should prepare a statement of unacceptable impact in relation to the DPD on the basis that Santos has not complied with section 42(3) of the *Environment Protection Act* as directed by the NTEPA

d. The climate impacts resulting from the Barossa Development's GHG emissions are indirect, significant impacts of the DPD. On the basis of the information in the Referral and the SER, the Minister could not be satisfied that these significant impacts have been appropriately avoided or mitigated or can be appropriately managed.

Recommendation 4: The NT EPA should prepare a statement of unacceptable impact on the basis that DPD's significant indirect climate impacts have not been appropriately avoided or mitigated and cannot be appropriately managed.

e. The potential marine impacts of the project relating to factors such as aquatic ecosystems, including marine fauna, are unacceptable.

Recommendation 5: The NT EPA should prepare a statement of unacceptable impact based on the lack of ability to conclude, on the information provided by Santos, that the risks will be contained to an acceptable level.

f. Santos has not sought and documented community knowledge and understanding of the natural and cultural values of areas that may be impacted by the DPD as required by s43(c) of the Environment Protection Act, including by way of a cultural heritage impact assessment, and as such the risks posed by the project are unacceptable.

Recommendation 6: The NT EPA should prepare a statement of unacceptable impact based on the lack of ability to conclude, on the information provided by Santos, that the risks will be contained to an acceptable level.

II. LEGISLATIVE FRAMEWORK

EPA's task: assessment report and approval or statement of unacceptable impact

5. The EPA's ultimate task in the environmental impact assessment (**EIA**) process for the DPD is to prepare an assessment report and either a draft environmental approval or statement of unacceptable impact and provide these to the Minister.[5]
6. The assessment report must be based on the original referral, any further information, the SER prepared by the proponent and submissions made in relation to the referral and SER.[6] Its purposes are to:[7]
    a. assess whether the DPD is likely to meet the environmental objectives;[8] and
    b. assess the potential significant environmental impacts of the DPD; and
    c. make recommendations for avoiding, mitigating and managing those impacts; and
    d. advise the Minister as to the environmental acceptability of the DPD.
7. The assessment report must assess:[9]
    a. the potential environmental impacts and risks of the DPD; and
    b. whether there are any significant residual impacts remaining after all reasonable measures to avoid and then mitigate and manage the risks have been taken.
8. Under the EP Act the environment means 'all aspects of the surroundings of humans, including physical, biological, economic, cultural and social aspects',[10] and the impact of an action means an event or circumstance that is a direct *or indirect* consequence if an action.[11] An impact may be cumulative or may occur over time.[12]
9. In preparing the assessment report, the EPA must consider the referral information, the SER, and any public submissions on the referral and SER.[13] If the EPA exercises its power to request additional information from the proponent, it must also consider that information and submissions in response to that information.[14]
10. Along with the assessment report, the EPA must prepare either a draft environmental approval or draft statement of unacceptable impact.[15] A statement of unacceptable impact may be provided if the EPA considers that:[16]
    a. Project will have an unacceptable environmental impact; and
    b. The impact cannot be avoided, mitigated or managed.

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[5] *Environment Protection Act 2019* (NT) (**EP Act**), ss 63, 64, 75.
[6] EP Act, s 64; *Environment Protection Regulations 2020* (NT) (**EP Regs**), rr 156. 157.
[7] EP Regs, r 156(3).
[8] None of which have been declared. In lieu, the NT EPA has set out its own list of environmental factors and objectives, see here: weblink.
[9] EP Regs, r 156(4)
[10] EP Act, s 6.
[11] EP Act, s 1(1).
[12] EP Act, s 10.
[13] EP Regs, r 157.
[14] EP Regs, r 157.
[15] EP Regs, rr 158,159. EP Act ss 65, 66.
[16] EP Act, s 66

Minister's task: decision based on assessment report, draft approval or draft statement of unacceptable impact

11. Upon receiving the assessment report, the Minister decides whether to grant or refuse to grant an environmental approval.[17] When deciding upon making either an environmental approval or statement of unacceptable impact, the Minister must have regard to the principles of environmental protection and management set out in Part 2 of the EP Act, (discussed at [2121]), and:[18]
    a. the objects of the EP Act (set out at [1313]);
    b. the EPA's assessment report; and
    c. other matters the Minister considers relevant.
12. Before the Minister can grant an approval – either in response to a draft approval or draft statement of unacceptable impact – they must be satisfied that:[19]
    a. the proponent is a fit and proper person to hold an approval;
    b. the community has been consulted on the potential environmental impacts and environmental benefits of the DPD;
    c. the significant impacts of the DPD have been appropriately avoided or mitigated or can be appropriately managed; and
    d. if appropriate, environmental offsets can be provided in accordance with the EP Act for significant residual adverse impacts on the environment that cannot be avoided or mitigated.

Legislative context

13. The objects of the EP Act are contained in s 3, and are:[20]

    (a) to protect the **environment** of the Territory; and
    (b) to promote ecologically sustainable development so that the wellbeing of the people of the Territory is maintained or improved without adverse impact on the environment of the Territory; and
    (c) to recognise the role of environmental impact assessment and environmental approval in promoting the protection and management of the environment of the Territory; and
    (d) to provide for broad community involvement during the process of environmental impact assessment and environmental approval; and
    (e) to recognise the role that Aboriginal people have as stewards of their country as conferred under their traditions and recognised in law, and the importance of participation by Aboriginal people and communities in environmental decision making processes.
14. Ecologically sustainable development (**ESD**) is prescribed under the EP Act as:[21]

[17] EP Act, ss 69, 76.
[18] EP Act, s 73(1); s76(2).
[19] EP Act s 73(2) (2); 76(5)
[20] EP Act, s 3.
[21] EP Act, s 4.

development that improves the total quality of human life, both now and in the future, in a way that:

(a) maintains the ecological processes on which all life depends; and

(b) recognises the need for development to be equitable between current and future generations.

15. As discussed above, environment under the EP Act means 'all aspects of the surroundings of humans, including physical, biological, economic, cultural and social aspects'.[22]
16. The object contained in s 3(b) of the EP Act when understood in that context creates a dependent nexus between the wellbeing of people in the Northern Territory and development that maintains ecological processes on which life depends.
17. These objects provide clear and cogent direction: where environmental impact assessments for developments are undertaken through the EP Act, it should be constrained so that it:
    a. is consistent with protection of the overall environment in the Northern Territory;
    b. improves or maintains the wellbeing of people in the Territory, without adverse impact on the environment; and
    c. maintains the ecological processes upon which life depends; and
    d. is equitable between current and future generations.

Purpose and duties in EIA process

18. Part 4, which deals with the EIA process, describes the purpose of that process as including:
    a. to ensure that actions do not have an unacceptable impact on the environment, now and in the future;[23] and
    b. to ensure actions that may have a significant impact on the environment are assessed according to the principles of ESD (set out below at [22]) according to the environmental decision-making hierarchy.[24]
19. Whether the DPD has a significant impact will depend on the context, and intensity of the impact and 'the sensitivity, value and quality of the environment impacted on and the duration, magnitude and geographic extent of the impact.[25]
20. The same part then goes on to set out the duties on proponents as part of the EIA process, which include to:
    a. Consider the principles of ESD;[26] and
    b. Seek and document community knowledge and understanding (including traditional knowledge and understanding) of cultural values of the areas that may be impacted by the proposed action.[27]

Principles of environment protection and management

[22] EP Act, s 6.
[23] EP Act, s 42(a).
[24] EP Act, s 42(b).
[25] EP Act s 11.
[26] EP Act, s 43(e).
[27] EP Act, s 43(c).

21. The Minister is the decision maker in relation to the approval or refusal of the DPD and will be required have to take the EPA's assessment report into account in relation to their decision.[28] Part 2 of the EP Act sets out the principles that a decision maker must consider and apply under the EP Act, which are set out below. The EPA's assessment report should include the EPA's assessment in relation to the principles that the Minister must consider and apply.[29]

Proponent and decision maker to apply the decision-making hierarchy

22. Section 26 of the EP Act sets out the environmental decision-making hierarchy which applies to decision makers and proponents, and states that in making decisions that affect the environment they must apply the following in, order of priority:[30]
    a. first, ensure that actions are designed to avoid adverse impacts on the environment;
    b. second, identify options to mitigate adverse impacts on the environment to the greatest extent practicable; and
    c. third, if appropriate, provide for environmental offsets in accordance with the EP Act for residual adverse impacts on the environment that cannot be avoided or mitigated.

Decision maker must consider and apply principles of ESD

23. Under s 17 of the EP Act, the Minister and other decision makers under the EP Act are obliged to consider and apply the principles of ESD (together, the **ESD principles**) in making decisions under the EP Act and EP Regs.[31] The ESD principles include:
    a. That decision makers are expected to 'integrate both long-term and short-term environmental and equitable considerations'[32] (**the decision-making principle**);
    b. That '[i]f there are threats of serious or irreversible environmental damage, lack of full **scientific** certainty should not be used as a reason for postponing measures to prevent environmental degradation.' [33] And '[d]ecision-making should be guided by: (a) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and (b) an assessment of the risk-weighted consequences of various options' (together, **the precautionary principle**);
    c. that '[d]ecisions should be based on the best available evidence in the circumstances that is relevant and reliable'[34] (**the principle of evidence-based decision making**);

[28] EP Act, ss 73(1)(b), 76(1)(a).
[29] This is consistent with the purpose of the EIA process (to ensure projects that may have significant environmental impacts will be assessed according to principles of ESD) per s 42(b) of the EP Act, and the assessment report (to assess potential significant environmental impacts) per EP Regs r 156(3)b) and what the assessment report must assess (potential environmental impacts and risks of the DPD) per EP Regs r 156(4)(a).[29]
[30] EP Act s 26.
[31] EP Act, s 17(1)-(2).
[32] EP Act, s 18(1).
[33] EP Act, s 19.
[34] EP Act, s 20.

d. that '[t]he present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations'[35] (**the principle of intergenerational and intragenerational equity**); and
e. that '[b]iological diversity and ecological integrity should be conserved and maintained' (**the principle of biological diversity and ecological integrity**).

24. A decision maker is not required to specify how they considered ESD principles in the reasons.[36] The EP Act is novel in requiring that decision makers must; 'consider and apply' (emphasis added) ESD principles when making environmental assessments.
25. ECNT submits that 'applying' ESD principles is a higher task than 'considering' ESD principles. 'Considering' enables a decision-maker to discuss, cite, weigh and outline a reasoning process but ultimately approve a project, even if its existence would undermine ESD principles.[37] In contrast, 'applying' ESD principles, ECNT submits, requires the Minister to ensure the project is consistent with those principles, thereby bringing them to bear and putting them into practical operation.[38]
26. Consistent with the purpose of the EIA process and purpose of the EP Act,[39] the EPA's assessment report must include consideration and application ESD principles, so that the Minister can consider and apply ESD principles when deciding whether or not to approve the DPD.

Precautionary principle

27. Courts are yet to consider how to apply the precautionary principle in the NT, but in NSW where the articulation of the principle is virtually identical, Chief Judge Preston of the Land and Environment Court has found there are two preconditions to its application, both of which must be present: [40]
    a. a threat of serious or irreversible environmental damage (substantiated by scientific evidence); and
    b. scientific uncertainty as to the damage.
28. On the first precondition, a 'threat' is critical, but it does not need to have necessarily occurred.[41] The threat must be a foreseeable risk, and may be direct or indirect, long-term, secondary, incremental, cumulative and/or interrelated.[42] Once a threat has been identified, it must be shown that that threat is serious or irreversible. In assessing whether a threat meets that threshold, courts will consider:[43]
    a. The geographical reach of the threat (local, territory, national, global);
    b. The magnitude of the impact on the environment;
    c. Whether the threat is intermittent or would persevere;

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[35] EP Act, s 21.
[36] EP Act, s 17(3)
[37] See for example in *Haughton v Minister for Planning* (2011) 185 LGERA 373, [159]-[184].
[38] *Macquarie Dictionary* (online at 26 June 2023) 'apply'.
[39] EP Act, s 41(b)(i);
[40] *Telstra Corporation v Hornsby Shire Council* (2006) 67 NSWLR 256 (***Hornsby Shire Council***) *Adani Mining Pty Ltd v Land Services of Coast and Country Inc & Ors* (2015) 36 QLCR 394, [268]; *Waratah Coal Pty Ltd v Youth Verdict Ltd & Ors (No 6)* [2022] QLC 21, 26 (***Youth Verdict***).
[41] *Hornsby Shire Council,* [129].
[42] *Hornsby Shire Council*, [130]
[43] *Hornsby Shire Council*, [131].

d. The value of the environment under threat;
e. The complexity and connectivity of the possible impacts;
f. Whether the possible impacts are manageable;
g. The level of public concern, and whether there is rational or scientific evidence for that concern; and
h. Whether the possible impacts are reversible, and a timeframe for reversing impacts along with the difficulty or cost of reversing.

29. The second precondition, scientific uncertainty as to the damage, requires understanding the nature and scope of the damage. This means considering:[44]
    a. the sufficiency of the evidence that there could be serious or irreversible environmental harm caused by the project;
    b. the level of uncertainty, and kind of uncertainty; and
    c. the potential to reduce uncertainty given what is possible in principle, economically and within a reasonable time frame.
30. In terms of the level of scientific uncertainty that is acceptable, Preston CJ has said the 'principle may consequently apply to all post-industrial risks for which a cause-and-effect relationship is not clearly established but where there is a 'reasonable scientific plausibility'.[45]
31. Subsection 19(2) of the EP Act creates additional guidance for decision-makers, which appears to apply generally to decisions, rather than specifically to the project to which subsection 19(1) of the EP Act relates. This guides the Minister to carefully consider 'serious or irreversible damage to the environment *wherever practicable*' and undertake an 'assessment of the risk-weighted consequences of various options'.

Principle of intergenerational and intragenerational equity

32. Section 21 of the EP Act sets out the principle of intergeneration and intragenerational equity as follows: '[t]he present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations'.[46]
33. This requires an analysis of how a project benefits members of current generations, and members of future generations, particularly on their enjoyment of an environment which is healthy, diverse and productive. GHG emissions from the Barossa Development should be considered in assessing, considering and applying this principle.[47] The principle of intragenerational equity is a component of the principle of intergenerational equity.[48]
34. There are three principles that form the basis of the first element: intergenerational equity:
    a. The conservation of options principle, which requires current generations to conserve the health, diversity and productivity of the environment to ensure future generations have options to solve their problems and satisfy their needs;[49]

[44] *Hornsby Shire Council*, [141].
[45] *Hornsby Shire Council*, [148].
[46] EP Act, s 21.
[47] *Hunter Environment Lobby Inc v Minister for Planning* [2011] NSWLEC 221 [19]–[21], [100]; *Waratah Coal Pty Ltd v Youth Verdict Ltd & Ors* (No 6) [2022] QLC 21, [1841].
[48] Brian Preston, 'The judicial development of ecologically sustainable development' (Conference Paper, Environment in Court IUCNAEL Colloquium, 22 June 2016), 27.
[49] Brian Preston, 'The judicial development of ecologically sustainable development' (Conference Paper, Environment in Court IUCNAEL Colloquium, 22 June 2016), 26.

b. The conservation of quality principle, which requires each generation maintain the health, diversity and productivity of the environment to ensure they are passed on in a no worse condition than they were received;[50] and
c. Finally, the conservation of access principle, which means conserving the legacy of past generations, so that future generations have equitable access to that legacy.[51]

[50] Brian Preston, 'The judicial development of ecologically sustainable development' (Conference Paper, Environment in Court IUCNAEL Colloquium, 22 June 2016), 26.
[51] Brian Preston, 'The judicial development of ecologically sustainable development' (Conference Paper, Environment in Court IUCNAEL Colloquium, 22 June 2016), 27.

III. UNCERTAINTY CONCERNING THE NECESSITY OF THE DPD AND ASSOCIATED IMPACTS

35. The purpose of the DPD, if approved, is to 'allow gas from the Barossa field to be transported to and processed at the existing Santos-operated DLNG facility'.[52] The DPD is thus a component part of the Barossa Development, a gas project with a significant emissions profile, as outlined in **Section IV**, below. This is clear from the Referral documents and the SER.
36. Santos could use the pre-existing Bayu-Undan pipeline to transport gas from the tie in point to the DLNG facility for this purpose.[53] This approach was adopted by the Barossa Project's previous proponent on the following basis:

    > ConocoPhillips is proposing to tie-in to the existing Bayu-Undan to Darwin Pipeline to avoid duplication of existing pipeline infrastructure within the vicinity of Darwin Harbour. This approach minimises the potential environmental impacts and risks to a number of key values and sensitivities in Darwin Harbour.[54]

37. Subsequent to NOPSEMA's acceptance of the Barossa OPP, Santos has elected not to take this approach and instead seeks environmental approval for the DPD because it states that it intends to use the existing Bayu-Undan pipeline for the Bayu-Undan CCS Project. [55]
38. As the EPA has identified in its direction to Santos dated 12 January 2023, the potential significant impacts associated with the DPD could be avoided through the use of the existing Bayu-Undan Pipeline for the transport of gas to DLNG. In light of this, the EPA requested that Santos provide its rationale for why it selected the DPD as opposed to less environmentally damaging alternative approaches.
39. A number of submissions in response to the Referral also raised concerns about the viability and certainty of the Bayu-Undan CCS Project and the risk that CCS will not reduce GHG emissions from the Barossa Development.[56]
40. It is clear from Table 3-1 of the SER that the DPD has significantly greater environmental impacts and risks as compared with the Bayu-Undan pipeline tie in option during its construction phase, with respect to marine environmental quality, marine ecosystems, community and economy factors and culture and heritage in particular.[57] It is also clear that operating two pipelines instead of one will have significantly greater environmental impacts during both the operation and construction phase.
41. Table 3-1 demonstrates that the main reason the DPD is preferred by Santos is to preserve the Bayu-Undan Pipeline for CCS. In order to justify its adoption of this approach, Santos attributes a number of purported environmental and economic benefits, including claims of potential abatement of millions of tonnes of GHG emissions.
42. ECNT submits that these purported benefits are currently unproven and unsubstantiated and that the EPA can have no certainty that these purported benefits will be realized for the reasons that follow.

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[52] SER, 17.
[53] SER, 62.
[54] Conoco Phillips *Barossa Area Development Offshore Project Proposal,* (March 2018), weblink, 116.
[55] SER, 17.
[56] SER, 111.
[57] SER, 67-78.

