information sheet

jansz-io compression underwater sound

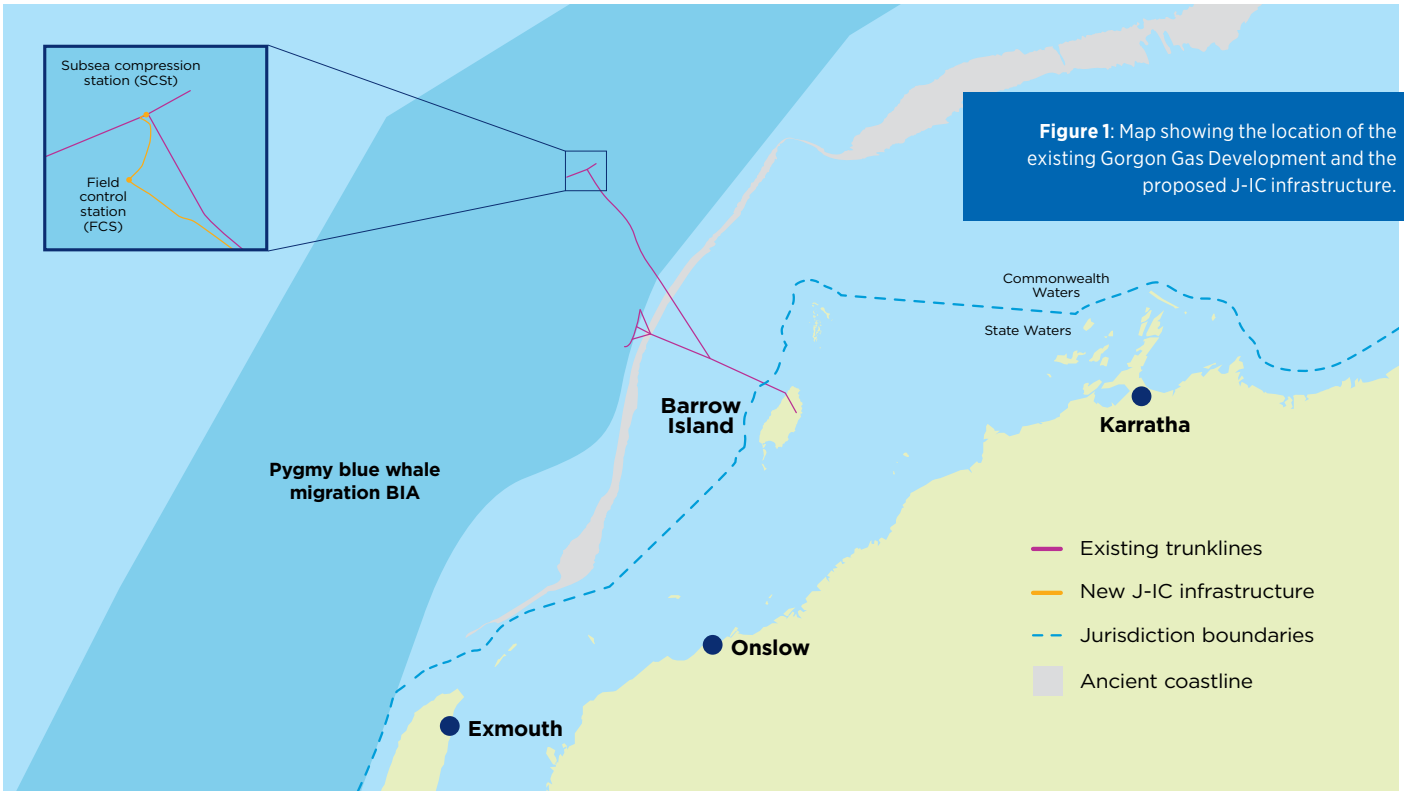


Figure 1: Map showing the location of the existing Gorgon Gas Development and the proposed J-IC infrastructure.

overview

Chevron Australia, on behalf of the Gorgon Joint Venture, operates the Gorgon Project located off the northwest coast of Western Australia (WA).