43. Firstly, there is significant uncertainty about whether Santos' Bayu-Undan CCS plans will proceed. This is apparent in numerous places in the SER. For example, in response to concerns raised in public submissions about the Bayu-Undan CCS plans, Santos states:[58]

> The CCS system is not included in this DPD Project proposal as this is still **undergoing technical and economic assessments**. **Should the CCS system be implemented,** the infrastructure within NT jurisdiction will be subject to referral to the NT EPA.
>
> …
>
> Santos will comply with all relevant regulatory requirements associated with the construction and operation of a CCS system in Timor-Leste and Australia. CCS at the Bayu-Undan field **will not commence until all appropriate approvals are in place,** including those required by the Timor-Leste Government.
>
> (emphasis added)

44. It is clear from the SER that the technical viability of the use of the Bayu-Undan pipeline for CCS is still being assessed by Santos.[59]

45. As Santos admits, the technical feasibility of repurposing the Bayu-Undan pipeline for CCS is uncertain. There are significant environmental impacts associated with CCS. Repurposing or converting conventional hydrocarbon pipelines, such as the Bayu-Undan pipeline, for CO_2 when they were not originally designed for CO_2 can increase the potential for rupture.[60] The presence of water can lead to formation of carbonic acid which is corrosive to carbon steel.[61] Additionally, analysis by the Institute for Energy Economics and Financial Analysis suggests that the DPD proposal will increase combustion CO_2 emissions for the Barossa Development overall because of the requirements for processing and compressing.[62] These concerns are set out further below at paragraphs [124]-[137].

46. Santos has not yet made a final investment decision (**FID**) on Bayu-Undan CCS. It is unclear if or when this decision will be made. Last year Santos said that the Bayu-Undan CCS Project would begin to store carbon from 2027,[63] but in recent discussions about the project with East Timorese President Jose Ramos-Horta, the chair of one of the key financial backers, SK Group, said the project wouldn't be completed until 2030.[64] CCS projects have often been planned and

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[58] SER, 111.

[59] See, for eg SER, 64, which makes it clear that the Bayu-Undan Pipeline is still being 'assessed for feasibility in CCS service'.

[60] Robert Kuprewicz, *Accufacts' perspective on the state of federal carbon dioxide transmission safety regulations as it relates to carbon capture, utilisation and sequestration within the US*, (Pipeline Safety Trust, March 2022) weblink 8-9.

[61] Robert Kuprewicz, *Accufacts' perspective on the state of federal carbon dioxide transmission safety regulations as it relates to carbon capture, utilisation and sequestration within the US*, (Report for Pipeline Safety Trust, March 2022) (weblink) 8-9.

[62] John Robert, *Santos' proposed new Darwin Harbour Pipeline for Barossa gas potentially enabling a CCS scheme remains problematic*, (Report for Institute for Energy Economics and Financial Analysis, February 2022) (weblink) 7-8.

[63] William Plampton, 'Santos' Darwin Pipeline Duplication (DPD) Project confirmed – Australia's energy transition is taking shape' *S&P Global* (online, 26 September 2022) weblink; Daniel Fitzgerald, 'Future of Santos's $4.7 billion Barossa Development unclear after safeguard mechanism reforms' *ABC News* (online, 31 March 2023) weblink.

[64] Choi Dong-hoon, 'Chey Tae-won, Chairman of SK Group, met with the President of Timor-Leste… Discussed business operation', *Maeil Ilbo* (online, 2 June 2023) weblink.

then abandoned: between 2009 and 2021, of the 42 planned projects, 20 have been developed.[65]

47. Moreover, the Bayu-Undan CCS project is currently unlawful, because Australia does not comply with international law requirements regarding the export of carbon dioxide streams under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention) and the 1996 Protocol to the Convention (London Protocol).
48. Consequently, ECNT submits that the EPA cannot be certain that Santos will pursue CCS, and thus require the DPD at all, given the uncertainty about the legal, economic and technical viability of the Bayu-Undan CCS Project, and the risks of using the existing pipeline. Additionally, there is significant uncertainty about the effectiveness of CCS at mitigating or offsetting the emissions associated with the Barossa Development (outlined further below at paragraphs [135]-[141]).
49. Santos indicates in Table 3-1 that its plans to use the Bayu-Undan pipeline will have their own significant risks and impacts. These are not set out comprehensively in the SER and it is clear that such an assessment is currently not possible due to economic and technical uncertainty that remains in relation to the Bayu-Undan CCS plan. As noted by Santos in the SER, these risks and impacts will be set out in a further referral to the NT EPA concerning works to adapt the Bayu-Undan pipeline to carry CO2 and then operate the Bayu-Undan pipeline for that purpose.
50. However, despite failing to set out the risks associated with the Bayu-Undan CCS plan, and likely not being in a position to do so, Santos relies heavily on the plan's purported environmental and economic benefits throughout the SER.
51. ECNT submits that in circumstances where the significant impacts associated with the use of the Bayu-Undan pipeline for CCS are uncertain and unable to be assessed, Santos cannot be permitted to rely on purported environmental and economic benefits of CCS, as it has on multiple occasions in the SER,[66] particularly given the paucity of information in the SER to substantiate Santos' claims.
52. Consequently, no approval should be granted in relation to the DPD unless there is both:
    a. Investment certainty in all aspects of the Bayu-Undan CCS plan (including FID for Bayu-Undan CCS).
    b. All other approvals necessary for the Bayu-Undan CCS plan, both in Australia and East Timor, have been granted (including assessment by the NT EPA for the modification and use of the DPD to convey CO2).
53. When these purported environmental and economic benefits are removed from consideration, the environmental impacts of the DPD are clearly greater than those of the Bayu-Undan tie-in proposal, making it a clearly more environmentally damaging approach, methodology or technology. The NT EPA, and the Minister, are required pursuant to s 42(c) of the EP Act to give weight to this consideration in their assessment of whether Santos has taken all reasonable measures to avoid, and then mitigate and manage the significant impacts associated with the Referral.
54. In light of the above, Santos has failed to address the concerns raised about both whether its CCS plans are technically and economically viable, and whether they are capable of reducing the GHG

[65] Emma Martin-Roberts et al 'Carbon capture and storage at the end of a lost decade' (2021) 11(4) *One Earth* weblink.
[66] See for example, SER, 75-78 (environmental benefits) and 327-328 (economic benefits).

emissions from the Barossa Development at the scale required to prevent significant climate impacts.

55. Santos has failed to show why construction of the DPD is justified in circumstances where its own project documents make it clear that there is significant uncertainty about whether the Bayu-Undan CCS Project will proceed, and that the construction of the pipeline will have significantly greater environmental impacts than available alternatives (which may also be significantly more cost effective).
56. Accordingly, consistently with r 156(3) and (4) of the EP Regs, the NT EPA must conclude in its assessment report that:
    a. Santos has failed to take all reasonable measures to avoid, and then mitigate and manage the significant climate, marine and cultural heritage impacts of the DPD set out below at [66]-[221].
    b. In these circumstances, environmental offsetting is not appropriate because it is not the case that these impacts 'residual impacts that cannot be avoided or mitigated'.
57. Further, the NT EPA must:
    a. Recommend that no consideration should be given to the purported benefits of CCS prior to investment certainty (final investment decisions concerning the entirety of the Bayu-Undan CCS plan) and certainty concerning the technical specifications of the Bayu-Undan plan and its risks and impacts (through the grant of all necessary approvals);
    b. Recommend in its assessment report that in the absence of certainty about the economic and technical viability of the Bayu-Undan CCS Project the DPD is not environmentally acceptable and no approval should be granted;
    c. State that the actions contained in the Referral and SER will have an unacceptable impact that cannot be appropriately avoided, mitigated or managed for which environmental offsets are not appropriate; and
    d. Prepare a statement of unacceptable impact.
58. The Minister cannot in these circumstances be satisfied as required by s 73(2) of the EP Act that the significant impacts of the actions in the Referral have been appropriately avoided or mitigated or can be appropriately managed.
59. Accordingly, the Minister:
    a. must accept a statement by the NT EPA of unacceptable impact in relation to the DPD; and
    b. must refuse to grant the environment approval.[67]

[67] EP Act, s 76.

IV. DIRECT AND INDIRECT CLIMATE IMPACTS OF THE DPD

60. The actions set out in the Referral documents and SER relate to the construction and operation of a new gas export pipeline and associated infrastructure, in NT waters and land. The DPD will enable gas from the Barossa gas field to be transported and processed at Santos's DLNG facility into liquified natural gas (**LNG**).[68] It is clear that the DPD is a necessary and indispensable component of Barossa Development.
61. The Federal Court has held that ancillary but necessary components of projects are required to be assessed as part of the project as whole. In *Australian Conservation Foundation Inc v Minister for the Environment* [2021] FCA 550, the Court held that the North Galilee Water Scheme Project was an ancillary activity to the Carmichael Coal Mine Project rather than a separate and independent action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). The Court made it clear that assessment ought not be limited to a narrow sense of individuated operations when those operations are so connected and closely associated as to be integral to a broader project. [69]
62. The EPA's task in drafting the assessment report requires it to assess the potential environmental impacts of the DPD. Under the EP Act and EP Regulations, 'impacts' include direct and indirect impacts on the environment.[70] A direct impact is defined as an impact that 'is a direct consequence of the action'.[71] A 'indirect' impact of an action is defined as an action that is an event or circumstance that is an indirect consequence of 'the action and the action is the substantial cause of that event or circumstance'.[72] The EP Act's definition also includes direct and indirect impact that are cumulative and occur over time.[73]
63. The extraction, transport, processing and use of gas in energy production are all clear consequences of the construction and operation of the DPD. The construction and operation of the DPD is, further, the substantial cause of the GHG emissions associated with the extraction, transport, processing and use of gas in energy production, and their impact on the environment.
64. As such, ECNT submits that in assessing the impacts the DPD, the Minister must have regard to the scope 1, 2 and 3 GHG emissions of the Barossa Development as direct and indirect impacts of the actions that are the subject of the Referral and EIA. Consideration of the impacts of scope 1, 2 and 3 GHG emissions is consistent with the definition of 'impact' in the EP Act and EP Regs.
65. As set out below at [**67**]-[**109**], these impacts are 'significant impacts' within the meaning of s 11 of the EP Act. The Minister, when deciding whether to grant environmental approval for an action, must consider whether she is satisfied that the significant impacts of the action have been appropriately avoided or mitigated or can be appropriately managed.[74]
66. Accordingly, ECNT submits that the significant impacts substantially caused by the GHG emissions of the Barossa Development set out below are indirect impacts of the DPD that must be assessed in the NT EPA assessment report.

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[68] SER, 17; LNG is a fossil fuel primarily used for combustion to create energy.
[69] *Australian Conservation Foundation Inc v Minister for the Environment* [2021] FCA 550, [92]-[93].
[70] EP Act ,s 10(1).
[71] EP Act, s 10(1)(a).
[72] EP Act, s 10(1)(b).
[73] EP Act, s 10(2).
[74] EP Act, s 73(2).

Climate impacts of the DPD

67. An impact is a 'significant impact' within the meaning of the EP Act if it is an impact of major consequence, having regard to their context and intensity, and the sensitivity, value and quality of the environment impacts on the duration, magnitude and geographic extent of the impact.[75]

68. The Barossa Development is associated with an extraordinarily high level of greenhouse gas (**GHG**) emissions, given the gas contains 18% carbon dioxide (**CO_2**) by volume.[76] This is a higher level of CO_2 by volume than any other gas resource currently made into LNG.[77] Total emissions from producing 3.7 million tonnes (**Mt**) of LNG per year from the Barossa Development will result in 5.4 Mt of CO_2 per year, or 15.4 Mt per year including scope 3 GHG emissions,[78] which is 'extreme by any standard' and effectively makes the Barossa to Darwin project "a CO_2 emissions factory with an LNG by-product" – a truly questionable investment in a rapidly evolving market.[79] GHG emissions from coal, oil and gas are the largest drivers of climate change globally,[80] and a rapid reduction in fossil fuel production and use is required for the world to limit warming to 1.5°C.[81]
69. ECNT has previously noted in its submission to the EPA dated 15 February 2022 that the DPD and broader Barossa Development will have a potentially significant impact on the 'Atmospheric Emissions' EPA environmental factor through large contributions to global greenhouse gas concentrations (see: paragraphs [26], [34]).
70. Santos has now provided breakdown of emissions by scope and source.[82] It estimates total emissions from the Barossa Development will be:
    a. Scope 1: 51.6 Mt CO2-e (0.08 Mt CO2-e in the NT; 51.5 Mt CO2-e in Australia but outside of the NT);
    b. Scope 2: 0.003 Mt CO2-e, all within the NT; and
    c. Scope 3: 244.4 Mt CO2-e (32.3 Mt CO2-e within the NT, 01 Mt CO2-e in Australia but not in the NT; 212 Mt CO2-e overseas).
71. This estimate varies greatly from estimates previously provided by former proponent ConocoPhillips. The following analysis in Table 1, below, demonstrates these differences:

Table 1: Emissions presented in SER are significantly lower than those presented in Offshore Project Proposal

[75] EP Act, s 11.
[76] John Robert, 'Should Santos' Proposed Barossa Gas "Backfill" for the Darwin LNG Facility Proceed to Development?' (Institute for Energy Economics and Financial Analysis, March 2021) weblink, 2.
[77] John Robert, 'Should Santos' Proposed Barossa Gas "Backfill" for the Darwin LNG Facility Proceed to Development?' (Institute for Energy Economics and Financial Analysis, March 2021) weblink, 2.
[78] SER, 297. SER, 297.
[79] John Robert, 'Should Santos' Proposed Barossa Gas "Backfill" for the Darwin LNG Facility Proceed to Development?' (Institute for Energy Economics and Financial Analysis, March 2021) weblink, 2.
[80] Zeke Hausfather, 'Analysis: Fossil-fuel emissions in 2018 increasing at a faster rate for seven years' Carbon Brief, 5 December 2018 weblink; United Nations, *Causes and effects of climate change*, weblink.
[81] International Energy Agency, *Net Zero by 2050: A roadmap for the Global Energy Sector* (Report, May 2021) 20 weblink; Climate Council, *Aim high, go fast: Why emissions need to plummet this decade'* (Report, 2021).
[82] SER, 290-294.

Emission type	OPP estimate (mt co2e over lifecycle of project) From Table 4-7 in OPP from ConocoPhillips[83]	SER estimate (mt co2e over lifecycle of project) from Table 10-4 in DPD SER
Reservoir	45.5	33.7
Fuel	37.7	15.9
Flare	1.4	0.9

72. Additionally, the annualized reservoir CO2 emissions from Santos (1.35) is at the very bottom of the range ConocoPhillips provided in the OPP. The new fuel number is less than half of what was in the OPP, but the technology used by Santos does not vary greatly from that proposed previously. In the SER, Santos provides no explanation as to why it has come to dramatically different emissions estimates than what was previously calculated. ECNT submits that further information regarding how these emissions estimates were arrived at must be produced by Santos in order to establish the credibility of these estimates.
73. ECNT also submits that Santos has incorrectly categorized some of their emissions. Santos counts DLNG facility emissions as Scope 3 emissions for the Barossa project when they should be Scope 1. They justify this by saying the ownership structure of DLNG is different to the offshore component, for the Barossa joint venture is comprised of Santos (50%), SK E&S (37.5%) and Jera (12.5%) whereas the current DLNG shareholders are Santos (43.4%), SK E&S (25%), INPEX (11.4%), Eni (11.0%), JERA (6.1%), Tokyo Gas (3.1%). The slightly different ownership structures of various components of what ECNT submits is a single overall project does not, ECNT submits, mean that emissions from DLNG are not part of the Scope 1 emissions of the overall Barossa project. ECNT submits that DLNG emissions are clearly Scope 1 for the Barossa Development (emissions produced by facilities owned by the company itself) and not Scope 3.
74. In the SER, Santos attempts to put Barossa Development and DPD emissions in the global context by providing its annual contribution as a percentage of annual global and national emissions, and global targets.[84] Based on those figures, Santos rebuffs concerns about the Barossa Development taking up a significant portion of the global carbon budget by arguing that the contribution of the DPD is minor within the national and global context.[85] Santos ignores overall Barossa Development emissions in responding to submitters concerns about the carbon budget.[86]
75. Santos' analysis of the direct and indirect emissions impact of the DPD on climate change is incomplete and flawed. Santos purports to set Barossa Development emissions in context by providing annual emissions as a percentage of contributions to various 2030 outlooks which are 'in line with the Paris Agreement' and 'achieve net zero emissions in 2050'.[87] In only articulating

[83] https://www.nopsema.gov.au/sites/default/files/documents/2021-03/A598152.pdf Pg 128
[84] SER, 297.
[85] SER, 108.
[86] SER, 107-108.
[87] SER, 296-297.

the Barossa Development emissions as a percentage of those 2030 goals, this fails to provide complete context for these emission in a number of ways:

a. The SER does not provide context of all other emissions locked in at 2030, to understand whether Barossa Development emissions would be part of exceeding the 2030 goals.

b. The SER only provides emissions outlooks for 2030, five years into the 25-year Barossa Development, and does not account for the declines of emissions needed for the net zero and Paris Agreement targets to be met.

c. To understand the regional context of these emissions in terms of the Paris Agreement, Santos needed to provide a comparison of Barossa Development emissions against the relevant carbon budget at a national and NT-level to keep global warming under 2 °C.[5]

76. Without this further analysis, the NTEPA cannot ascertain whether the Barossa Development emissions will comply with or are contrary to those goals and targets, and is unable to assess the extent to which Barossa Development emissions will contribute to continuing global warming.
77. In lieu of that information, the EPA should rely on other reputable sources to understand the impact of new gas projects, such as the Barossa Development on international, national and Territory emissions targets. The following reputable research and reports support the view the Barossa Development emissions will undermine the Paris Agreement targets and the NT's net zero emissions by 2050 goal:
    a. The International Energy Agency's report 'Net Zero by 2050: A Roadmap for the Global Energy Sector' (May 2021) confirms that to achieve net zero emissions by 2050, fossil fuel use needs to decline drastically and no new oil and natural gas fields are required.
    b. Research published in the *Nature* journal in 2015 which concluded that 'the unabated use of all current fossil fuel reserves is incompatible with a warming limit of 2 °C'.[88]
    c. The IPCC Special Report 'Global Warming of 1.5°C' urges that emissions reductions must begin as soon as possible, by 25-45% from 2010 levels by 2030, to ensure warming doesn't exceed 1.5°C', with more rapid reductions producing better warming outcomes.[89]
    d. Extensive analysis of carbon budgets compatible with warming scenarios such as 1.5°C, for example the Climate Council report 'Aim High, Go Fast: Why Emissions Must Plummet', which also highlights the need for rapid emissions reductions before 2050.[90]
78. Consequently, ECNT submits that the emissions from the Barossa Development, as indirect impacts of the DPD, are likely to undermine the NT's net zero by 2050 target and the Paris Agreement goals.
79. ECNT submits that the climate impacts associated with the GHG emissions of the Barossa Development are significant impacts within the meaning of the EP Act on the basis of the information set out below.

[88] Christope McGlade and Paul Ekins 'The geographical distribution of fossil fuels unused when limiting global warming to 2°C' (2015) 517, 187-190.
[89] IPCC, 'Summary for Policymakers of IPCC Special Report on Global Warming of 1.52 °C approved by governments' (special report, 2021).
[90] Climate Council, 'Aim High, Go Fast: Why Emissions Must Plummet', (Report, April 2021).

Climate impact on the EPA's environmental factors

80. The Minister should not approve the DPD unless Santos can demonstrate the climate impact of the Barossa Development, as an indirect impact of the DPD, is consistent with the EPA's environmental factors and objectives.
81. The EPA's environmental objectives (**EPA Objectives**) have been formulated as indicators against which to assess whether the environmental impact of a proposed action may be significant and ultimately whether it is likely to be acceptable.[91] The EPA Objectives were created in lieu of the Minister declaring environmental objectives under the EP Act and EP Regs, which would have had flow on effects to decision makers, proponents and the EPA.[92] ECNT thus submits that the NT EPA is required in its assessment report to assess whether the DPD is likely to meet the environmental objectives, consistent with r 156(3) of the EPA Regs.
82. Australia and the NT are already experiencing the effects of climate change, and further emissions will continue to exacerbate the current pressures global warming is already having on ecosystems, habitats, biodiversity and water systems.[93] The effects of climate change will be felt across all of the EPA's environmental factors.[94]
83. Temperatures are already rising in the Northern Territory.[95] According to the NT Government's *Climate Change Response: Towards 2050* published in 2017, 'over the last century, annual average temperatures across the Territory have increased by 0.5°C in the west and 2.2°C in the south-east.'[96] The NT government's net zero by 2050 target is driven by the goal of keeping temperature increases well below 2°C.[97] Despite the aspirations of nations and territories (including the NT) to reduce emissions to keep warming well below 2°C, current policies mean the world is on track for around 2.7°C of global warming above pre-industrial levels by the end of the century.[98]
84. The NT government-commissioned report from 2020 'Climate Change in the Northern Territory: State of the science and climate change impacts' (**NT Climate Report**)[99] modelled three different emissions pathways – GHG concentrations (in CO2 equivalent parts per million) in 2100 at 650, 850 and 1370.[100] The NT Climate Report predicted temperature increases of:[101]
    a. 1.1 to 2.6°C at 650 CO2 equivalent parts per million;

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[91] EPA, *NT EPA Environmental factors and objectives: Environmental impact assessment general technical guidance* (22 May 2022) weblink, (**EPA Objectives**) 5, 6.
[92] EPA Objectives, 5, 6.
[93] Ian Cresswell, et al , *State the Environment Report 2021* (2021) weblink, key findings.
[94] EPA Objectives, 6.
[95] Ian Cresswell, et al , *State the Environment Report 2021* (2021) weblink, temperature; Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) weblink (**NT Climate Report**).
[96] NT Climate Report, 6
[97] NT Climate Report, 6.
[98] Timothy Lenton et al, 'Quantifying the human cost of global warming' *Nature Sustainability* (22 May 2023) (weblink).
[99] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink) (**NT Climate Report**).
[100] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 10.
[101] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 10.

b. 1.4 to 3.1°C at 850 CO2 equivalent parts per million; and
c. 2.6 to 4.8°C at 1370 CO2 equivalent parts per million.

85. The emissions from the Barossa Development will contribute to these predicted temperature increases in temperature.
86. ECNT submits that the effects of climate change as a result of emissions from the Barossa Development are inconsistent with the EPA Objectives and demonstrate that Barossa Development will have a significant impact on the environment. Below, ECNT sets out:
    a. the particular significant impacts related to the objectives the EPA directed Santos to address (namely atmospheric processes, marine ecosystems and marine environmental quality); and
    b. the significant impacts on the EPA Objectives related to people.

Atmospheric processes

87. The NT EPA should not approve the DPD Project as Santos has not shown it is consistent with the NT government's net-zero emission targets.
88. The 'Atmospheric Processes' factor requires the NT EPA to assess the DPD against the following objective:[102]

> Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.

89. In the 'Northern Territory Climate Change Response: Towards 2050' (**Climate Change Response**)[103] the NT government cites the Paris Agreement target of limiting warming to less than 2°C and pursuing efforts to limit warming to 1.5°C. [104] The Climate Change Response states that the NT will meet its net zero goal by, among other things, taking action to reduce emissions, and the strategies to reduce emissions 'must… be matched to our emissions profile'. [105] The largest portion of NT's emissions come from energy – 44 per cent.[106]

90. In response to concerns about GHG emissions, the EPA requested Santos '[d]emonstrate how the proposal will be implemented to meet the NT EPA's objectives for the Atmospheric Processes environmental factor and the NT Government's goal of achieving net zero greenhouse gas emissions by 2050' including Scope 3 emissions.[107]

91. The SER claims to demonstrate in section 10.7 'how the DPD Project will be implemented to meet the NT EPA's objectives for … achieving net zero greenhouse gas emissions by 2050.'[108]Section 10.7 states the DPD Project will meet NT EPA objectives because (1) emissions

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[102] EPA, *NT EPA Environmental factors and objectives: Environmental impact assessment general technical guidance*, 22 May 2022 (weblink), 6.
[103] NT Government, *Northern Territory Climate Change Response: Towards 2050* (July 2020) (weblink) 6.
[104] NT Government, *Northern Territory Climate Change Response: Towards 2050* (July 2020) (weblink) 6.
[105] NT Government, *Northern Territory Climate Change Response: Towards 2050* (July 2020) (weblink) 7.
[106] NT Government, *Northern Territory Climate Change Response: Towards 2050* (July 2020) (weblink) 7.
[107] EPA, *Address Submissions and Direction To Include Additional Information In The Supplementary Environmental Report (SER),* (12 January 2023) (weblink) 1-3;
[108] SER, 297.

from vessels used to inspect the pipeline will be limited by mobilising vessels only as necessary; (2)emissions from operations are low, as the pipeline is meant to transport saleable gas; (3) faults will be readily identified to address any potential leaks; and (4) the overall Barossa Development allegedly represents 0.86% of Australia's 2022 GHG emissions.[109]

92. This analysis is flawed and fails to demonstrate consistency with the 2050 net zero target for two reasons:
    a. Firstly, simply stating that a project represents a certain proportion of national GHG emissions provides no analysis as to whether the Northern Territory can meet its own net-zero targets by 2050 if the Barossa Development proceeds.
    b. Secondly, it omits consideration of the emissions in the NT associated with the Barossa Development as a whole which, for reasons set out above at paragraphs [60]-[66],are indirect impacts of the DPD. Santos sets out these emissions in the SER, but fails to provide any analysis about how they will impact the NT's net zero by 2050 goal.[110]
93. Scientists agree that most of efforts to get to net zero emissions need to occur in this decade in order to achieve the Paris Agreement target of keeping warming below 2°C, [111] which, as discussed above, is the objective that underlies the NT's net zero policy. As stated in the Climate Council report 'Aim High, Go Fast: Why Emissions Must Plummet':

> The effort in Australia to help limit warming to well below 2°C has to include several key elements:
>
> > Banning any new fossil fuel developments, including gas.
> >
> > Phasing out all existing fossil fuels and replacing them with other energy sources, built around renewable electricity
> >
> > …

94. A recent International Energy Agency report, 'Net Zero by 2050: A Roadmap for the Global Energy Sector' also confirms that to achieve net zero emissions by 2050 requires no new oil and gas fields.[112] The Barossa Development is a new gas field, and should not be approved if the NT is to act consistently with its own net-zero policy.
95. Without a credible plan to avoid and mitigate emissions – and Santos provides no such plan—any project that significantly increases the NT's emissions profile cannot logically be said to contribute to the NT's net zero goal.
96. Santos has failed to demonstrate the DPD and Barossa Development is consistent with the EPA environmental factor on atmospheric processes. Further, in view of strong evidence that new projects such as the Barossa Development will undermine global efforts to keep warming below 2°C and keep the world, and NT, on track towards net-zero by 2050.

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[109] SER, 317.

[110] See SER, 291-292, 294.

1. [111] Climate Council, 'Aim High, Go Fast: Why Emissions Must Plummet', (Report, April 2021) weblink.

[112] International Energy Agency, 'Net Zero by 2050: A Roadmap for the Global Energy Sector', (Report, May 2021) weblink.

Marine ecosystems

97. The environmental objective associated with the EPA 'marine ecosystem' factor is set out as follows: [113]

    Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

98. In the SER, Santos notes that climate-change induced sea level rise and marine heatwaves and warming have been and will impact oceanic processes and ecosystems including coral reefs and coastal ecosystems,[114] and identifies oceanic processes and coral reefs as places of potential significant environmental impact from climate change.[115] But Santos avoids any analysis of the how, specifically, emissions from the Barossa Development and DPD will contribute to global warming and how that warming will have negative environmental impacts on marine ecosystems in the NT.

99. As discussed above, the Barossa Development emissions support locking in warming beyond 1.5°C and 2°C. This level of warming places marine ecosystems under further threat of the environmental impacts that include the following:

    a. Sea-level rises result in less light for seagrass, reducing where the important food for dugongs.[116] Further warming at any level will increase sea levels, but increases in line with a medium emissions pathway (eg of warming from 1.1 to 2.6°C) gives sea level rises of 0.28 to 0.64 m in the NT.[117]

    b. Further marine heatwaves, causing coral bleaching, which damages reef ecosystems,[118] and local flora extinctions.[119] Warming that exceeds the Paris Agreement targets increases the likelihood of these events (which are already occurring)[120] and is likely to double the intensity of these heatwaves.[121]

    c. Warmer temperatures and higher sea-levels have flow-on effects that depending on the type of flora or fauna and how they rely on other flora or fauna, that are not easy to predict. For example, in 2015, a dieback of mangroves in the Gulf of Carpentaria was attributed to the cumulative stress of unusually hot and dry conditions and consequential lower sea levels.[122]

    d. Higher ocean acidity (as a result of higher CO2 levels in the atmosphere and oceans acting as a carbon sink)[123] impact all parts of the marine ecosystem, from microbial

[113] EPA, *NT EPA Environmental factors and objectives: Environmental impact assessment general technical guidance*, 22 May 2022 (weblink), 6.
[114] SER, 311-312.
[115] SER, 316
[116] NT Climate Report, 29.
[117] NT Climate Report, 25.
[118] NT Climate Report, 30.
[119] Kathryn Smith, et al, 'Biological Impacts of Marine Heatwaves' *Annual Review of Marine Science* (2023) (weblink) 129.
[120] Selina Ward, 'New coal bleaching outbreak in NT a worrying sign of our warming oceans' *The Conversation*, (20 March 2018) (weblink).
[121] NT Climate Report, 26.
[122] NT Climate Report, 32.
[123] NT Climate Report, 3.

organisms to large predators, [124] affecting their ability to grow, reproduce, their food and nutrients. [125]

Marine environmental quality

100. The 'marine environmental quality' factor requires the NT EPA to assess the DPD against the following objective:[126]

> Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.

101. As for marine ecosystems, Santos sets out the current climate and other environmental impacts on marine environmental quality, but fails to interrogate in the SER how the emissions and warming from the Barossa Development will impact upon the quality and productivity of water.[127] The section of the SER which does address this objective only addresses the physical impacts of laying and operating the DPD, ignoring the emissions impacts of the whole Barossa Development.[128]

People

102. The EPA's objectives in terms of people include:[129]
    a. Human health: Protect the health of the Northern Territory population; and
    b. Community and economy: Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.
103. Santos does not address climate change as a result of emissions from the Barossa Development will impact either of the above objectives in the SER.[130] In responding to submissions which raised concerns about how climate change contributes to human health risk, Santos said:

> Santos acknowledges the social impacts of climate change. Australia contributes to meeting global temperature goals under the Paris Agreement through its nationally determined contributions (NDCs). The Barossa Development, including the DPD Project, will comply with all Commonwealth and NT GHG legislative requirements. Through Australian legislative compliance the Barossa Development will contribute towards Australia's NDCs which in turn contribute towards meeting global climate commitments under the Paris agreement.

104. This fails to address the underlying concern: that the emissions from the Barossa Development will contribute to climate change, and that climate change will have real health consequences for people in NT. As discussed above at paragraphs, the Barossa Development emissions support locking in warming beyond 1.5°C and 2°C. This is likely to increase the number of days over 35

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[124] Andrew Lenton, Kathleen McInnes and Julian O'Grady, 'Maine projections of warming and ocean acidification in the Australasian region' 65(1) 2015 *Australasian Meteorological and Oceanographic Journal*, 2.
[125] Andrew Lenton, Kathleen McInnes and Julian O'Grady, 'Maine projections of warming and ocean acidification in the Australasian region' 65(1) 2015 *Australasian Meteorological and Oceanographic Journal*, 2.
[126] EPA, *NT EPA Environmental factors and objectives: Environmental impact assessment general technical guidance*, 22 May 2022 (weblink), 6.
[127] SER, 311-312, 1165.
[128] SER, 132-133.
[129] EPA, *NT EPA Environmental factors and objectives: Environmental impact assessment general technical guidance*, 22 May 2022 (weblink), 6.
[130] It does address how the

degrees in Darwin from 47 (historical average) to between 80-133 in 2040, 108 to 172 in 2050 and 152 to 214 in 2090.[131]

105. The consequences of more days over 35 degrees are well-known, and the effects of more days of extreme temperatures are already felt in the NT. Increasing temperatures and extreme heat days increase risks to the health of humans and animals, due to dehydration and heat stress exacerbating pre-existing health conditions.[132] The NT already has the highest rates heatwave fatality rates in Australia,[133] with more hot days meaning increases in heat-related deaths.
106. The NT Climate Report also signals that climate change is likely to create economic disruption through impacts on some of the NT's industries. For example, mango production (the NT's largest horticultural product) using current breeds may not be viable due to the fruit's sensitivity to temperature changes at flowering. As temperatures increase, and weather events become more extreme, the construction industry will face safety concerns for workers' during building.[134] Iconic tourist destinations may also become less appealing, for example, through sea-level rise impacts on the Kakadu wetlands.[135]
107. Coastal communities will bear the brunt of the impacts of predicted sea level rises of between 0.2 m and 0.23 m by mid-century (2036-2065) and 0.59 m to 0.72 m by the end of the century (2075-2104). [136] Higher sea levels increase the likelihood of flooding in low-lying coastal areas and communities, damaging infrastructure, roads, homes, businesses and sites of Aboriginal cultural significance and increasing the chance of groundwater contamination. [137] Storm surges and flooding are also more likely to impact water and wastewater infrastructure as seas rise, increasing the risks to public health of each extreme weather event.[138]
108. Climate change attributable to emissions from the Barossa Development are indirect impacts of the DPD. The ECNT submits that the effects of this climate change amount to a significant environmental impact given:[139]
    a. In the current context, impacts of climate change are already well-known and understood, and the EPA is able to draw cogent conclusions from the Barossa Development emissions to understand what further effects these will have on the NT's environment;
    b. The impacts will increase in intensity across the NT as more emissions are locked in, with longer marine heatwaves (causing extinctions and biodiversity loss) , more days of extreme heat (causing death in humans and animals), higher likelihood of flooding and damage from sea-level rises and weather events (causing death, infrastructure damage and social upheaval);

[131] NT Climate Report, 42.
[132] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 16, 30.
[133] Lucinda Coates, Jonathan van Leeuwen, Stuart Browning, Ashley Avci, Andrew Gissing, 'heatwave fatalities in Australia: new analysis' Risk Frontiers Holdings, 21 December 2021, (weblink)
[134] NT Climate Report, 33.
[135] NT Government, Mangoes, (weblink). Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 33-35
[136] NT Climate Report 27.
[137] NT Climate Report 27, 31.
[138] NT Climate Report, 32.
[139] EP Act, s 11.

c. Many areas of the NT are already environmentally sensitive due to the pressures of climate change, feral animals and land clearing, with tropical savannahs the second most intensely collapsing ecosystem in Australia,[140] and the arid zone facing collapse;[141]
d. Environments across the NT are of high value in terms of biological and ecological diversity[142] and the cultural value, especially for Aboriginal Territorians;
e. Climate change is locked in and set to continue,[143] so the effects of climate change will endure for as long as GHG emissions continue unabated;
f. The extent of the impact of climate change will be widespread and severe, especially during extreme events such as heatwaves, storm surges and extreme weather; and
g. The geographical effects of climate change will be felt across the entire NT (and world).

109. Accordingly, consistently with r 156(3) and (4) and 159 of the EP Regs, the NT EPA must conclude in its assessment report that the direct and indirect impacts of the DPD:
a. are unlikely to meet the EPA Objectives due to the significant environmental impacts of climate change as a result of the Barossa Development;
b. amount to significant environmental impacts given their context and intensity, and the sensitivity, value and quality of the environment impacts on the duration, magnitude and geographic extent of their impact; and
c. amount to unacceptable environmental impact.