Since 2015, offshore production wells and pipeline infrastructure have gathered natural gas from the Jansz-Io and Gorgon gas fields and transported it to the Gorgon Gas Facility on Barrow Island. From the Gorgon Gas Facility, gas is processed for export as liquefied natural gas (LNG) or piped to the mainland for WA domestic gas users.

As predicted, the Jansz-Io gas field reservoir pressure has declined over time. To enhance the recoverability of gas and maintain current rates of production at the Gorgon Gas Facility, Chevron Australia plans to install and operate a subsea compression station (SCSt), floating field control station (FCS) and associated infrastructure.

Installation of compression infrastructure in the Jansz-Io field was always contemplated as a means of maintaining current production levels over the approved life of the Gorgon development and will support the ongoing delivery of energy to customers in WA and the Asia Pacific region for decades to come.

Chevron Australia has undertaken extensive consultation for the Jansz-Io Compression (J-IC) infrastructure installation activities, with the corresponding Gorgon Gas Development Pipeline and Subsea Infrastructure Installation and Pre-Commissioning Environment Plan accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) in May 2024.

We are now undertaking further consultation to inform a revision of the Gorgon Gas Development Gorgon and Jansz Feed Gas Pipeline and Wells Operations (Commonwealth Waters) Environment Plan (referred to in this fact sheet as 'the EP'), to account for the operation of J-IC infrastructure.

Together with the Gorgon and Jansz Feed Gas Pipeline and Wells Operations (including J-IC) information sheet, the purpose of this fact sheet is to support consultation with relevant persons prior to the submission of the EP to NOPSEMA for assessment.

key information

- Chevron Australia has undertaken a robust environmental impact and risk assessment of J-IC operational activities, however there may still be considerations we are not yet aware of but need to understand to fully assess the potential impacts and risks.
- Through consultation, we are seeking feedback and input from relevant persons to ensure we have considered all relevant information and to incorporate into our proposed controls, or co-design further control measures if required.
- To date, Chevron Australia's environmental assessment has identified that:
  - Traditional Owner groups in the northwest region of WA have identified Sea Country as an important value and expressed a deep obligation to protect songlines, dreaming stories and the marine fauna connected to them, including whales, dugong and turtles.
  - The SCSt will be situated on the seabed, approximately 200 kilometres (km) offshore at a water depth of ~1,350 metres (m).
  - Operation of the SCSt will result in a localised change to underwater sound.
  - A number of cetaceans (whales and dolphins) are likely to transit the area surrounding the SCSt and may be particularly sensitive to underwater sound.
  - The SCSt will be located within the pygmy blue whale migration Biologically Important Area (BIA). BIAs are spatially defined areas for marine species listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), where the species are known to display biologically important behaviours such as breeding, foraging, resting or migrating.
  - Pygmy blue whales are also subject to an Australian Government Blue Whale Conservation Management Plan (CMP), which states that anthropogenic (human-made) noise in a BIA will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area.
  - Chevron Australia has committed to operate the SCSt in a manner that is not inconsistent with the CMP. This includes ensuring received underwater sound levels within relevant pygmy blue whale foraging dive depths remain below the behavioural response threshold for marine mammals (120 dB re 1 µPa).

how is underwater sound measured?

It is important to note that underwater sound levels are not directly comparable to in-air sound levels.

The intensity, or 'loudness,' of a sound wave is influenced by the speed of the sound wave and the density of the medium through which the sound is travelling. Water has a much greater density than air, and the speed of sound in water is greater than the speed of sound in air. The higher density and higher sound speed result in a lower intensity sound wave.

The intensity of sound is measured using a decibel (dB) scale. The dB is a ratio between two values – a measured value and a reference value.

In water, the reference value of 1 micropascal (µPa) is used, so when abbreviated, underwater sound levels are presented as *dB re 1 µPa*. In air, a different reference value of 20 µPa is used, and sound levels are presented as *dB re 20 µPa*.

To obtain an approximate comparison between underwater and in-air sound, 61.5 dB can be subtracted from the underwater sound level to obtain the in-air equivalent.

To understand the difference between sound levels in water and air, consider this example – a sound of 100 dB re 1 µPa in water is within the range of ambient (background) ocean sound levels. However, a sound of 100 dB re 20 µPa in air is about equivalent to standing next to an operating lawnmower.