Referral and SER contain no credible plan to avoid, mitigate or offset emissions

110. The material set out in the SER demonstrates that Santos does not have a credible plan to avoid, mitigate, manage or offset the Barossa Development's GHG emissions, and consequently, the indirect, significant environmental impacts of the DPD.[144] Without a cogent plan, the impact of emissions from the DPD and Barossa Development will translate into the climate change and significant environmental impacts for the NT described above.
111. The EPA has directed Santos to provide information demonstrating the application of the decision-making hierarchy (part 2 of the EP Act), and that all reasonable and practicable measures would be applied to avoid and/or reduce emissions, including through best practice design, technology and management.
112. In response, Santos limits the measures it plans to take to reduce or avoid GHG emissions to emissions associated with the construction and operation of the DPD and ignores Barossa

[140] Dana Bergstrom et al, 'Combating ecosystem collapse from the tropics to the Antarctic' 27(9) (*Global Change Biology*, 2021), 1694.
[141] Nick Kilvert 'Australia's lesser-known ecosystems are heading for collapse. Here's what we stand to lose' (ABC News, 21 March 2021) https://www.abc.net.au/news/science/2021-03-21/ecosystem-collapse-mangroves-gidgee-desert/13234044 .
[142] NT Government, *About animals NT*, https://nt.gov.au/environment/animals/about-animals-in-nt#:~:text=Mammals,kapalgensis%20and%20Hipposideros%20diadema%20inornatus; NT Government, *Threatened plants* https://nt.gov.au/environment/native-plants/threatened-plants; NT Government, *Sites of conservation significance*, https://nt.gov.au/environment/environment-data-maps/important-biodiversity-conservation-sites/conservation-significance-list ; NT Government, *important wetlands*, https://nt.gov.au/environment/soil-land-vegetation/important-wetlands.
[143] NT Climate Report, 34.
[144] SER, 299-307; 317; 361-379.

Development emissions.[145] It specifically notes that 'FPSO and DLNG and the resultant emissions are not within the scope of the DPD Project'.[146]

113. Section 10.6 of the SER sets out Santos' plans for emissions management and mitigation of the DPD itself.[147] The section refers to Section 12 which covers 'management actions to manage (avoid and mitigate) the impacts and risks to the NT EPA Environmental Factors'. These are set out in a table entitled 'Management actions that will be used for avoidance, mitigation and monitoring of impacts to the relevant environmental factors for the DPD Project'.[148] This table lists three 'management measures' which are limited to addressing the emissions from the DPD alone, and do not address emissions from the Barossa Development, being: [149]

> Maintenance undertaken in accordance with maintenance regime by qualified personnel.
>
> Implementing Marine Order 97 (Marine Pollution Prevention - Air Pollution) including (as required by vessel class) ensuring that vessels maintain a Ship Energy Efficiency Management Plan (SEEMP).
> Implement a risk-based inspection (RBI) schedule for vessel-based pipeline inspection, maintenance and repair (IMR) activities, in accordance with industry standards, to ensure the safe operation and integrity of the pipeline and to optimise the frequency of IMR vessel activities (with associated emissions).

114. The SER indicates that Santos considers that it cannot avoid or manage many of the GHG emissions associated with the DPD itself except to a limited and inadequate extent.[150] Some of the measures are already mandated by legislation or are best practice, and it is unclear whether they mitigate emissions 'to the greatest extent possible' on the basis of all other available mitigation measures given the technology available. Further, it does not consider that it is required to offset residual GHG emissions relating to the construction and operation of the DPD. [151]

115. The only element of the broader Barossa Development section 10.6 addresses in relation to mitigation and management is the DLNG facility, which states:

> The operation of DLNG complies with the requirement of the Australian Government's Safeguard Mechanism. This includes surrendering carbon credit units for any of DLNG's Scope 1 emissions above the approved baseline.

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[145] SER, 299-300.
[146] SER 300.
[147] SER, 317.
[148] SER, 371.
[149] SER, 371.

[150] Santos will use less energy efficient fossil fuel vessels during construction due to a lack of alternative vessels and unavailability of more efficient fossil fuel vessels. Higher efficiency vessels were disregarded due to their unavailability during construction timeframes. During the many decades of proposed operations, Santos states that fossil fuel vehicles will be needed for inspection, maintenance and repair of the DPD. Santos claims emissions from these activities cannot be avoided because only fossil fuel-powered vessels can undertake this work, but that they would consider using new technologies to reduce inspection times and vessel size. See SER, 300-301.
[151] SER, 409

The DLNG facility currently operates under the Environment Protection Licence (EPL217-03) which was issued under Section 34 of the *Waste Management and Pollution Control Act 1998* on 19 September 2017, expiring on 18 September 2025 and its associated environmental management plan.

116. In response to the EPA's direction to 'provide an overarching long-term emissions target trajectory and proposed interim trajectory targets, and the measures and methods that will be used to meet the targets', Santos states that it will employ the following measures and methods:
    a. Complying with its obligations under the Commonwealth Safeguard Mechanism in relation to Scope 1 emissions.[152] Santos says it will achieve this goal through CCS projects including the Bayu-Undan CSS Project.[153] In other parts of the SER, Santos instead appears to say it will rely on offsets: the tables outlining Barossa Development emissions are caveated by saying the emissions 'estimate excludes the effect of any offsets that will be surrendered in compliance with the Safeguard Mechanism'.[154]
    b. Various abatement measures such as 'designing facilities to reduce Barossa fuel, flare and vent emissions', 'reporting GHG emissions', 'undertaking optimisation of energy efficiency' and 'complying with the requirement of the Safeguard Mechanism';[155]
    c. Its own net-zero Scope 1 and 2 emissions by 2040 target, achieved through 'CCS and a broad range of operational efficiency initiatives';[156] and
    d. Its own target to reduce 'customer emissions (Santos Scope 3) by 1.5 MT CO_2 per annum' using offsets and 'the supply of clean fuels';[157] and
    e. A diagram (Figure 10-3) which purports to set out Santos' climate transition action plan for net-zero by 2040. The figure provides no concrete numbers in terms of emissions reduction and includes projects or ideas for projects that remain highly uncertain – including the Bayu-Undan CCS Project and 'PNG CCS'.[158]

117. Santos' plans to avoid, mitigate or manage emissions and the effects of the GHG emissions of the Barossa Development are deficient in several ways:
    a. Because Santos does not acknowledge that the EP Act decision making hierarchy applies to the emissions associated with the broader Barossa project, it provides no cogent detail about the measure it will apply to avoid and/or reduce its Scope 1, 2 and 3 emissions and the associated environmental impacts. This is a significant omission in the SER, given that the GHG emissions associated with the broader Barossa Development are significant indirect emissions of the DPD.
    b. Santos is heavily relying on the Bayu-Undan CCS project and other yet to be commenced CCS projects for offsetting reservoir emissions, Scope 1 emissions and to reduce the emissions effects of fuel, flare and vent.[159] As discussed at [35]-[59] the Bayu-Undan CCS Project remains financially and technically uncertain and insufficient information has been provided to the EPA for it to be confident that this is a credible mitigation measure.

[152] SER, 298.
[153] SER, 17.
[154] SER, 292.
[155] SER, 298.
[156] SER, 298.
[157] SER, 299.
[158] SER, 299.
[159] SER, 298.

c. None of the above plans or obligations to meet emissions targets provide a clear and cogent pathway to net emissions reductions for all emissions from the Barossa Development. Each describes an aspiration for Santos as a company or a particular project or management technique it hopes to pursue. But Santos does not set out specific, clear and measurable plans for *how* it will achieve these projects and targets and by *how much* each project, scheme or efficiency will assist with offsetting or reducing emissions. Even on the Safeguard Mechanism, Santos variously cites CCS and offsets as key to meeting its obligations, without precision.

d. Santos' emissions reduction targets for scope 3 emissions are negligible in the context of the emissions profile of Santos' customers and the Barossa Development – it amounts to one fifteenth of the annual Barossa Development emissions.[160] Without a credible plan to reduce, mitigate or manage scope 3 emissions from the entire Barossa Development, Santos is locking in the warming from those emissions.

e. Santos has not clearly articulated its plans according to the decision-making hierarchy. In relation to the GHG emissions of the Barossa Development, Santos describes offsets as a potential method option alongside avoidance and mitigation measures. The EP Act directs proponents to only use offsets for residual adverse impacts that cannot be avoided or mitigated.[161] Because Santos does not consider it is required to address the GHG emissions of the Barossa Development as a whole, the SER does not acknowledge the potential role to be played by offsetting in Santos' plans and does not articulate why offsetting is appropriate. This is a significant omission, given that it is clear from the SER that Santos intends to rely significantly on offsetting in relation to the Barossa Development's GHG emissions.[162] This was confirmed recently in a FAQ document drafted by Santos outlining plans to purchase carbon credits to offset reservoir emissions.[163]

118. In light of the above, neither the EPA nor the Minister can be satisfied that Santos has complied with the environmental decision-making hierarchy. Further, the Minister cannot be satisfied of the factors under s 73(2) of the EP Act which must be met for her to grant the environmental approval for the DPD.

119. Even if Santos were to rely upon offsets for residual adverse impacts that cannot be avoided or mitigated, it must do so in accordance with the EP Act.[164] Section 125 of the EP Act enables the Minister the establish a framework for environmental offsets, which may set out the requirements for different types of offsets.[165] This has occurred for emissions offsets, and the rules of what offsets can be used are set out in the Greenhouse Gas Emissions Offsets Policy and Technical Guidelines (**Offsets Guidelines**).[166]

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[160] SER 297.
[161] EP Act, s 26(1)(c).
[162] See for eg, the sections of the SER described at [116].
[163] Santos, 'Barossa Gas Project: Frequently Asked Questions' (26 April 2023) weblink, 20.
[164] EP Act, ss 73(2)(a), s 26(1)
[165] EP Act, s 125.
[166] NT Government, *Greenhouse Gas Emissions Offsets Policy and Technical Guidelines* (5 August 2022) weblink (**Offsets Guidelines**).

120. The Offsets Guidelines allow only Australian Carbon Credit Units (**ACCUs**) (the preferred unit),[167] or units that meet the following criteria:
    a. Able to be counted towards the NT's net-zero emissions by 2050 target;
    b. The administering framework allows them to be surrendered to satisfy jurisdictional requirements in the NT; and
    c. Units are not sold at any point in time.
121. Santos' Scope 1 emissions for the Barossa Development are also limited by the application of the Commonwealth Safeguard Mechanism, which requires Santos to fully offset or mitigate all reservoir carbon emissions, along with reducing net scope 1 emissions year on year.[168] Safeguard Mechanism emissions can only be offset using ACCUs or Safeguard Mechanism Credits.[169]
122. Rob Cawthorne's report at **Annexure A** sets out the following hurdles for Santos complying with the EP Act, meetings its obligations under the Safeguard Mechanism and in limiting the global warming effect of the Barossa Development emissions:
    a. Due to the Barossa Development's high reservoir and scope 1 emissions it is 'highly plausible' there will not be enough Australian Carbon Credit Units (**ACCUs**) available for Santos to meet its obligations under the Safeguard Mechanism;[170]
    b. Increased demand for ACCUs as a result of the Barossa Development creates a 'high potential' to see ACCU prices increase to $75, representing an approximate rise in residential electricity supply rates of 20%;[171] and
    c. Santos could not rely solely on ACCUs to offset all non-Safeguard Mechanism emissions (scope 2 and 3) of the Barossa Development, and would need to use international offsets if it wished to meet its own corporate targets, which may be more difficult to ensure are real and permanent sources of abatement.[172]
123. In any case, the use of international offsets would not allow Santos to comply with Safeguard Mechanism requirements.

Uncertainty about the effectiveness of CCS at mitigating the significant emissions associated with the Barossa Project

124. One method that Santos puts forward to address the Barossa Development's high emissions is to pipe the CO_2 first from the reservoir to Darwin to process at a Carbon Capture and Storage (**CCS**) facility, and then 500 km offshore for subsea injection in the Bayu-Undan field via an old pipeline.[173] The success of this plan depends, firstly, on repurposing the nearly 20-year-old, 500 km-long subsea Bayu-Undan Gas Export Pipeline, initially designed for natural gas, to transport pressurised CO_2 for injection into the depleted Bayu-Undan reserve.[174] As has been canvassed previously, there is no evidence presented by Santos that this can occur. Secondly, the plan

[167] Offset Guidelines, 9-10.
[168] Piers Verstegen and Rod Campbell, *Safeguard Mechanism reforms and the Barossa Project* (Report, May 2023) weblink, 1-2.
[169] Piers Verstegen and Rod Campbell, *Safeguard Mechanism reforms and the Barossa Project* (Report, May 2023) weblink, 5.
[170] Annexure C, 4-5.
[171] Annexure C, 5.
[172] Annexure C, 5.
[173] Santos, "Darwin Pipeline Duplication Project Supplementary Environmental Report – Executive Summary," p. 3-8 (Mar. 2023).
[174] *Id*. *See also, id*. at p. 406, Table 15-1.

assumes that the CCS processing facility, once constructed, will be able to capture the large scale of carbon produced by the Barossa project, which also has not been established. Finally, the plan depends on the subsea Bayu-Undan gas field being capable of long-term storage of CO_2, despite the lack of evidence supporting this kind of site or method for sequestering CO_2 at scale.

125. There are significant feasibility risks and uncertainties related to Santos's plan. Santos has, to date, failed to demonstrate that: (1) the Bayu-Undan pipeline is technically capable of transporting pressurised CO_2 without a high risk of rupturing; and (2) the Bayu-Undan field could be used to sequester carbon long-term at scale.

Technical uncertainties concerning plans to repurpose the Bayu-Undan Pipeline

126. Santos's plan to repurpose the ageing Bayu-Undan natural gas pipeline for CO_2 raises questions of technical feasibility as well as higher safety and environmental risks. There are very few examples worldwide of natural gas pipelines that have been successfully repurposed to transmit pressurised CO_2, and none approaching the distance anticipated for CCS at Bayu-Undan. The feasibility and risks of transporting CO_2 via pipeline depend on the impacts of severe weather on the pipeline, the chemical composition of impurities expected in the CO_2 stream that can cause corrosion, the pressures and weights of the gas, challenges related to changing the flow direction, and technical specifications of the pipeline design.
127. Severe weather 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. On 22 February 2020, a CO_2 pipeline ruptured near Satartia, Mississippi that released an estimated total of 31,4052 barrels of CO_2. The cause of the Satartia rupture was stress on the pipeline when heavy rains led to a landslide, which created axial strain on the pipeline and resulted in a full circumferential girth weld failure.[175] The pipeline that ruptured in Satartia was made of a stronger grade of steel than the Bayu-Undan pipeline and was designed to better transport CO_2.
128. Corrosion poses another risk of pipeline rupture. Unlike methane, which comprises the bulk of natural gas, CO_2 forms an acid (carbonic acid, H_2CO_3) with any exposure to water, which is strongly corrosive to carbon steel.[176] 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.[177] Because of the limitations of capture technologies, CO_2 transported through pipelines will unavoidably contain impurities, threatening pipeline integrity.[178]
129. The existing Bayu-Undan pipeline is already vulnerable to corrosion. The Bayu-Undan pipeline, which became operational in 2005, is constructed from American Petroleum Institute (API) 5L X65 carbon steel,[179] which can be vulnerable to corrosion and stress particularly when exposed

[175] U.S Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC Pipeline Rupture/Natural Force Damage, (26 May 2022).
[176] Gregory Cooney *et al.*, *Evaluating the Climate Benefits of CO2-Enhanced Oil Recovery Using Life Cycle Analysis*, 49, Environ. Sci. Technol., 7491–7500 (2015).
[177] 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).
[178] V. E. Onyebuchi *et al.*, *A systematic review of key challenges of CO2 transport via pipelines*, 81, Renew. Sustain. Energy Rev., 2563–2583 (2018).
[179] Santos Ltd. Bayu-Undan to Darwin Gas Export Pipeline Environment Plan, 7710-057-EIS-0001, https://docs.nopsema.gov.au/A856933. See Table 2-2: Structural Design parameters for the Pipeline, at 28.

to trace amount of water and sulphur dioxide (SO_2).[180] Corrosion-resistant alloys with specialised coatings may be selected for new CO_2 pipelines, but it is unlikely Santos could retrofit an existing pipeline like Bayu-Undan with corrosion-resistant coatings.

130. Over-pressurisation can also lead to pipeline rupture. Natural gas and CO_2 have different requirements for the pressures at which they can be safely and effectively transported; this makes it particularly difficult to repurpose a pipeline designed to carry one type of gas to carry the other. Although repurposing natural gas pipelines for CO_2 transport is a popular idea among proponents keen to lower construction costs,[181] doing so often depends on the pipeline's ability to operate safely at higher pressures.

131. CO_2 is usually transported via pipeline at very high pressures (1500-2200 pounds per square inch at gauge (**psig**)) for efficient transmission.[182] Few existing natural gas pipelines are, in practice, viable options for handling these pressures.[183] The high pressure results in the CO_2 being transported in a supercritical fluid phase, meaning it is no longer a gas. However, pressures must be carefully maintained to keep CO_2 in this desired high-density fluid phase, and typically CO_2 pipeline diameter, wall thickness, and compression infrastructure are all intentionally designed to sustain CO_2 within the required pressure range.[184] Conversely, natural gas transmitted in offshore pipelines in gas phase are generally within a lower pressure range. This is the case for the Bayu-Undan gas pipeline; it would normally operate at much lower pressures over its entire 500 km length than would be typical for supercritical CO_2. For instance, the outlet pressure at the Darwin LNG plant is typically 754 psig, a pressure at which CO_2 would no longer be in its most efficiently transmissible form.[185]

132. Successful conversion of pipelines from natural gas to CO_2 transmission are globally rare and limited to short pipeline lengths, over which transmission of gas-phase CO_2 (rather than supercritical) is more feasible.[186] Indeed, there are only two known examples of an operational repurposed natural gas pipeline: the West Gwinville Pipeline, a 16-inch diameter pipeline spanning just 50 miles operated by Denbury Resources in Mississippi,[187] and theOCAP Pipeline in the Netherlands which repurposed a 26-inch diameter, 51-mile oil pipeline to transport gas phase CO_2 at 101-304 psig.[188] Neither of these examples points to the viability of Santos's proposal.

133. Repurposing a natural gas pipeline could significantly alter the overall mass load of the pipeline, and this increased mass can increase the risk of a pipeline rupture. The density of the supercritical phase CO_2 could be as much as 10 times greater than the density of natural gas,

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[180] Kaiyang Li & Yimin Zeng, *Long-term corrosion and stress corrosion cracking of X65 steel in H2O-saturated supercritical CO2 with SO2 and O2 impurities*, 362, Constr. Build. Mater., 129746 (2023).
[181] Patrick Rabindran, H. Cote & I. Winning, *Integrity Management Approach to Reuse of Oil and Gas Pipelines for CO2 Transportation* (2011) (weblink); Onyebuchi et al., *supra* note 15.
[182] Suoton P. Peletiri, Nejat Rahmanian & Iqbal M. Mujtaba, *CO2 pipeline design: A review*, 11, Energies, 2184 (2018).
[183] David E. Dismukes, Michael Layne & Brian F. Snyder, *Understanding the challenges of industrial carbon capture and storage: an example in a U.S. petrochemical corridor*, 38, Int. J. Sol. Energy, 13–23 (2019).
[184] Peletiri, Rahmanian, and Mujtaba, *supra* note 28.
[185] Ibid.
[186] Peletiri, Rahmanian, and Mujtaba, *supra* note 28.
[187] Dismukes, Layne, and Snyder, *supra* note 29.
[188] Global CCS Institute 2014, The Global Status of CCS: 2014, Melbourne, Australia (weblink)

while the density of CO_2 in gas phase is more like natural gas.[189] Therefore, if CO_2 is transported in gas phase the weight and mass of the pipeline may not change. However, for supercritical phase CO_2, the weight of the pipeline may increase 10-fold. As above, it is not likely that transporting the CO_2 in gas phase is technically possible or efficient at the distance required.

134. Further, pipelines being repurposed for CO_2 transport for geologic sequestration may necessitate the reversal of inlet to outlet. Reversing flow direction can alter where the stresses on the pipeline are the greatest.[190] These stresses can increase the risk of rupture or damage and therefore must be assessed.

Subsea injection method unproven

135. The stated purpose of the DPD Project is to facilitate the subsea injection of CO_2 for storage in the depleted Bayu-Undan gas condensate field, as part of Santos's plan to comply with net-zero emissions target. Prior to approving the DPD Project, the NT EPA should require Santos to show that permanent or long-term storage of CO_2 in Bayu-Undan is feasible.
136. Long-term storage of CO_2 beneath the sea is not proven at scale. Australia's Parliament has long recognised that one of the "most substantial risks associated with CCS is the leakage of CO_2 from storage sites. While there is some experience with geological storage of CO_2 and natural gas for periods of approximately 10-20 years, long term storage over many hundreds or thousands of years has not been proven."[191] Similarly, the US government recognised in October 2022 that, for "CCS to succeed in mitigating atmospheric emissions of CO_2, it is assumed that each reservoir type would permanently store the vast majority of injected CO_2, keeping the gas isolated from the atmosphere in perpetuity. That assumption is untested."[192]
137. Even if the CO_2 can be successfully injected in the seabed, Santos has not addressed the real risk of leakage. As the Center for International Environmental Law and US government has noted, geological formations where CO_2 is stored can contain unseen passages through which gas can escape.[193] Examples of this have been documented. In the Sleipner offshore CCS project in Norway, CO_2 was injected at a lower-level injection point and migrated into a previously unidentified shallow layer.[194]
138. A second hurdle is establishing that targeted formations will in fact store as much CO_2 as expected. In the Snøhvit project in Norway, the targeted storage site rejected the most of the

[189] E. Østby *et al.*, 'Safely repurposing existing pipeline infrastructure for CO2 transport – Key issues to be addressed' *Pipeline Technology Journal* (2022) (weblink)
[190] US Pipeline and Hazardous Materials Safety Administration, *Guidance for Pipeline Flow Reversals, Product Changes, and Conversion to Service* (2014) (weblink)
[191] Australia Parliament, Standing Committee On Science And Innovation, "The environmental benefits and risks of carbon capture and storage and public perception" in "Between a rock and a hard place The science of geosequestration," (Aug. 2007) (weblink)
[192] Congressional Research Service, *Carbon Capture and Sequestration (CCS) in the United States Updated October 5, 2022*, p. 9 (2022) (weblink)
[193] Center for International Environmental Law, "Deep Trouble: The Risks of Offshore Carbon Capture and Storage," p. 2 (June 2023) (citing Rebecca C. Smyth and Susan D. Hovorka, "Best Management Practices for Offshore Transportation and Sub-seabed Geologic Storage of Carbon Dioxide (OCS Study BOEM, 2018) espis.boem.gov/final%20reports/5663.pdf
[194] IEEFA, *Norway's Sleipner and Snøhvit CCS: Industry models or cautionary tales?* (2023) (weblink) ("[h]ad this unknown layer not been fortunate enough to be geologically bounded, stored CO_2 might have escaped").

CO_2 that was injected. As a result, a "geological structure thought to have 18 years' worth of CO2 storage capacity was indicating less than six months of further usage potential."[195]

Emissions involved in the CCS process and total emissions impact

139. In addition, the calculation of the total emissions from the Barossa Development excludes the high emissions that could result from the process of CO_2 removal and compression of CO_2.[196] This gap in the analysis is significant. As the Institute for Energy Economics and Financial Analysis (IEEFA) has noted, emissions from separating CO_2 and from compressing the gas and transporting it 500 km to Bayu-Undan is likely to be highly significant.[197]
140. CCS facilities have consistently underperformed their stated abilities to capture CO_2. Problems emerge when facilities are built at larger scales and struggle to capture large volumes of CO_2. The proposed CCS facility in Darwin would potentially be the world's largest.[198] In addition to addressing the feasibility issues with the CO_2 pipeline conversion and the use of the Bayu-Undan field for storage as set out above, Santos must also demonstrate that its CCS facility will be able to capture the amount of CO_2 that is planned in order to reduce the Barossa Development's overall emissions.
141. Given this significant uncertainty about the technical viability of Santos' plans to use CCS at Bayu-Undan, neither the NT EPA or the Minister should consider these plans provide a potential way to avoid, mitigate or manage the significant, indirect climate impacts of the DPD.

ESD principles relating to the risk of climate change

142. As discussed above, when deciding whether to approve the DPD the Minister must consider *and apply* the ESD principles,[199] which means putting them into practical operation, see [25] above. It is additionally part of the purpose of the EIA process is to ensure that projects that may have a significant environmental impact (such as the DPD, as described above) on the environment are assessed according to the ESD principles.[200]
143. Santos's consideration of ESD principles in the SER omits any consideration or application of the direct or indirect emissions and climate change impacts of the Barossa Development, considering only the impacts of the construction or operation of the DPD itself.[201]
144. Applying a key ESD principle to the impact of climate change on EPA Objectives -- the precautionary principle – to the GHG emissions of the Barossa Development demonstrates a strong basis for refusing to grant approval of the DPD.

The precautionary principle

145. As discussed at [27]-[31], the precautionary principle requires considering the threat of damage (which must be serious and irreversible) and the uncertainty of the damage.

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[195] *Id*.
[196] SER at p. 293 ("The impact of the Bayu-Undan CCS project on Scope 3 emissions has not been included here").
[197] IEEFA, "Darwin Pipeline Duplication Project Submission to the NT EPA" at p. 2.
[198] SER, p. 17.
[199] EP Act s 17(2).
[200] EP Act s 42(b)(i).
[201] SER, 406-407.

146. ECNT submits that the threats identified in [80]-[109] above are serious and, if they are not avoided, irreversible based on the following: [202]

a. The magnitude of the impact on the environment is great – it will impact all parts of the NT in different ways, and in some places have impacts that are more devastating. For example, such as low-lying coastal community of the NT may experience being fully inundated, while higher temperatures across the NT will create heat stress everywhere.
b. Most of the threats are likely to persevere and occur every year, becoming worse and warming increases, such as changes in temperature. Others may be more intermittent, but will occur in more extreme ways, such as cyclones.
c. As the impacts of climate change will be felt across the NT, and are likely to impact unique environments such as in Kakadu National Park (home to 75 threatened species).[203]
d. Some threats due to climate change are clear and apparent (eg temperature rises), while others – due to how interdependent and connected the climate system is – are less readily apparent (eg changes to flora and fauna lifecycle).[204] This makes some climate impacts less possible to predict.
e. Some climate threats are manageable, or can be managed as part of a climate adaptation policy approach.[205] But, given the increasing unpredictability of extreme weather events and the limitations on adaptation measures, many cannot.
f. Climate change is of great public concern. The 2022 Ipsos Climate Change report found 83% of Australians are very or somewhat concerned about climate change.[206]
g. The above threats are unlikely to be reversible given that some level of continued warming is already 'locked in' by virtue of emissions already emitted, which will stay in the atmosphere for up at 120 years.[207] As a result it may take more than a century for serious impacts from climate change to be reversed, if all human-induced emissions were stopped overnight.[208]

147. While there is significant scientific consensus around the effects of climate change (eg temperature and sea level rises) and certainty about some of the damage it is likely to cause into the future (increasing heat-related deaths, inundation of low-lying areas), due to the complexity

[202] *Hornsby Shire Council*,[131].
[203] Department of Climate Change, Energy, Environment and Water, 'Kakadu Threatened Species Strategy', Australian Government (weblink).
[204] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 6.
[205] United Nations Climate Change, 'Adaptation and resilience' (weblink).
[206] Ipsos, 'Ipsos Climate Change Report 2022' April 2022 (weblink).
[207] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 5.
[208] David Herring and Rebecca Lindsey, Can we slow or even reverse global warming? (2022) (weblink)

and interconnectedness of climate systems, the exact nature of effects on biodiversity,[209] droughts[210] and rainfall levels[211] are less certain.

148. Given this, ECNT submits the nature and scope of the uncertainty engages the precautionary principle because:
    a. There is sufficient evidence that the phenomenon of climate change will occur, as a result of GHG emissions, but there is not full certainty about all damage that it will cause. This is because the way these effects or impacts are predicted are based on models that may not always be adapted to every region or area, and even when they are, broader global simulations must be factored in.[212]
    b. The level of uncertainty relates to the exact nature of the damage on the environment as a result of all climate change effects, perhaps best catergorised as methodological uncertainty due to the limitations of modelling to provide clarity on the harms.
    c. There is limited potential to reduce the uncertainty without significant improvements in climate modelling.
149. Consequently, there is a threat of serious or irreversible environmental damage (the effects of climate change), and a lack of full scientific certainty about all of the harm or effects, and the precautionary principle is engaged.
150. **Conclusion: Climate impacts**
151. On the basis of the above, the NT EPA must conclude in its assessment report that:
    a. the climate impacts resulting from the Barossa Project's GHG emissions are indirect, significant environmental impacts of the DPD (for the reasons set out at [86]-[**Error! Reference source not found.**]. above);
    b. Santos has failed to take all reasonable measures to avoid, and then mitigate and manage these risks (for the reasons set out at [110]-[**Error! Reference source not found.**] above);
    c. In these circumstances, environmental offsetting is not appropriate because it is not the case that these impacts are 'residual impacts that cannot be avoided or mitigated'; and
    d. In any event, sufficient offsetting is unlikely to be available.
152. Further, the NT EPA must:
    a. State that the actions contained in the Referral will have an unacceptable impact that cannot be appropriately avoided, mitigated or managed for which environmental offsets are not appropriate; and
    b. Prepare a statement of unacceptable impact.
153. The Minister cannot in these circumstances be satisfied as required by s s 73(2) of the EP Act that the significant impacts of the actions in the Referral have been appropriately avoided or mitigated or can be appropriately managed.
154. Accordingly, the Minister:
    a. must not grant environmental approval for the DPD; and

[209] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 30.
[210] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 17-19.
[211] Northern Territory Government, 'Climate Change in the Northern Territory: State of the science and climate change impacts' (2020) (weblink), 17-19.
[212] NT Climate Report, 9.

b. must accept a statement by the NT EPA of unacceptable impact in relation to the DPD.

V: THE MARINE IMPACTS OF THE DPD PROJECT

155. The SER identifies numerous risks of significant marine impact,[213] but downplays the risks and damage either as a result of insufficient testing or faulty analysis. The below analysis highlights, in particular, the inadequacies of the SER and consequent risks of damage in the following marine domains:

a. seabed habitat through seabed disturbance;

b. marine mammals and crocodiles through noise emissions; and

c. the marine environment, as a result of a wet buckle event.

Seabed disturbance

156. Offshore, there are soft corals in the project area, but they are sparse.[214] In Darwin Harbour, there are more corals, including a reef with high density of epibiota.[215] Density of corals and seagrass increases towards the inner Darwin Harbour, with the densest area surveyed occurring in rocky reefs in the shallow protected areas of the inner harbour.[216] The DPD area overlaps with seagrasses, macroalgae, and hard-corals,[217] and a small amount of mangrove trees.[218]

157. Each of these marine species are important. Seagrasses and mangroves protect against coastal erosion and storm surge, macroalgae are important for ecosystem health for their role in fighting parasites[219] and sequestering carbon,[220] and corals support marine biodiversity. In this area, Santos is planning on trenching over 300,000 m^3 of sediment that will create sediment plumes and increase turbidity. [221]

158. Santos' overall conclusion regarding impacts to marine ecosystems from seabed disturbance is that the DPD 'is unlikely to result in changes the composition of benthic habitats across Darwin Harbour, or have wider impacts on the marine fauna that rely on those habitats.'[222] The primary assumption for this conclusion comes in the sentence immediately preceding this conclusion, which states that 'trenching and infrastructure footprints combined will impact less than 1% of

[213] Santos, Darwin Pipeline Duplication Project: Supplementary Environmental Report, May 2023, 241.
[214] SER, Appendix 6, Benthic Survey Report, p. 25
[215] SER, Appendix 6, Benthic Survey Report, p. 31.
[216] *Id*. p. 33.
[217] *See,* SER, Figure 9-9, p. 245; Figure 9-10, p. 246.
[218] SER, p. 103.
[219] Seham M Hamed et al, ' Role of marine macroalgae in plant protection & improvement for sustainable agriculture technology', *Beni-Suef University Journal of Basic and Applied Sciences* (2018) (weblink)
[220] Dorte Krause-Jensen & Carlon M Duarte 'Substantial role of macroalgae in marine carbon sequestration' *Nat. Geosci.* (2016) (weblink)
[221] SER, Appendix 3, Table 5.7.
[222] SER, Section 9.5.1, p. 242.

the benthic habitats across Darwin Harbour.'[223] This presents several issues, dealt with in further detail below: Santos's criterion for significant impact — the percentage of habitat impacted in Darwin Harbour — is meaningless without more information (**issue 1**).

a. The analysis makes a faulty assumption that a small loss of habitat is insignificant (**issue 2**).
b. An arbitrarily large domain area makes the percentage of habitat impacted misleadingly small (**issue 3**).

Issue 1: meaningless criteria for significant impact

159. The primary criteria for determining impacts to marine ecosystems from seabed disturbance is percentage of habitat impacted.[224] The amounts of habitat in hectares are in Table 9-4 of the SER. Santos provides no information to give this criterion any meaning. Consequently, it is unclear what number of hectares, or what percentage of habitat, would need to be impacted for there to be significant harm, or whether the level is the same for all habitats and all species.

160. Additionally, the SER does not address whether small percentages of habitat impacted could be significant in the light of cumulative harms from industrial processes in Darwin Harbour. Without more information, there is no way for the EPA to know whether a small percentage of total habitat impacted in Darwin Harbour has any meaning for marine ecosystem health.

Issue 2: faulty assumption about significance of habitat loss.

161. The loss of even one hectare of habitat has been considered significant for species that are designated as Matters of National Environmental Significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Cth) when those species are particularly threatened or have limited range.[225]

162. By analogy, the loss of even small amounts of habitat could be a significant environmental impact under the EP Act. By concluding that there will be no harm mainly because only one percent of habitat in all Darwin Harbour will be impacted, Santos has failed to meaningfully assess whether habitat loss will result in ecosystem impacts or harm to fauna that depend on those habitats.

163. Habitat loss and ecosystem disturbance may be problematic for small populations of cetaceans and marine megafauna that show high site fidelity to areas used for foraging, mating, resting, or calf rearing, particularly where multiple industrial projects overlap.[226] Santos asserts that Darwin Harbour is "occasionally visited by small pods of false killer whales,"[227], but this is inconsistent

[223] SER, Section 9.5.1, p. 242.
[224] SER, Section 9.5.1.
[225] Michelle S. Ward et al, 'Lots of loss with little scrutiny: The attrition of habitat critical for threatened species in Australia' J*ournal for the Society of Conservation Biology (*2019) (weblink)
[226] Bernd Würsig, 'Cetaceans' *Science* (1989) (weblink); Lars Bejder et al, 'Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli M*arine Ecology Progress Series* (2009) (weblink)
[227] SER, p283

with recent research that suggests that the species occupies shallow waters in the Harbour more frequently than previously thought, experiences very little demographic exchange other populations, and demonstrates high levels of habitat fidelity, which makes disturbance to or destruction habitats within the harbour more impactful than assumed.[228]

164. Although Santos describes some macroalgae communities impacted,[229] and specifies the size of habitats impacted,[230] Santos does not specify what habitats are affected, how they are affected, how important they are for larger ecosystem health,[231] or how important these areas are for migrating species when those species are in the project area.

165. There are many reasons to believe that trenching over 300,000 m^3 of seabed materials[232] will have a significant impact.

166. Firstly, the tolerance levels for corals were exceeded, but not analysed. In response to public comments, Santos conducted a sediment plume analysis. Santos assessed harm to coral by looking at whether the total of suspended solids concentration (**SSC**), expressed in mg/L, exceeds tolerance levels developed by INPEX. In Mid Harbour, hard corals can tolerate levels of SSC of up to 10.7 mg/L in the dry season.[233] Data in the sedimentation report shows SSC concentrations in the dry season of 17 mg/L or greater at Weed Reef 1,[234] a point within Mid Harbour.[235] Thus, Santos's own modelling shows that there are points in Mid Harbour experiencing SSC levels above hard coral tolerance levels. Santos does not assess how these maximum exposure levels might harm corals.

167. Secondly, Santos's methodology, which focuses on depth-averaged values instead of maximum values of sediment, may be failing to capture significant impacts given that corals are on the seabed where sediment values are often at their maximum. Santos' analysis uses SSC values that are averaged over all water-depths at a given location.[236] Sediment plumes are often lightest, or less dense in terms of mg/L, near the surface.[237] Sediment plumes are often most dense near the seabed.[238] Corals in the project area are located on or near the seabed where those dense SSC values are most likely to occur.[239] Santos fails to justify a methodology that uses depth-averaged values when sensitive receptors such as corals would be most impacted by the maximum values. Santos's methodology has thus failed to provide the regulator with the information necessary to understand likely harms.