Sound source level: refers to the estimated sound level at a nominal distance of one metre from the sound source (presented as *dB re 1 µPa @ 1m*).

Received sound level: refers to the estimated sound level that would be measured at a defined distance from the source. Received sound levels are considered when assessing the sound levels that may be heard by marine fauna. The received sound level will vary depending on the distance between the source (e.g. the SCSt) and the animal that is hearing it.

Table 1: approximate source level of some common underwater sounds in the northwest WA marine area.

Sound source	Sound source level (dB re 1µPa)
Natural seismic activity (earthquake)	75-212
Jet ski	149
Container vessel	186
Pygmy blue whale song	179
Sperm whale clicks	163 – 223

Frequency: The frequency of a sound refers to the number of vibrations that occur in a sound wave per second and is measured in hertz (Hz). Low-pitched sounds have lower frequencies and high-pitched sounds have higher frequencies.

Different cetaceans have different hearing ranges, for example pygmy blue whales and other baleen whales are considered low frequency cetaceans as they have a lower frequency hearing range when compared to toothed whales, such as sperm whales, which have a higher frequency hearing range.

SCSt sound source level and operating conditions

The SCSt is based on proven design and technology used in an existing facility currently operating in the North Sea, near Norway. During operations, it will generate low frequency, continuous sound that will add to the existing ambient ocean soundscape.

To predict underwater sound source levels at the SCSt, technical acoustic experts at the Centre for Marine Science and Technology (CMST) at Curtin University and Novicos GmbH were engaged to conduct extensive modelling and measurement studies, using data acquired from the similar operating facility and the in-air sound measurement of the actual J-IC compressors taken during the manufacturing and testing process.

Modelling has predicted an underwater sound source level between 166 dB and 179 dB re 1 µPa @ 1m, depending on operating conditions.

Over the life of the SCSt, the compressors will be operated at different power loads.

- When operated at maximum power load, modelling has predicted a maximum sound source level of 179 dB re 1 µPa @ 1m with a high degree of certainty.
- When operated at lower power loads, a sound source level of 166 dB re 1 µPa @ 1m is predicted (minimum sound source level).

As of December 2024, it is expected the initial and more typical operating conditions over the life of the SCSt will be at power loads closer to the mid range between maximum and minimum sound source levels [Figure 2].

how can underwater sound impact marine fauna?

Regulators in Australia assess the impacts or risks of anthropogenic (human-made) underwater sound on marine fauna based on sound effect thresholds derived from best available science, and consideration of associated areas for biologically important behaviour.

Continuous, non-impulsive underwater sound from offshore activities has the potential to impact marine fauna in a range of ways, including:

- Physical injury, including permanent hearing loss (known as permanent threshold shift, or PTS), and temporary hearing loss (known as temporary threshold shift, or TTS).
- Behavioural changes, ranging from avoidance of the area, increased swimming speeds, disruption of foraging behaviour, and changes to or cessation of vocalisations.

While this fact sheet has a particular focus on pygmy blue whales, potential impacts to other EPBC Act listed and culturally important marine fauna (e.g. whales, dugong, turtles and fish) are also being considered and assessed in the preparation of the EP and are summarised in Table 2.

When determining the potential effects of sound exposure, animals are placed into hearing groups to account for the fact that different species do not hear equally well at all frequencies and therefore do not have the same potential for effects to their hearing at all frequencies.

For cetaceans, PTS and TTS impacts for non-impulsive (continuous) underwater sound are assessed based on accumulated sound exposure levels over a 24-hour period (SEL24h), which is weighted for each hearing group.

For low-frequency cetaceans such as the pygmy blue whale, the PTS and TTS thresholds are $SEL_{24h\ weighted}$ 199 dB re 1 μPa^2s and $SEL_{24h\ weighted}$ 179 dB re 1 μPa^2s respectively.

Both PTS and TTS are not considered a credible risk, as a low frequency cetacean would need to remain within close proximity to the SCSt for an extended period of time, and given that marine mammals need to surface regularly to breathe air, such sound exposure would not be possible.

Further to this, research has shown pygmy blue whales spend most of their time within the top 15 m of the sea surface when migrating through offshore WA waters.