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[228] Carol Palmer et al, 'Evidence of resident coastal population(s) of false killer whales (Pseudorca crassidens) in northern Australian waters' F*rontiers in Marine Science* (2023) (weblink)
[229] SER, p. 253.
[230] SER, Table 9-4.
[231] See, SER Section 9.5.1; see also, SER, p. 253.
[232] SER, Appendix 3, Table 5.7.
[233] SER, Table 8-2.
[234] SER, Appendix 3, Table 7.2, Figure 7.18.
[235] SER, Appendix 3, 73.
[236] SER, Appendix 3, 54.
[237] SER, Appendix 3, 54.
[238] SER, Appendix 3, 54.
[239] SER, Appendix 6, p. 25 (describing "seabed" environment to contain corals).

168. Third, Santos did not develop sensitivity for soft corals in the project area. To determine if there is an impact, Santos relies on tolerance levels developed by INPEX for hard corals, mangroves, and seagrass. There is no tolerance level developed or referenced for soft corals. Soft corals are present in the project area. Because corals have such a wide range of tolerance levels, Santos should have assessed what soft corals' tolerance levels are for SSC, as they could vary quite significantly from hard corals. Santos's failure to use or refer to a soft-coral tolerance level means that its analysis hasn't provided the regulator with the information it needs to determine impacts on soft corals and the impact of the project.

169. Further, Santos's approach to modelling coral impacts fails to account for accretion of sediments over time and the smothering of corals. Santos's conclusion of no significant impact doesn't take into account how the cumulative impacts of SSC concentrations can result in sediment accumulating on top of corals or seagrass over time. Sediment can collectively build up on corals (sometimes called smothering) and this leads to coral mortality. Santos has three types of excavation-related activities that will generate sediment plumes that will last between four to six weeks to make the trenches for the pipeline. Sediment levels in Darwin Harbour approach or exceed dry season tolerance levels of 12.4 mg/L several times over the course of trenching operations. Although Santos models how sediment plumes change in time, there is no analysis about how the temporal aspect of sedimentation occurring multiple times near tolerance levels can harm corals by causing smothering or cumulative accretion on top of corals.

170. Santos also provided no explanation as to whether tolerance levels developed by INPEX five years ago or more are relevant considering stresses and cumulative impacts that seagrasses and corals face today and will face in the future. Santos' tolerance levels rely on data collected from INPEX between 2010-2018. There is no explanation as to whether corals and seagrasses have faced additional threats from climate-change related issues, such as ocean acidification, warmer temperatures, and extreme weather events that can damage corals and seagrasses. Similarly, there is no analysis as to whether cumulative harms in Darwin Harbour related to water quality from industrial or commercial discharges over time have made seagrasses or corals less tolerant to sediment levels in the water.

171. Finally, Santos' plume maps do not account for background SSC levels. The plume map appears to model SSC from trenching activities without taking into account background levels of sediment. High levels of sediment have long been noted to be present in Darwin Harbour and these background levels have been a major cause for threats to biodiversity in the area. The sedimentation analysis must be updated to clarify what are the background levels of sedimentation already present in the area and whether the SSC tolerance thresholds will be exceeded once background levels are taken into account.

Noise emissions

172. Santos recognises three types of harms from noise to marine life: [240]

    a. acoustic masking;

[240] SER, 255.

b. behavioral changes; and

c. physiological impacts such as hearing loss.

173. Hearing loss may be in the form of a temporary threshold shift (**TTS**) from which an animal recovers within minutes or hours, or a permanent threshold shift (**PTS**) from which the animal does not recover.[241]

174. Santos' overall conclusion of no significant impact relies on two key assumptions: that industry standard management controls will be sufficient to avoid physiological harms to marine life, and that behavioral impacts from all activities, including extremely loud dredging-related hammering and excavating, will be temporary and similar in scale to existing commercial vessels in Darwin Harbour.[242] Both of these assumptions are faulty and the analysis fails to adequately assess impacts from noise for the following reasons.

Physiological harm

175. Santos' analysis of physiological harm is limited to hearing loss, however many other impacts are relevant. For decades, science has demonstrated that physiological impacts of underwater noise go far beyond hearing loss. For example, anthropogenic-generated noise can cause physiological stress, alter metabolic rates, induce embolisms, and alter life history traits.[243] The SER does not address and assess physiological impacts beyond hearing loss, omitting a significant site of serious environmental impact.

Behavioural impacts: dolphins and dugongs

176. To support its conclusion that the project will not have significant impacts on marine mammals such as dolphins and dugongs, the SER relies on thresholds of how loud underwater noises may be before triggering behavioural impacts.[244] For dolphins and dugongs, the SER uses an impulsive acoustic threshold of 160 dB to assess whether harm will occur.[245]

177. Using a single acoustic threshold of 160 dB is not an appropriate method for determining behavioural impacts for different marine species and is not in line with best available science. For example, in 2013, the US National Marine Fisheries Service characterised this 160

[241] SER, 255.
[242] SER, 269.
[243] CR Kight, PJ Swaddle, 'How and why environmental noise impacts animals: An integrative, mechanistic review' *Ecology Letters* 14, 1052–1061 (2011); RM Rolland, 'Evidence that ship noise increases stress in right whales," *Proceedings of the Royal Society B: Biological Sciences* 279 (1737), 2363-2368(2012); EP Fakan and MI McCormick, 'Boat noise affects the early life history of two damselfishes' *Marine Pollution Bulletin* 141, 493-500. (2019); K de Jong, et al, 'Predicting the effects of anthropogenic noise on fish reproduction' *Reviews in Fish Biology and Fisheries* 30 (2), 245-68 (2020); SD Simpson, J Purser, A Radford, 'Anthropogenic noise compromises antipredator behaviour in European eels' *Global Change Biology,* 21(2); NJ Kleist, et al, 'Chronic anthropogenic noise disrupts glucocorticoid signaling and has multiple effects on fitness in an avian community' *Proceedings of the National Academy of Sciences of the United States of* America 115(4), E648-E657 (2018).
[244] SER, Table 9-8, 267.
[245] SER, Table 9-8, 267.

dB threshold as 'generic criteria' that should remain in use only until updated threshold information is provided.[246] Similarly, in 2018, the US government concluded that '[s]tudies of marine mammals in the wild and in experimental settings do not support' use of a single 160 dB threshold because, among other things, of a recognized 'potential for … harassment at exposures to received levels below 160 [dB]'.[247]

178. Furthermore, scientific studies have found that harm may occur to marine mammals below 160 dB. For example, a study from Bedford Institute of Oceanography in Canada surveyed hundreds of studies on behavioural changes in marine mammals in response to anthropogenic noise and found that 'behavioural responses were observed starting at approximately 110 dB re 1 µ Pa.'[248] This 'suggests that a relatively low RL [received level of sound] might result in biologically significant impacts (by affecting foraging, socialising, reproduction, or overall survival).'[249]

179. The US government has recognized that a better approach to determining the behavioural impacts of noise on marine mammals, in line with 'best available science' is a 'probabilistic assessment of risk that considers multiple criteria, including behavioural context and sensitivities particular to each species, in addition to distance and decibel levels.[66] As the Bedford Institute study concluded, the large range of factors that influence the threshold of harm include the movement and depth of the sound source; the proximity of the sound source to the receiver; the ratio of signal to background noise; the sound level above hearing threshold; the bathymetry in the area; and the receivers' species, sex, age, reproductive state, prior experience, motivation, and behavioural state before exposure.[250]

180. Accordingly, the use of a single generic 160 dB threshold across all dolphin and dugong species in the area, without comprehensive consideration of other contextual factors, is inadequate and does not provide an accurate or a comprehensive assessment of the true behavioural impacts to these species. Without this information, the EPA cannot properly assess the impact on these species from the DPD.

Behavioural impacts: sea turtles

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[246] Klaus Lucke, Paul Nachtigall, Doug Nowacek and Aaron Thode, 'Peer Review Report: National Oceanic and Atmospheric Administration Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals: Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts' (2013) (weblink) 10.

[247] National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce, 'Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico', 83 Federal Reg. 29,212, 29,247-48 (June 22, 2018) (weblink).

[248] Catalina Gomez, Jack Lawson, Andrew Wright, Alejandro Buren, Dominic Tollit, Véronique Lesage, 'A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy', *Canadian Journal of Zoology* (2016). 94. 10.1139/cjz-2016-0098, 811.

[249] Catalina Gomez, Jack Lawson, Andrew Wright, Alejandro Buren, Dominic Tollit, Véronique Lesage, 'A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy', *Canadian Journal of Zoology* (2016). 94. 10.1139/cjz-2016-0098, 811.

[250] Catalina Gomez, Jack Lawson, Andrew Wright, Alejandro Buren, Dominic Tollit, Véronique Lesage, 'A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy', *Canadian Journal of Zoology* (2016). 94. 10.1139/cjz-2016-0098, 803.

181. The SER relies on two studies (McCauley *et al.* (2000) (**McCauley**) and Popper *et al.* (2014) (**Popper**)) to derive a single 166 dB impulsive behavioural threshold for sea turtles.[251] However, McCauley arrived at this threshold after a brief experiment with 'caged green and loggerhead turtles'.[252] More specifically, the McCauley study exposed one green sea turtle and one loggerhead sea turtle to only two events of airgun blasts with a maximum of 2 hours of continuous blasting.[253] However, as Popper point out, these figures are likely unreliable as animals in tanks or even in large enclosures show very different responses to behavioral stimuli than do wild animals.

182. In light of the limited research on sea turtles,[254] the SER should have taken a cautionary approach and conducted studies to assess at what levels sea turtles may experience behavioural impacts. Without those studies, the EPA cannot fully understand the risks to sea turtles of the DPD.

Behavioural impacts: crocodiles

183. To add to the SER's layers of uncertainty and assumptions, it applies the sea turtle 166 dB behavioural threshold to crocodiles merely because 'there are no known studies that have investigated the effects of noise on crocodiles'.[255] Gaps in scientific knowledge, however, do not warrant the use arbitrary numbers for impacts assessments. A study to establish the threshold at which crocodiles experience behavioural impacts from underwater noise should be done before assessing impacts on this species.

SER understates dredging noise impacts

184. The SER's assertion that limiting dredging to 2-3 months will ensure that noise impacts are minor is unsupported by the record. A primary reason the SER concludes that the impacts of underwater noise will be minor is that the intense noises from dredging will last only 2-3 months.[256] However, the assertion that 2-3 months of intense noise will have no impact is unsupported by any record evidence. There is no scientific citation or analysis in the SER or the two specialist studies showing that 2-3 months of noise at the levels expected to occur from dredging this project will have only minor impacts.

185. Scientific literature suggests that longer-term exposure to noise can result in fatal harm even if there are no apparent shorter-term behavioural impacts from that noise. For example, initial studies of noise impacts on feeding humpback whales in Newfoundland, Canada initially found

[251] SER 262, 267.
[252] SER 262.
[253] US Geological Survey, *Environmental Impact Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Central Gulf of Alaska* (2011) (weblink), 173.
[254] Arthur Popper, Richard Fay, 'Rethinking sound detection by fishes', *Hearing Research* (December 2003) 273, 25–36.
[255] SER, 262.
[256] SER 268-269.

no behavioural changes.[257] However, after a subsequent increase in entrapment rates in the area, scientists conducted dissections of the auditory systems of two stranded whales and found damaged ear structures that were likely damaged by noise.[258]

186. In light of the risks from cumulative, longer-term exposure to noise, the SER must assess whether noise generated over the 2-3 month period may result in significant cumulative harms at either the individual- or population-level of species in the area.

Failure to assess impacts specific to acoustic masking

187. The SER acknowledges that one of the main harms to marine fauna from underwater noise is 'acoustic masking', which occurs when anthropogenic noises 'interfere with, or mask, biological signals, therefore reducing the communication and perceptual space of an individual'.[259]

188. It is important to assess acoustic masking because it can result in detrimental effects to marine species. The masking of breeding sounds of fish species can reduce breeding success.[260] Acoustic masking of habitat sounds may also prevent important structure-building organisms (ie, corals in shallow coastal areas) from locating suitable habitat.[261] Studies also show that anthropogenic noise sources mask whale communication and induce chronic stress. These effects can aggregate and affect the structure of ecological communities.[262]

189. The SER fails to study harms related to acoustic masking. The specialist report on noise from rock breaking acknowledges that acoustic masking impacts 'are not addressed in this report' and that only some general information on masking is provided 'for completeness only'.[263] The specialist report on modelling underwater noise does not mention masking at all.[264] The SER and the specialist report on marine fauna noise management both assess the concept of 'masking' only in relation to how commercial vehicle traffic in Darwin Harbour may mask the noise of Santos's vehicle traffic.[265] As a result of these gaps in analysis, the SER has failed to address how

[257] Catalina Gomez, Jack Lawson, Andrew Wright, Alejandro Buren, Dominic Tollit, Véronique Lesage, 'A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy', *Canadian Journal of Zoology* (2016). 94. 10.1139/cjz-2016-0098, 812.
[258] Catalina Gomez, Jack Lawson, Andrew Wright, Alejandro Buren, Dominic Tollit, Véronique Lesage, 'A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy', *Canadian Journal of Zoology* (2016). 94. 10.1139/cjz-2016-0098, 812.
[259] SER, 255.
[260] Arthus Pipper, Mardi Hastings, 'The effects of human-generated sound on fish' *Integrative Zoology* (2009, 4) 43–52; EP Fakan and MI McCormick, 'Boat noise affects the early life history of two damselfishes' *Marine Pollution Bulletin*, (2019, 141), 493-500; Irene Katharina Voellmy, Julia Purser, Douglas Flynn and Phillipa Kennedy, 'Acoustic noise reduces foraging success in two sympatric fish species via different mechanisms' *Animal Behaviour* (2014, 89), 191-8.
[261] [78] Michelle Fournet, 'Judicial Review – Environmental Authorisation for Exploration of Oil And Gas Granted to Sasol / Eni – Marine Ecology Expert Input' filed in *South Durban Community Environmental Alliance v. Minister of Environment,* (2021High Court, Gauteng Division South Africa), 5.
[262] NEED TO ADD ONCE EJ has added.
[263] SER, Appendix 9.
[264] See, Appendix "Underwater Noise Modelling Report (Talis)" (references for "mask" or "masking" not present in the document).
[265] [82] SER, 268; SER Appendix 7, 64.

boat and dredging noise will mask sounds important for marine fauna's communication and perception of space. Failure to address acoustic masking is a significant gap in the analysis.

Avoidance of habitat is a harm, not mitigation

190. The SER relies on species' ability to move away from a sound source to conclude that the project's added noise from vessels and dredging will have minimal impacts.[266] However, the report fails to recognize that this avoidance movement is, in fact, a behavioural change that costs individuals' energy and could have significant impacts. Avoidance of habitat is especially significant given that important turtle nesting sites are nearby the dredging locations, as are locations for foraging for other species.[267] Avoidance of noise pollution sources among cetaceans can also impact survival and reproduction rates due to stress and reduced foraging success.[268] Movement to avoid physiological harm from the project's noise pollution must be assessed as an impact, not as a mitigating factor.

Impact of 'wet buckle' event on marine environment

191. Santos notes that if there is a 'wet buckle' of the pipeline, seawater treated with Hydrosure will be injected into the pipeline.[269] After a wet-buckle event, Santos plans to flush the pipeline with 550 mg/L of Hydrosure that contains biocides to preserve the pipeline that will kill marine organisms within the pipeline.[270] These chemicals will then disperse into the marine environment. Hydrosure's biocide is Alkyl dimethyl benzyl ammonium chloride (**ADBAC**).[271] The United States EPA has found that ADBAC is categorized as 'highly toxic to fish' and 'very highly toxic to aquatic invertebrates…on an acute exposure basis.'[272]

192. Santos only studied low level exposure to Hydrosure over 2-3 day period, not shorter-term higher level exposure.[273] To assess whether seawater discharge would have an impact on marine organisms, Santos uses a No Observable Effect Concentration (**NOEC**) that was derived by Chevron exposing organisms to chemicals in Hydrosure for between 48 and 96 hrs.[274] A NOEC means that impacts 'only occur when a species is exposed to a concentration above the NOEC threshold for longer than 48 hours. [275] The NOEC threshold that Santos relies on to assess whether species might be impacted is .06 mg/L of Hydrosure over a 12, 24, and 48-hour period.

193. The NOEC criterion, which assesses impacts from exposure to relatively low levels (.06 mg/L) over a period of days, is inadequate to capture impacts to organisms exposed to higher amounts

[266] SER 268.
[267] SER, 259; SER Appendix 7, 64.
[268] Karin A. Forney et al, 'Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity' (2017), https://doi.org/10.3354/esr00820, Endangered Species Research
[269] SER, Appendix 5, 1.
[270] SER, 167.
[271] SER, 168 see Table 8-3.
[272] United States Environment Protection Agency, 'Reregistration Eligibility Decision for Alkyl Dimethyl Benzyl Ammonium Chloride (ADBAC)', 3 August 2006 (weblink), 45.
[273] SER, 175.
[274] SER, 175.
[275] SER, 175.

over shorter time frames, as would seem to be the case here. Santos's near-field modelling shows that toxic plumes could stretch 30 meters with a concentration ranging from 40.6 mg/L – 550 mg/L.[276] Santos's far-field modelling shows plumes with concentrations 2-3x higher than the .06 mg/L NOEC threshold (.23 mg/L) stretching 4 km away.[277] Santos does not begin to assess any impacts until 12 hours when concentrations have diluted, failing to explain whether organisms were impacted in between the time of release and 12 hours later.

194. Santos failed to assess the impact on micro-organisms vital to coral health. Micro-organisms are key for coral health.[278] Thus, impacts to some micro-organisms may result in overall significant impacts for the marine environment and should be taken seriously.

195. Even relatively low levels of the biocide ADBAC in treated seawater can be lethal at very short time periods. In Italy, for example, it has been found that ADBAC is lethal to micro-organisms at time-scales of 30-minutes with a NOEC level of 3.52 mg/L.[279] At a minimum, Santos should define the levels (mg/L) that corals, and the microorganisms important for coral health, may be harmed over time periods ranging from immediate exposure to 12, 24, and 48 hours.[280] In doing so, Santos should consider cumulative stresses that corals and other organisms would be facing, such as from sedimentation/turbidity. Santos should model these potential impacts near sites that the EPA has specifically asked Santos to focus on, such as the Charles Point Reef Fish Protection Area.

196. Additionally, Santos failed to model locations of high accumulation of toxic wastewater**.** Santos acknowledges that there can be patches of high accumulation of toxins from treated seawater if the release location is near shallow intertidal areas where the potential for mixing and dilution is reduced.[281] The three points Santos selected to model whether there would be significant impacts are not well-within the shallow areas where the potential for mixing and dilution reduces, but are farther offshore.[282] To accurately assess the risk of harm, Santos should model a release point or points well within these intertidal areas where the toxins will accumulate.

Cumulative marine environmental quality impact of projects

197. Santos' cumulative impact assessment identifies ten projects with overlapping marine environmental impacts and identifies impacts of existing harbour users, given the size and significance of the Port of Darwin.[283] It describes the project and likely impacts of the project on

[276] SER, Appendix 5, Table 7.1.
[277] SER, Appendix 5, Table 9.1.
[278] St Petersburg Coastal and Marine Center, 'Coral micobial ecology' United Sates Geological Survey, 18 December 2018 (weblink).
[279] See Italy, 'Directive 98/8/EC concerning the placing biocidal products on the market Inclusion of active substances in Annex I to Directive 98/8/EC , Alkyl (C12-16) dimethylbenzyl ammonium chloride Product-type 8 (Wood preservative)' June 2015 (weblink) 84 for respiration inhibition in micro-organisms in sludge treated with ADBAC within 30 minutes.
[280] The SER defines toxicity limits for 5 species, claiming this is representative of impacts for all species in the area. SER, Table 8-4, p. 169.
[281] SER, Appendix 5, 22.
[282] SER, Appendix 5, Table 1.1, Figure 1.1.f
[283] SER, 381-385.

the marine environment, including of dredging, infrastructure construction and increased turbidity.[284] Projects are classified into 'degree' of cumulative impact – high, medium and low.[285] Santos goes on to provide further details of activities of these projects, which, they say, if these occurred simultaneously with the DPD, could have minor environmental impacts.[286]

198. This analysis addressed each project discretely and considered any total losses as a percentage of total habitat in Darwin Habour, but did not provide the total size of habitats impacted. [287] It assumed low percentage loss would mean minor impacts on species and environments, which is not the case: small losses of habitats or species that accumulate over time can result in significant environmental impacts.[288]

199. The effects of persistent marine construction and associated vessels on small dolphins have previously been described but are confounded when multiple industrial activities co-occur with varying methods and intensity.[289] The outcome can be devastating for populations in areas that continue to degrade and where research and mitigation measures are absent or insufficient. Populations with small home ranges and strong site fidelity, such as the population of false killer whales found in and around Darwin Harbour, are especially vulnerable to habitat displacement in highly disturbed areas because they may have few suitable alternatives.[290]

200. The SER also does not address the cumulative impacts on marine species from the combination of events (eg sedimentation, noise, toxins, and light). Studies examining the effects of contaminated sediment also had significantly higher effect sizes than studies on clean sediment alone or noise, suggesting additive or synergistic impacts from dredging-related stressors.[291]

201. Further cumulative factors that threaten the survival of coastal dolphins, whales and marine megafauna include reduced or degraded freshwater outflow to estuaries, underwater noise, habitat loss, fisheries interactions, contamination from industrial, municipal and agriculture discharge, climate change and increasing development pressures.[292]

202. Santos' failure to properly address the cumulative impact of the DPD on the marine environment, unless remedied, must be fatal to the approvals sought. [293] Without it the EPA and

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[284] SER, 381-385.
[285] SER, 387-389.
[286] SER, 391-396.
[287] SER, 393-397.
[288] Michelle S. Ward et al, 'Lots of loss with little scrutiny: The attrition of habitat critical for threatened species in Australia' (08 September 2019) https://doi.org/10.1111/csp2.117, Journal for the Society of Conservation Biology.
[289] Victoria L.G. Todd et al, 'A review of impacts of marine dredging activities on marine mammals' (2014) https://doi.org/10.1093/icesjms/fsu187, ICES Journal of Marine Science
[290] Ibid.; Karin A. Forney et al, 'Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity' (2017), https://doi.org/10.3354/esr00820, Endangered Species Research

[291] Amelia Wegner et al, 'A critical analysis of the direct effects of dredging on fish' (27 March 2017) *Fish and Fisheries*.
[292] Lyndon Brooks et al, 'Monitoring variation in small coastal dolphin populations: An example from Darwin, northern territory, Australia (2017) http://doi.org/10.3389/fmars.2017.00094 Frontiers in Marine Science
[293] *Gray Gray v Minister for Planning* [2006] NSWLEC 720, [122].

Minister cannot have adequately assessed and considered the significance of any environmental harm.[294]

Conclusions in relation to marine impacts

203. On the basis of the information provided in the Referral and in the SER, it is not possible to determine that unacceptable impacts will be able to be avoided, mitigated or managed.

204. The principle of evidence-based decision-making states that 'decisions should be based on the best available evidence in the circumstances that is relevant and reliable'.[295] As discussed above, much of the evidence provided in the SER by Santos on marine impacts appears not to be the best available.

205. On the basis of the information contained in the SER and currently before the EPA, the EPA must conclude in its assessment report that:

a. the DPD will involve unacceptable significant environmental impacts to the marine environment.
b. For the reasons set out above, it is clear that Santos has failed to take all reasonable measures to avoid, and then mitigate and manage these risks.

206. Accordingly, the NT EPA must prepare an assessment report finding that:

a. The actions contained in the Referral will have an unacceptable impact that cannot be appropriately avoided, mitigated or managed for which environmental offsets are not appropriate; and
b. Prepare a statement of unacceptable impact.

207. Further, the Minister:

a. must not grant environmental approval for the DPD; and
b. must accept a statement by the NT EPA of unacceptable impact in relation to the DPD.

VI. CULTURAL HERITAGE IMPACTS OF THE DPD PROJECT

208. Santos recognises that First Nations communities in the region have cultural connections to the DPD Project area. In particular, the Larrakia people maintain "an innate connection to the land and sea in the region" around Darwin Harbour and adjacent coastal waters.[296] The SER states: "Cultural, spiritual and heritage sites of significance are located throughout the region where traditional harvesting remains an important practice."[297] In addition, "[o]ffshore from Darwin Harbour, the waters around the Tiwi Islands … similarly hold a spiritual connection, and a source of food and wellbeing, for the Tiwi people."[298]

[294] *Gray Gray v Minister for Planning* [2006] NSWLEC 720, [122].
[295] EP Act, s 20.
[296] SER, p. 355.
[297] SER, p. 355.
[298] SER, p. 355.

209. Santos notes that its activities including pipeline installation, trenching, anchoring, spoil disposal, and installation of other infrastructure has the potential to disturb cultural heritage sites.[299] Yet, Santos dismisses the impacts and risk to First Nations cultural heritage as minor.
210. In relation to the adequacy of existing reviews of cultural heritage in the project area, the National Indigenous Australians Agency (**NIAA**) communicated in their comments to the Department of Climate Change, Energy, the Environment and Water and published in the Department's Statement of Reasons for the Darwin Pipeline Duplication (DPD) Project (EPBC 2022/09372) assessment approach decision (**SoR**) that "Traditional Owner groups affected by the proposed project have concerns about its potential impacts, including impacts on the ocean environment, hunting areas and cultural heritage" and "noted the need for thorough and sensitive consultation with Traditional Owners about this project while the legal proceedings about the Barossa Development are active, as well as post-decision." The NIAA's submission on this issue highlights the importance of thorough assessment of cultural heritage as well as careful, informed, and collaborative impact management and mitigation.
211. Santos' conclusion that the project's impacts and risk to First Nations cultural heritage is minor is flawed and unsupported by evidence, for reasons set out below.

Adequacy of cultural heritage assessment

212. The SER indicates that to identify First Nations underwater cultural heritage, Santos relied on: (a) a 2010 draft environmental impact statement prepared by INPEX Browse Ltd (which concludes that there are registered Indigenous sacred sites within Darwin Harbour that are within or adjacent to the DPD Project area, including three rocky seabed areas or shoals and sand/rock bars); and (b) an Authority Certificate obtained from the Aboriginal Areas Protection Authority (AAPA) in relation to one registered sacred site (5073-105) that overlaps with the project area.[300]
213. It is inadequate to only use a desktop analysis to identify First Nations underwater cultural heritage, and to assume that such heritage is registered. This is because such heritage is unlikely to be comprehensively recorded in a database compared to other types of underwater heritage (such as shipwrecks) due to the impacts of colonisation and the prominence of oral history in First Nations knowledge systems.
214. Further, although Santos recognises that First Nations communities have spiritual and cultural connections to the waters outside Darwin Harbour,[301] the SER does not demonstrate that Santos has assessed the impacts of the DPD Project on First Nations cultural heritage outside of Darwin Harbour. Instead, the SER is focused only on registered cultural heritage inside the Harbour. This is despite a significant portion of the proposed pipeline lying outside Darwin Harbour.
215. The NIAA recommended that Santos "undertake a new First Nations cultural heritage survey of the entire project area with Traditional Owner participation. Further, that cultural heritage assessment should incorporate the offshore portions of the project area and address tangible and intangible values. Intangible values may include culturally significant species, ecological communities, biogeographic features and song lines."

[299] SER, p. 358.
[300] SER, pp. 355-356.
[301] SER, p. 355.

216. In the case of unexpected maritime archaeological finds that may be considered culturally significant, Santos proposes to implement an Unexpected Maritime Archaeological Finds Protocol developed by its maritime archaeology consultants.[302] It is unclear whether this protocol would also apply to First Nations cultural heritage, and the SER and Appendix 16 provide only limited information about the content of the protocol.
217. ECNT notes the recommendation of the NIAA that Santos "collaborate with Traditional Owners to develop a Cultural Heritage Management Plan (CHMP) to formalise agreed measures for cultural heritage management and impact mitigation, and jointly agreed protocols addressing the identification, protection and management of both tangible and intangible cultural values that may be revealed during project construction and operations."
218. With reference to the above, ECNT submits that Santos should develop a protocol and action plan that prioritises the preservation in situ of any First Nations underwater cultural heritage, before allowing any activities that may impact the heritage, in line with NIAA recommendations. Removal or damage of First Nations underwater cultural heritage may be impossible without harm to the cultural values of the place, object, or site, including its intangible cultural heritage values. Santos should ensure it obtains the free, prior, and informed consent of relevant First Nations communities prior to derogating from the principle of in situ preservation in the case of unexpected finds.

Conclusions in relation to cultural heritage impact

219. On the basis of the information provided in the Referral and in the SER, it is not possible to determine that unacceptable impacts to cultural heritage will be able to be avoided, mitigated or managed.

220. On the basis of the information contained in the SER and currently before the EPA, the EPA must conclude in its assessment report that:
    a. the DPD will involve unacceptable significant impacts to cultural heritage.
    b. For the reasons set out above, it is clear that Santos has failed to take all reasonable measures to avoid, and then mitigate and manage these risks.
221. Accordingly, the NT EPA must prepare an assessment report finding that:
    a. The actions contained in the Referral will have an unacceptable impact that cannot be appropriately avoided, mitigated or managed for which environmental offsets are not appropriate; and
    b. Prepare a statement of unacceptable impact.
222. Further, the Minister:
    a. must not grant environmental approval for the DPD; and
    b. must accept a statement by the NT EPA of unacceptable impact in relation to the DPD.

[302] SER, p. 359; Appendix 16, p. 140.

VII. ADDITIONAL INFORMATION THAT SHOULD BE REQUESTED BY THE NT EPA

223. Regulation 124 of the EP Regs enables the EPA to direct Santos to provide additional information that it considers necessary to facilitate consideration of the supplementary environmental report.
224. ECNT submits that the EPA should direct Santos to provide the following information on the basis that it is necessary to fully assess the environmental risks and impacts of the DPD:
    a. The amount of marine habitat impacted in hectares by the DPD and other projects in the Darwin Harbour which have cumulative impact on marine life;
    b. A methodology for predicting habitat loss which uses maximum values of sediment;
    c. An assessment of the tolerance or sensitivity levels for soft corals;
    d. A comprehensive noise emissions tolerance assessment for dolphins and dugongs which considers contextual factors in order to understand the true behavioural impacts of the DPD;
    e. A study to understand the harms of acoustic masking on Darwin Harbour marine fauna from the DPD;
    f. Methodology of Santos' GHG emissions estimations for the DPD and Barossa Development; and
    g. Plans to decommission the DPD.
225. ECNT submits that due to the uncertainty created by the lack of sufficient information in the SER, the EPA must direct Santos to provide this information to be provided pursuant to r 124 of the EP Regs on the basis that it is necessary to fully assess the environmental risks and impacts of the DPD.
226. ECNT further submits that upon receiving and publishing additional information from Santos under rr 124, the EPA must exercise its power under r 126 to invite ECNT and other submitters to make a submission on the additional information. This is consistent with s 3(d) of the EP Act, namely that an object of the EP Act is to 'provide for broad community involvement during the process' of an EIA and the decision-making principle set out at s 18 of the EP Act, which relevantly states that decision-making processes should provide for community involvement in relation to decisions and actions that affect the community.

Expert report:

Darwin Pipeline Duplication Project (DPDP) and Barossa Project

Author: Rob Cawthorne, Managing Director, Carbon Reduction Institute Pty Ltd

for Environment Centre Northern Territory (ECNT)

Date of request: 16 June 2023

Date of submission: 27 June 2023

Background: As one the originators of the Carbon Reduction Institute Pty Ltd (CRI) founded in 2006 I am one of the few professionals that entered the carbon market in its embryonic stages. As the managing director of the organisation, I have overseen almost 3000 carbon inventory audits and lifecycle assessments, and the supply of over 2 million carbon credits. As part of my role at CRI I provide education and presentations to organisations and industry bodies on carbon markets and climate legislation.

From 2000 I was involved in the development of Australia's first emissions trading scheme: The Hunter River Salinity Trading Scheme and one of the first working models of an environmental trading scheme in the world. Between 2000 and 2020 I continued to manage the flood flow releases for this scheme.

I present primary research results and a review of material outlined below. As author of this report, I acknowledge that I have read and agree to comply with Practice Direction 6 – Expert Reports.

Summary

After reviewing the expert brief, Darwin Pipeline Duplication Project SER, and other publicly available information, it is in my opinion the Darwin Pipeline Duplication Project which enables the Barossa gas field is a significant greenhouse gas emitter.

It is also likely to supply constrain local carbon offset markets causing consumer prices to increase and making Australia's national climate goals harder to reach.

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

Glossary of Terms

mtpa - Million tonnes per annum

ACCU - Australian Carbon Credit Unit(s) are produced under the Carbon Farming Initiative and can be used by organisations to meet compliance needs under the safeguard mechanism or by organisations looking to voluntarily reduce their carbon footprint

SMC - Safeguard Mechanism Credit(s) are allocated to facilities captured under the safeguard mechanism. Companies that operate under their baseline are able to sell these credits while companies who operate over their baseline can purchase them to meet the baseline.

T-CO2e - The weight of Greenhouse gasses relative to warming potential of Carbon Dioxide (CO2)

NGA - Australian National Greenhouse Accounts

Barossa Project – Refers to the whole Barossa project including the Barossa Gas Field, Gas Export Pipeline, Darwin Duplication Project, and Darwin LNG plant as utilised in producing gas from the Barossa Gas Field.

Estimated Carbon Footprint for the Barossa Project

Information contained in the DPD SER with regard to the Barossa Project carbon footprint lacks detail and is complex to follow, to establish its validity and capture potential omissions I have undertaken a separate carbon footprint calculation where possible using other published information outlined in appendix A.

The Carbon Footprint has been calculated following the principles outlined in the GHG Protocol Corporate Accounting and Reporting Standard and Corporate Value Chain (Scope 3) Accounting and Reporting Standard. The footprint is a calculation of the entire Barossa Project and is limited to information available in the public domain as listed in appendix A, exclusions are not listed and not always identified resulting in a likelihood for a lower estimated carbon footprint.

The Barossa Project including all related facilities will produce approximately 304 million tonnes (table 1.3) of greenhouse gasses over the life of the Barossa gas field and generate 16.2 million tonnes per annum (table 1.2) when it reaches peak production.

Due to limitations in available information, ongoing GHG emissions from the energy used to operate the Barossa gas field and from the emissions generated in the project construction phase are likely to be understated, .

The calculation of the Carbon footprint allows the determination of Barossa Projects Safeguard mechanism compliance requirements as well as the required number of offsets for the project to reach carbon neutral / net zero.

At peak production of 3.7mtpa of gas per annum, the Barossa project produces an annual carbon footprint of 16.26m T-CO2e making it equivalent to the emissions of the 92nd largest country in the world. Just a fraction smaller than Kenya (16.3m t-CO2e) with a population of 49 million.

TABLE 1.1 – Relative to Country

https://www.worldometers.info/co2-emissions/co2-emissions-by-country/		CO2 footprint	Population
91	Kenya	**16,334,919**	**49,051,534**
92	Barossa Project	**16,267,692**	

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

The Department of Climate Change, Energy, the Environment and Water reports the footprint of the Northern Territory as 17.4m T-CO2e[v], only a fraction larger than 16.2m t-CO2e in total that will be produced by the Barossa Project each year at peak production.

The emissions from the Barossa project that are included and will be additional to the carbon footprint of the NT will be the reservoir emissions, gas field production emissions and those from the DPDP which together total 2.58m t-CO2e, and will increase the NT's carbon footprint by 14.9%. Emissions from any local usage and distribution would also add to this value.