The marine mammal behavioural response threshold refers to the sound level at which marine mammals may exhibit changes in behaviour, which is 120 dB re 1 µPa for non-impulsive sound sources.

As shown in Figure 2 and Figure 3, modelling has predicted the received sound level will remain below 120 dB re 1 µPa at the maximum recorded dive depth (306 m) of a pygmy blue whale in the northwest marine region of WA.

partnering with leading research scientists

Chevron Australia has a proud history of partnering with leading science and research institutions to protect biodiversity and manage conservation on Barrow Island and in offshore waters.

We have made significant investments in research and technology to inform our environmental impact and risk assessment for J-IC, and to monitor and manage the operation of the SCSt to minimise environmental impacts and risks.

Through key partnerships with CMST and the Australian Institute of Marine Science (AIMS), we have invested more than $A6 million in research studies in the northwest marine region, and we are committed to sharing data to build industry knowledge.

CMST – understanding the existing underwater soundscape

Chevron Australia has engaged scientists at CMST to undertake a baseline monitoring study of underwater sound within and around the proposed J-IC operational area.

CMST deployed several deepwater, omni-directional acoustic receivers at various locations to allow for continuous passive acoustic monitoring (PAM) of whale vocalisations and other sounds and to establish an accurate baseline.

The background soundscape of the ocean is referred to as ‘ambient sound’ and is highly variable depending on location. Ambient sound can be made up of a range of sources including biotic sounds (e.g. from whales, dolphins, fish and crustaceans) and abiotic sounds (e.g. from wind, rain, earthquakes, vessels, marine construction activities).

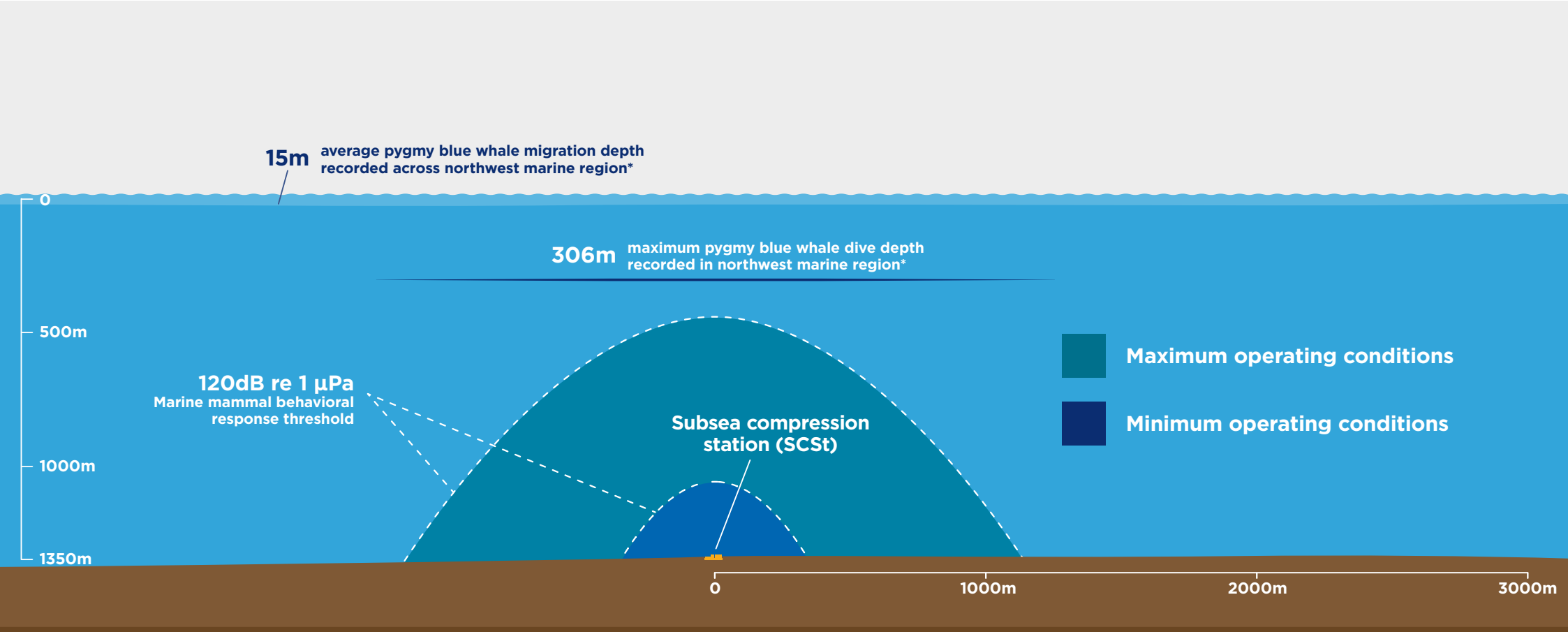
During the four-year monitoring period to-date, a broad range of sounds were detected, including from a variety of marine mammals, waves, wind, earthquakes, and vessel movements. CMST measurements close to the J-IC location indicate the typical ambient ocean sound level is approximately 100 dB re 1 µPa, ranging between 90 dB and 110 dB re 1 µPa.

The acoustic monitoring program will continue over the next two years and for the first three years of J-IC operations to build the scientific data on marine fauna in the region.

AIMS - pygmy blue whale research

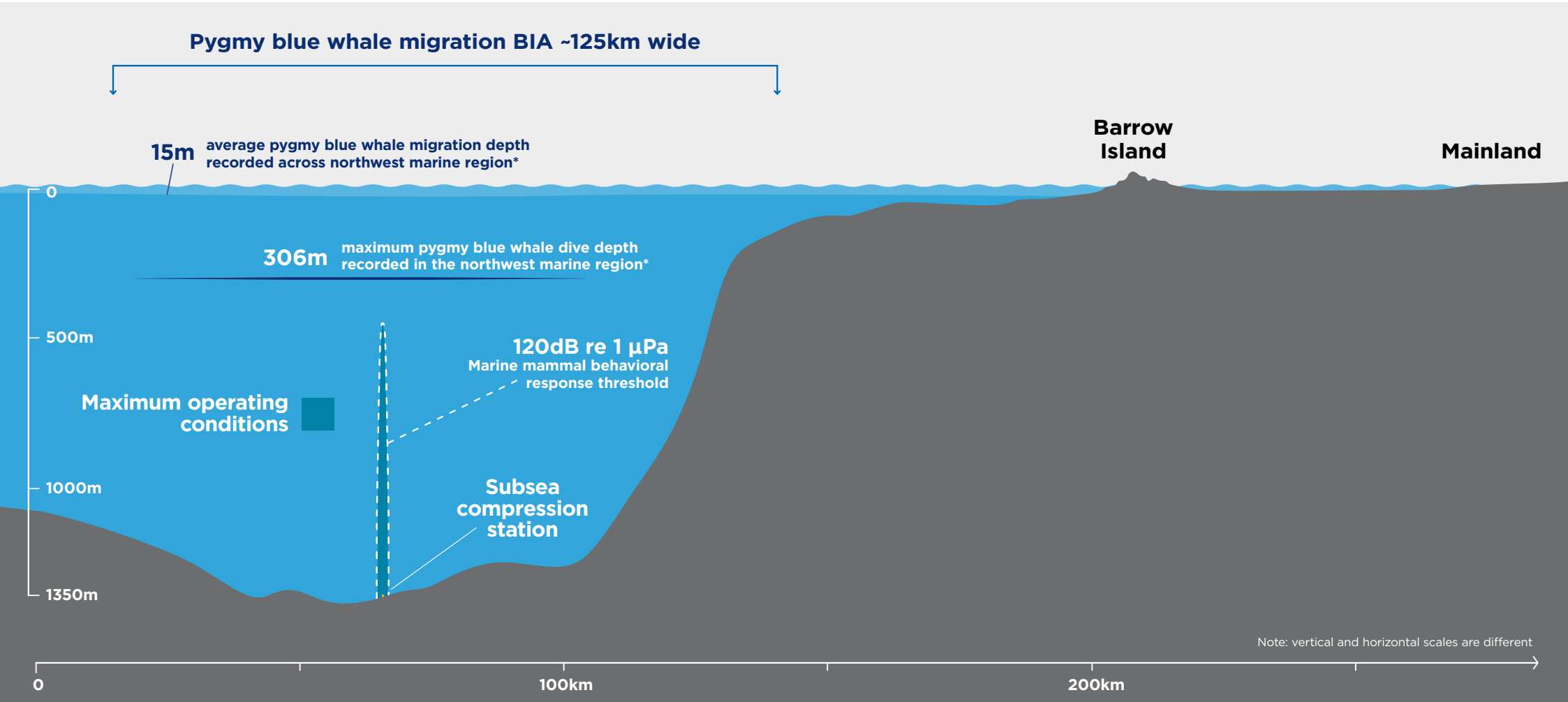
Since 2019, AIMS, in collaboration with the Centre for Whale Research has been undertaking pygmy blue whale tagging research to better understand their distribution, migration and feeding behaviours in the offshore waters of WA.