Methodology behind table 1.2 and 1.3 footprint calculations are listed in appendix A

TABLE 1.2 - Barossa Project - Peak Production Emissions 2025 (based on 3.7 mtpa gas production)

	DPD SER	Estimation
Scope 1 – Reservoir emissions	2,300,000	2,228,473
Scope 1 – Darwin LNG Facility (existing)	1,700,000	1,791,583
Scope 1 – Gas Field Production / Off shore processing	200,000	199,709
Scope 3 – Combustion emissions	11,000,000	10,568,339
Scope 3 – Oil Combustion		526,449
Scope 3 – Transportation and Distribution - Gas		823,560
Scope 3 – Transportation and Distribution – Oil		129,578
	15,200,000	**16,267,692**

TABLE 1.3 - Barossa Project – Lifetime emissions based on 3179.1 bcf (billion cubic feet) gas

	DPD SER	Estimation
Scope 1 – Reservoir emissions	33,700,000	41,523,138
Scope 1 – Darwin LNG Facility (existing)		33,382,566
Scope 1 – Gas Field Production / Off Shore processing	17,400,000	3,721,178
Scope 1 - Construction	300,00	
Scope 3 – Combustion emissions	192,200,000	196,919,865
Scope 3 – Oil Combustion	20,000,000	9,809,326
Scope 3 – Transportation and Distribution - Gas	32,300,000	15,345,402
Scope 3 – Transportation and Distribution – Oil		2,414,431
Scope 3 - Pipelines - 360km - $1.119b	206,000	258,265
Scope 3 - Barossa Development - $4.7b	954,000	1,084,760
	296,860,000	**304,458,930**

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

Offsets Available for Santos – Australian Carbon Credit Units (ACCUs) and Safeguard Mechanism Demand

Many facilities of the Barossa Project will be captured under Australia's emissions safeguard mechanism legislation requiring the facility to operate under a baseline which reduces each year. Furthermore, recent amendments to the legislation require all new gas fields to abate 100% of their reservoir emissions they generate along with meeting the required baseline.

For the Barossa Project operational emissions created at the field and at the DLNG will be captured under the safeguard mechanism. The emissions from the DPDP are estimated by Santos to be under the safeguard emissions threshold of 100k-TCO2e and are not included.

Using the Carbon Footprint calculated for the report the following figures have been used as Scope 1 emissions captured under the Emissions Safeguard Mechanism.

TABLE 2 – Safeguard Captured Emissions (scope 1 < 100k per facility)

SMC Baseline Emissions (scope 1) – operational energy	1,791,593 t-CO2e*
Barossa Reservoir Emissions – Fugitive from gas field	2,307,223 t-CO2e*
Barossa Gas Field Operational Emissions	199,709 t-CO2e*

** References and methodology are contained in appendix A*

The Carbon Farming Initiative.

The Carbon Farming Initiative Legislation allows carbon abatement projects in Australia to be registered with the Clean Energy Regulator. For each tonne of greenhouse gas the project abates the regulator registers and assigns an ACCU. ACCU's can be purchased from the abatement project operator by facilities under the Safeguard Mechanism Legislation to meet their baseline and other compliance needs.

ACCUs are purchased by the federal government under the Emissions Reduction Fund under auction. This gave project operators some certainty over the price they receive and created demand for ACCUs over the previous years. Recent contracts now have optional delivery as such it is expected the majority of demand will come from included safeguard mechanism facilities, state and territory demand and voluntary action.

Voluntary action is that which is not legislated by state, federal or local governments. Organisations often use a mix of local carbon offsets (ACCUs) and international offsets from various standards to meet their Carbon Offset needs.

ACCU Supply and Demand

Between FY2012 and FY2021 a total of 97.134 million ACCUs were produced under the Carbon Farming Initiative. FY2021 produced 16.508 million total ACCUs and after delivery under the emissions reduction fund (ERF) a surplus of 3.29 million ACCUs were available for liable parties under the Safeguard Mechanism and voluntary activities. [(i)]

In FY2022, the Clean Energy Finance Corporation reports 17.7 million[(ii)] ACCUs were produced in FY2022 and 1.5 million were used for voluntary action. Subject to the delivery of contracts under the Safeguard Mechanism, a total of 16.2 million ACCUs could be available for liable parties.

In FY2025 the total abatement needed under the Safeguard Mechanism for the 219 currently included facilities will be 19.23 million t-CO2e, without the inclusion of the Barossa project.

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

Under the safeguard mechanism legislation only scope 1 emissions are assessed. The requirement for Santos would be to purchase at least 2.4m t-CO2e abatement each year, increasing to 2.8m t-CO2e by 2030. Allowable credits under the Safeguard Mechanism legislation are ACCU's and Safeguard Mechanism Credit (SMC's). The Barossa project would increase the total demand for ACCUs and SMCs by 12.9% in 2025, and therefore it is highly plausible that Santos will not be able to find the available offsets to meet their requirements under the Safeguard Mechanism legislation.

This increased demand within a supply constrained market will cause the prices of ACCUs and SMCs for the 219 current liable facilities to increase; and create a high potential for the $75 penalty price, under the Safeguard Mechanism, being applied for those that cannot meet their abatement needs. If an ACCU price of $75.00 is passed on at cost to consumers without margin, an increase of 6c per kWh or approximately 20% of residential electricity supply rates will apply.

Under the Safeguard Mechanism legislation Scope 1 reservoir emissions must be fully offset; and as a result of the high levels of reservoir emissions in the Barossa gas field the total demand for abatement in FY2025 is expected to be 2.395m t-CO2e which is 3 times that of the largest facility currently included under the Safeguard Mechanism. Currently the largest facility included in the safeguard mechanism is Gorgon Operations which has an estimated abatement need of 795,237 t-CO2e in FY2025.

Table 3 shows estimated emissions from the Barossa project and how much abatement is required between 2025 and 2030. The Barossa will have the highest abatement needs of any current facility under the safeguard mechanism until 2030

Carbon Neutral / Net Zero Emissions.

Barossa Project - Scope 1 Emissions.

Scope 1 emissions from the Barossa project will be captured under the safeguard mechanism legislation. For most fossil fuel projects, the total of scope 1 emissions is usually small when compared to the scope 3 emissions from the distribution and combustion of the fuels themselves. The Barossa project has far higher scope 1 emissions than would be expected, however scope 3 from customer use is still more than 3 times the scope 1 emissions.

Barossa Project - Total Emissions

To negate the total emissions from the project (include all scope 2 & 3) Santos would need to purchase 16.2m t-CO2e each year, equal to the total number of ACCUs produced in FY2022. When the Barossa project is at peak production it is unlikely there will be enough local offsets for it to reach carbon neutral / net zero. To achieve carbon neutral / net zero Santos would be required to use international offsets such as those available under the Verified Carbon Standard (VCS) which will reduce the cost of abatement but can only be applied to emissions sources not captured under the Safeguard Mechanism. Santos would need to navigate the complexities of the international voluntary carbon markets and ensure that the offsets they purchase are real and permanent, likely reducing the options for Santos in the lower price carbon offset supply.

Based on the current market and volumes available Santos may be able to purchase quality offsets for around the $20.00 per credit. In FY2025 Santos would require 14 million international offsets and 2.5 million ACCU's or SMCs. It can be assumed that the Barossa project will put further pressure on a supply constrained market, leading to an ACCU and SMC price of $75.00 tCO2e. In this likely scenario the cost for Santos to offset the total project will be > $461.8m in FY2025, increasing to $466.4m in FY2026 and growing each year while production is at 3.7mtpa of gas

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

per annum. In the less likely scenario that the market remains in surplus, and the price remains at $38.50 the costs for offsetting the entire footprint will be $374.4m in FY2025.

Darwin Pipeline Duplication Project (DPDP):

The Darwin pipeline represents less than 1% of the total Barossa project. The DPDP connects the Barossa Gas field through the Gas Export Pipeline (GEP) to the Darwin LNG plant (DLNG).

Isolating the DPDP, Santos expects the project to generate 80,000 t-CO2e per annum however and 206,000 t-CO2e (scope 3) during its construction as it connects the Barossa Gas Field and Gas Export Pipeline to the Darwin LNG plant it indirectly produces more than 206-fold the annual volume.

Barossa Gas Field

The Barossa Gas Field by itself represents a significant emissions source. The field is reported to have one of the highest reservoir emissions proportions of any gas field. 18% reservoir CO2 by volume is 36.44% by mass. Using this ratio, the Darwin LNG plant which is able to process 3.7 million tonnes of CH4[(vi)]results in the release of 2.3 million tonnes of t-CO2e each year. Under the Safeguard Mechanism, 100% of reservoir emissions must be captured or offset.

The total of the reservoir emissions and reduction in operational emissions from the Barossa Project represents a 12.9% increase on the total abatement required from the 219 facilities under the safeguard mechanism in 2025, it will be the largest abatement / offset requirement of any single facility until 2030.

Bayu-Undan

Santos proposes to use the nearly expired Bayu-Undan gas field for Carbon Capture and Storage[(iv)]. The Darwin Pipeline Duplication Project will provide gas to the DLNG from the Barossa Gas field through the GEP. The DLNG plant will use the DPDP and existing pipeline to the Bayu-Undan field to transport CO2 to the field for storage. Santos hope to meet their compliance requirements as well as to voluntarily offset some of their scope 3 (combustion of product) emission.

The field site is outside of Australia's territorial waters, and because of this, under the Carbon Farming Initiative the regulator cannot approve the project to produce ACCUs. Operational emissions at the Bayu-Undan site are not captured in Australia's national inventory, nor is the stie captured under the Safeguard Mechanism legislation.

The Bayu-Undan CCS project has a number of other issues that could impact its viability as a CCS project as well as causing other greenhouse gas emissions.

- Carbon dioxide is heavier than methane, pushing carbon into an expired gas field helps extract any remaining gas that was not economically viable recover without CO2. The Bayu-Undan field is reported to still contain about 3.7% or 181.62 bcf Natural Gas, 2.02 Mmbbl Crude and Condensate[(iii)] if extracted and combusted would produce approximately 13.7million tonnes of CO2 and negating any benefit from the CCS for >3.5 years.

- The Bayu-Undan field is in Timor-Lestie waters and would impact their national inventory. Without appropriate agreements such as a Joint Implementation agreement this project would be subject to the climate legislation of both countries.

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

Facility name	State	Responsible emitter	Reported covered Emissions	2024	2025	2026	2027	2028	2029	2030
219 x captured facilities	**National**		137,500,000	13,144,862	19,238,264	25,033,089	30,543,967	35,784,813	40,768,853	45,508,683

Table 3

Facility name	State	Responsible emitter	Reported covered Emissions	2024	2025	2026	2027	2028	2029	2030
Santos			2,307,233		2,307,233	2,307,233	2,307,233	2,307,233	2,307,233	2,307,233
Santos			1,791,583		87,788	171,274	250,669	326,174	397,979	466,265
Santos	NT	Barossa Project			**2,395,021**	**2,478,507**	**2,557,902**	**2,633,407**	**2,705,212**	**2,773,498**
Gorgon Operations	WA	CHEVRON AUSTRALIA PTY LTD	8,318,842	407,623	795,273	1,571,551	1,902,168	2,216,585	2,515,596	2,799,955
Start up and Operations of the Ichthys LNG Project	NT	INPEX Operations Australia Pty Ltd	6,739,077	330,215	644,249	1,273,110	1,540,943	1,795,651	2,037,879	2,268,238
Port Kembla Steelworks	NSW	BLUESCOPE STEEL (AIS) PTY. LTD.	6,198,685	303,736	592,588	1,171,022	1,417,378	1,651,662	1,874,466	2,086,353
Qantas Airways Limited National Transport Facility	National	Qantas Airways Limited	3,057,585	149,822	292,302	577,623	699,141	814,705	924,606	1,029,122
Wheatstone Operations	WA	CHEVRON AUSTRALIA PTY LTD	3,907,075	191,447	373,512	738,104	893,383	1,041,054	1,181,489	1,315,043
WOR01	WA	South32 Worsley Alumina Pty Ltd	3,553,775	174,135	339,737	671,360	812,598	946,916	1,074,652	1,196,129
Queensland Alumina Limited Refinery	QLD	QUEENSLAND ALUMINA LIMITED	3,129,823	153,361	299,208	591,269	715,659	833,953	946,450	1,053,436
Liberty Primary Steel Whyalla Steelworks	SA	ONESTEEL MANUFACTURING PTY LIMITED	2,150,574	105,378	205,593	406,275	491,746	573,028	650,328	723,840
APLNG Facility	QLD	CONOCOPHILLIPS AUSTRALIA OPERATIONS PTY LTD	2,132,240	104,480	203,840	402,811	487,553	568,143	644,784	717,669
Moomba Plant	SA	Santos Limited	2,175,400	106,595	207,966	410,965	497,422	579,643	657,835	732,196
Rio Tinto Yarwun	QLD	RTA Yarwun Pty Ltd	2,128,344	104,289	203,468	402,075	486,663	567,105	643,606	716,358

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

APPENDIX A:

Carbon Footprint Calculation sources and methods:

Peak Production:

At peak production daily output from the Barossa Project for gas is equal to Darwin LNG facility which has a capacity of 3.7mtpa[vi],

and condensate is 4,107 bpd (barrels per day) - https://www.offshore-technology.com/marketdata/barossa-conventional-gas-field-australia

Total Barossa Project

The total volume of gas contained in the Barossa gas field is reported to be 3179.1 bcf, Using the calculator provided by Santos - Conversion calculator | Santos converts to 68,559,413 tonnes. This is equivalent to 18.633 years of peak production. For the purposes of calculating the total footprint this factor has been applied to the peak emissions output results excluding emissions applicable to the construction phase.

Scope 1 - Reservoir Emissions have been calculated using and correlated to information contained within the DPD SER.

The Darwin LNG facility has a capacity of 3.7mtpa[vi] of CH4 Gas each, and CO2 is 2.74 times heavier than CH4. To calculate the reservoir CO2 the following formula has been applied.

3,700,000 / 82(%) x 18(%) x 2.74 = CO2

Santos agrees that the reservoir CO2 emissions are 2.3 million tonnes in their answer on page 20 - Barossa-Gas-Project-Frequently-Asked-Questions.pdf (santos.com)

The DPD SER shows 2.5m t-CO2e for off-shore processing, it is assumed to include approximately 2.3m tonnes of reservoir CO2.

Scope 1 – Darwin LNG Facility

Emissions from the DLNG facility have been reported under the Safeguard Mechanism in 2022.

Scope 1 - Gas Field Production / Off Shore processing

Gas Field Production has been estimated using the expected production output of the DLNG in TJ relative to the CO2 (10,022) per TJ (9,766) of the Cooper Energy Gas Field in 2021 - https://cooperenergy.com.au/Upload/202011COOP_Productive_02_SustainabilityReport_Updated_Pages.pdf.

The total is 199,709 t-CO2e. The DPD SER which shows 2.5m tonnes which I assume includes 2.3m reservoir emissions leaving 200,000 remaining.

Scope 1 – Construction

The DPD SER shows that direct emissions from the construction of the Barossa plant (250k) and DPDP (50k) are expected to be 300,000 t-CO2e.

Scope 3 – Gas -Combustion Emissions

The Australian National Greenhouse Accounts shows - https://www.dcceew.gov.au/sites/default/files/documents/national-greenhouse-accounts-factors-2022.pdf

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

(Table 4 Direct (Scope 1) emissions from consumption of gaseous fuels including liquefied natural gas) – provides the factor of 51.53 t-CO2e per TJ of gas.

Using the calculator provided by Santos - Conversion calculator | Santos 3.7 million tonnes of gas = 205,109 TJ

205,109 (TJ) x 51.53 (t-CO2e/TJ) = 10,568,339t-CO2e

Scope 3 – Condensate -Combustion Emissions

The Australian National Greenhouse Accounts shows - https://www.dcceew.gov.au/sites/default/files/documents/national-greenhouse-accounts-factors-2022.pdf

Table 7 Direct (Scope 1) and indirect (scope 3) emissions from consumption of liquid fuels, including certain petroleum based products for stationary energy purpose – provides the factor of 69.88 t-CO2e per TJ and 45.3 GJ / Tonne

Using the calculator provided by Santos - Conversion calculator | Santos 4,107 barrels = 455.63 Tonnes

455.63 (tonnes) x 45.3 (GJ) / 1000 x 69.88 (t-CO2e / TJ) = 526,449 t-CO2e

Scope 3 – Transportation & Distribution of Gas by Customers

Once delivered to customers the gas will be used for various purposes, for the exercise of estimating the emissions from the Barossa Project I used the emissions factor as if it were delivered into the Victoria gas network. This is the lowest value of any gas network in Australia and represents a conservative assumption.

Table 5 Indirect (Scope 3) emissions from consumption of natural gas

State or territory	Scope 3 Emission Factors for Natural Gas (kg CO_2-e /GJ)	
	Metro	Non-metro
New South Wales and ACT	13.1	14.0
Victoria	4.0	4.0
Queensland	8.8	7.9
South Australia	10.7	10.6
Western Australia	4.1	4.0
Tasmania	C	C
Northern Territory	C	C

Using the calculator provided by Santos - Conversion calculator | Santos 3.7 million tonnes of gas = 205,109 TJ

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng

205,109 (TJ) x 4.0 (t-CO2e/TJ) = 823,560 T-CO2e

Scope 3 – Transportation, Distribution and processing of Condensate by Customers

Once delivered to customers the condensate will be used for various purposes, for the exercise of estimating the emissions from the Barossa Project and considering there is no factor in the NGA for condensate, the lower emissions factor in the category from Table 7 for Automotive gasoline of 17.2 has been used.

Using the calculator provided by Santos - Conversion calculator | Santos 4,107 barrels = 455.63 Tonnes

455.63 (tonnes) x 45.3 (GJ) / 1000 x 17.1 (t-CO2e / TJ) = 129,578 t-CO2e

Scope 3 – Pipelines and Barossa Development

100km of pipeline is reported to cost $373 million – at the same cost per km the total pipeline including GEP would cost $1.119b

The Barossa Development is reported to cost $4.7b (this may include the pipeline)

An emissions factor of .2308kg CO2e per $ has been applied using the Non-residential construction category from CRI's internal Input / Output tables.

$1,119,000,000 x 0.2308 / 1000 = 258,265 t-CO2e

$4,700,000,000 x 0.2308 / 1000 = 1,084,760 t-CO2e

(i) https://www.cleanenergyregulator.gov.au/Infohub/Markets/buying-accus/australian-carbon-credit-unit-demand
(ii) https://www.cleanenergyregulator.gov.au/Infohub/Markets/Pages/qcmr/december-quarter-2022/Australian-carbon-credit-units-(ACCUs).aspx
(iii) https://www.offshore-technology.com/marketdata/oil-gas-field-profile-bayu-undan-conventional-gas-field-timor-leste/
(iv) Darwin Pipeline Duplication Project - SER (nt.gov.au)
(v) https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2020/state-and-territory-greenhouse-gas-inventories-annual-emissions
(vi) https://www.santos.com/news/santos-announces-fid-on-the-barossa-gas-project-for-darwin-lng