Figure 2: Schematic illustrating the predicted horizontal and vertical extent of the SCSt underwater sound footprint above the marine mammal behavioural response threshold of 120 dB re 1 µPa.



*Relevant pygmy blue whale data is derived from current scientific research, which may change over time.

Figure 3: Schematic illustrating the predicted SCSt underwater sound footprint above the marine mammal behavioural response threshold of 120 dB re 1 µPa at maximum operating conditions, which represents less than two percent of the horizontal width of the ~125 km wide pygmy blue whale migration BIA.



*Relevant pygmy blue whale data is derived from current scientific research, which may change over time.

Chevron Australia is supporting AIMS to continue this work throughout 2024-2026, with a focus on collecting more data on diving and feeding behaviour in the northwest marine region.

In the waters off the northwest marine region, scientific studies have found pygmy blue whales show a preference to forage in the top 100 m from the sea surface, where krill density may be higher. Here, the maximum dive depth recorded is 306 m from the sea surface.

In the Perth Canyon, where there are nutrient rich upwellings, pygmy blue whales are known to forage at greater depth. In this region, the maximum dive depth recorded is 506 m from the sea surface.

This ongoing research allows AIMS to identify where pygmy blue whale movement patterns overlap with industrial activity and provides government regulators and operators, like Chevron Australia, more data to inform decision-making and avoid potential impacts from offshore activities.

SCSt underwater sound: proposed control measures[1]

While scientific modelling has predicted the maximum sound source level with a high degree of certainty, a conservative error margin (plus or minus 4 dB) has been considered in the development of appropriate control measures, including:

- An Environmental Performance Standard will be in place that commits to operating the SCSt in a manner that is not inconsistent with the Blue Whale CMP. This includes ensuring received sound levels within relevant pygmy blue whale foraging dive depths remain below the behavioural response threshold for marine mammals (120 dB re 1 µPa).
  - During commissioning, the SCSt will be turned on in a phased approach and acoustic recorders deployed from a vessel will provide initial data in near real-time to ensure sound levels remain within the expected operating parameters of the SCSt.
  - Passive acoustic loggers will also be deployed to monitor and record sound source levels while testing the full range of operating conditions (from minimum to maximum power loads).
  - If in-field testing during commissioning determines the received levels within relevant pygmy blue whale dive depths may exceed 120 dB re 1 µPa, a control measure will be implemented to limit the power load of the compressors and reduce sound levels.

underwater sound and marine fauna

Table 2: Summary of potential impacts and risks of SCSt underwater sound on key EPBC listed and culturally important marine fauna.

Species	Summary of potential impacts and risks
Marine mammals	
Pygmy blue whale (baleen whale)	Underwater sound modelling indicates both PTS and TTS are not credible risks to pygmy blue whales: – given a low frequency cetacean would need to remain within close proximity to the SCSt for an extended period of time, and given that marine mammals need to surface regularly to breathe air, such sound exposure would not be possible. In addition, pygmy blue whales are unlikely to encounter the predicted SCSt sound footprint above the marine mammal behavioural response threshold: – recent research has shown pygmy blue whales spend most of their time within the top 15 m of the sea surface when migrating through offshore WA waters. – in the northwest marine region, scientific studies have found pygmy blue whales show a preference to forage in the top 100 m from the sea surface. Here, the maximum dive depth recorded is 306 m from the sea surface. Taking the above into consideration, Chevron Australia considers that the SCSt can be operated in a manner that is not inconsistent with the Blue Whale CMP.
Other baleen whales e.g. Antarctic minke whale, dwarf minke whale, Antarctic blue whale, Bryde's whale, fin whale, humpback whale, sei whale and Omura's whale	For the same reasons outlined above for pygmy blue whales, PTS and TTS to other baleen whales are not considered a credible risk. It is also considered unlikely that other baleen whales would encounter the predicted SCSt sound footprint above the marine mammal behavioural response threshold. Baleen whales primarily feed on krill and prefer to migrate and feed within the upper water column, where prey availability is densest. Further to this, there are no known biologically important areas for other baleen whales within proximity to the J-IC location.

1 | These proposed control measures are subject to change through consultation with relevant persons and the subsequent NOPSEMA assessment process.

Species	Summary of potential impacts and risks
Toothed whales e.g. Sperm whale, dwarf sperm whale, pygmy sperm whale, beaked whales, killer whale, Australian humpback dolphin, Australian snubfin dolphin and spotted bottlenose dolphin	Underwater sound modelling indicates both PTS and TTS are not credible risks, given a toothed whale would need to remain within proximity to the SCSt for an extended period of time, which is not possible as it would need to surface to breathe air. Some species of toothed whales (such as sperm whales) may dive to depths where they would encounter the predicted SCSt sound footprint above the marine mammal behavioural response threshold. However, potential behavioural responses are only expected to occur in proximity to the SCSt. Further to this, toothed whales are known to opportunistically forage over wide ranging areas in pursuit of mobile prey (e.g. squid and fish). The J-IC location does not represent key foraging habitat and does not overlap any biologically important areas for toothed whales.
Dugong	Dugongs are primarily coastal animals, associated with shallow seagrass meadows. Any presence within deep offshore waters (more than 100 km from the nearest coastline) would be unexpected and likely to be of a transitory nature. As dugongs are known to be a shallow diving species, they would be highly unlikely to encounter the predicted SCSt sound footprint above the marine mammal response threshold.
Other marine fauna	
Marine turtles	While marine turtles are known to travel considerable distances from their nesting habitats, they spend most of their time within shallow coastal waters, where they feed and rest. Any presence within deep, offshore waters is expected to be of a transitory nature. The closest turtle nesting habitats to the SCSt are Barrow, Montebello, and Lowendal islands, over 135 km away. Further to this, most turtle species are shallow divers, rarely exceeding 40 to 50 m water depth and would therefore be unlikely to encounter the predicted SCSt sound footprint at a level that would result in a behavioural response.
Fish	Underwater sound modelling indicates the SCSt poses a low risk of causing injury or mortality to highly mobile pelagic fish. Bottom dwelling demersal fish may reside in and around the SCSt, and those fish that remain within close proximity to the SCSt for extended periods may receive sound above the non-impulsive (continuous) sound TTS threshold, however impacts are not expected to be detectable at a population level. Fish may elicit a behavioural response when swimming in proximity to the SCSt, however behavioural responses are unlikely at greater distances from the SCSt.

In addition to the summary of potential impacts and risks outlined above, Chevron Australia acknowledges that Traditional Owner groups in the northwest region have identified Sea Country as an important value and expressed a deep obligation to protect songlines, dreaming stories and the marine fauna connected to them.

We are committed to ongoing engagement and consultation with Traditional Owners and their representative bodies. This will continue to inform our understanding of cultural values and features and facilitate the co-design of appropriate controls to avoid impacts.

your input

We are seeking your feedback and input if you consider your functions, interests, or activities may be affected based on the information provided in this fact sheet or on our website.

We encourage you to provide additional details about the environment, aspects, consequences of the activity or control measures, or to ask for further information or consultation.

You can contact us with any questions, requests for information, or feedback at:

- 1800 225 195
- australia.chevron.com/**feedback**
- or scan the QR code

Relevant persons may request that the information provided be treated as confidential. Chevron Australia will make this known to NOPSEMA and it will be identified as sensitive information and not published in the EP.

references and related reading

The following sources are either directly referenced in this document or provide additional background information.

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