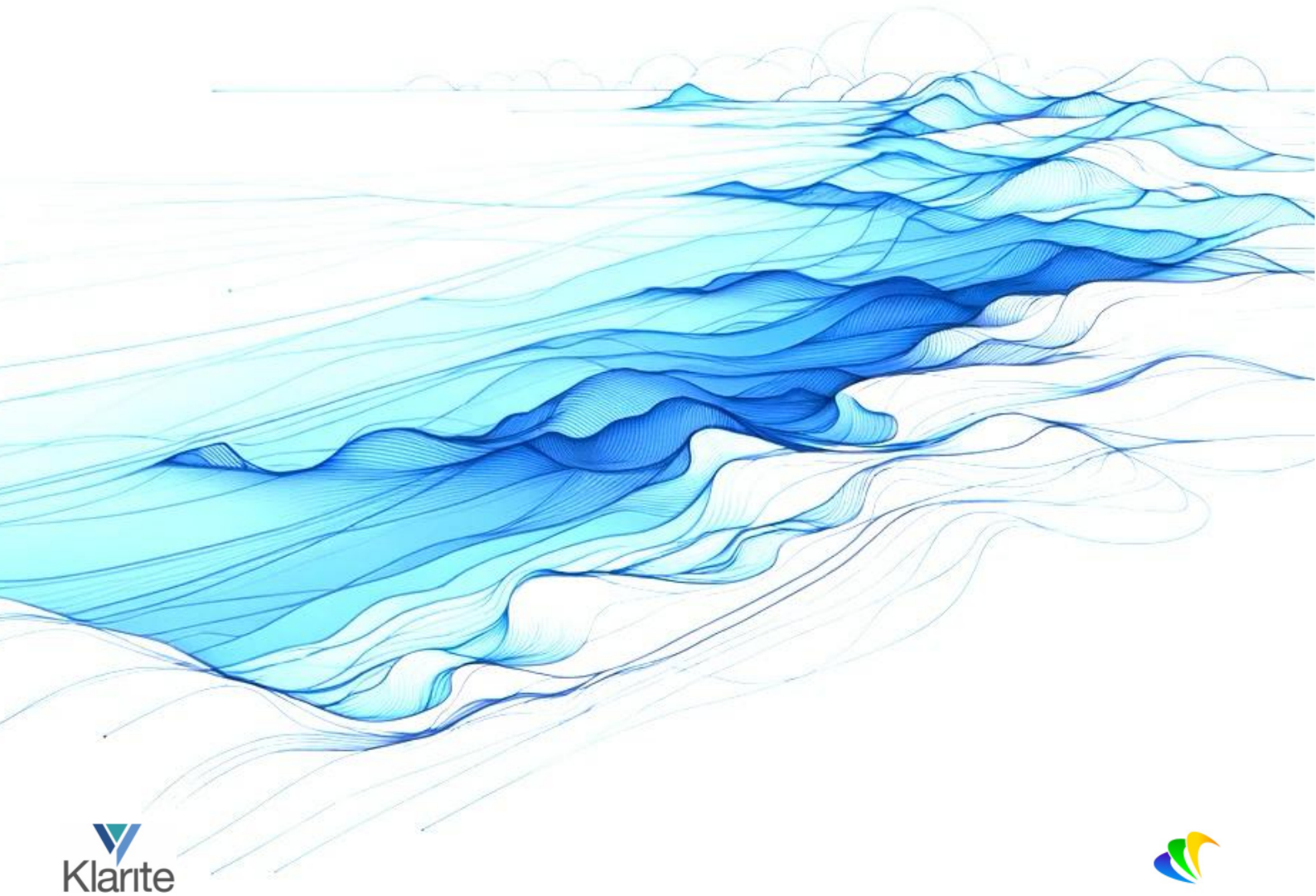
REGIA
Marine Seismic Survey

ALARP Assessment

Appendix F2: REG-EP-031-F2

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Klarite

Executive Summary

This report presents a comprehensive ALARP (As Low As Reasonably Practicable) assessment across ten environmental impact and risk pathways relevant to the Regia Marine Seismic Survey (Regia MSS). The assessment applies a consistent, step-by-step framework that combines baseline compliance obligations, discretionary control measures, and a semi-quantitative analysis of effectiveness and cost (sacrifice).

For each impact or risk pathway, the process identifies:

- The baseline level of residual impact or risk after legal and operational requirements are applied.
- The cumulative cost, time, or operational effort (sacrifice) required to implement additional control measures.
- The marginal environmental benefit achieved at each step.

Control measures were adopted where they delivered meaningful reductions in impact or risk relative to their cost. Measures were rejected where further reduction would be grossly disproportionate to the sacrifice required. This ensures that effort is concentrated where environmental returns are highest.

A final cross-pathway analysis confirmed that:

- Most total sacrifice was invested in pathways with the highest baseline risk, such as underwater sound, physical presence, and collisions with marine fauna.
- Pathways with already low impact levels, such as atmospheric emissions and planned discharges, showed diminishing returns, supporting early cut-off points in the assessment.
- A comparative metric — impact reduction per unit of sacrifice — demonstrates that CGG's approach delivers proportionate and justifiable environmental outcomes.

Overall, the assessment confirms that impacts and risks have been reduced to a level that is as low as reasonably practicable, in accordance with regulatory expectations and environmental best practice.

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1 Introduction

This document presents the **ALARP** (As Low As Reasonably Practicable) assessment undertaken by CGG for the Regia Marine Seismic Survey (**Regia MSS**). The ALARP principle is a core requirement of environmental management under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* ("**the Regulations**"). It requires that environmental impacts and risks associated with the activity are reduced to a level that is ALARP.

The ALARP assessment forms one of the key demonstrations in support of the Environment Plan (**EP**) for the Regia MSS. It complements the environmental impact and risk assessment by evaluating whether further reductions in environmental impacts and risks can be achieved through additional or alternative control measures, and whether any such measures are reasonably practicable to adopt in the context of the activity.

This assessment is supported by:

- The environmental assessments in Appendices D1–D4 and E1–E9, which establish the baseline level of environmental impact and risk after legislative requirements have been applied.
- The risk and impact matrices contained in Annexes 1 and 2 of Appendix B3.
- A stepwise, semi-quantitative evaluation of environmental benefit and associated sacrifice for each control measure considered.

Figures, tables, and supporting materials are provided to clearly communicate the decision-making process and demonstrate compliance with the ALARP requirement of the Regulations.

1.1 Purpose

The purpose of this assessment is to demonstrate that the environmental risks and impacts associated with the Regia MSS have been reduced to a level that is as low as reasonably practicable. It does so by evaluating whether additional or alternative control measures offer environmental benefit that is proportionate to the sacrifice required to implement them. The assessment provides a transparent, stepwise justification for which measures have been adopted and which have not, in accordance with the Regulations.

1.2 Definitions

The following definitions are used throughout this document and their distinctions and nested nature is imperative in being able to reproduce the outcomes of the assessments.

Table F2-1 - Definitions

Term	Definition
Measures	A collective term for anything that eliminates, substitutes, controls, manages, or administers an impact or risk.
Activity limitation	A measure that eliminates or substitutes, constrains, limits, or otherwise restricts the activity such that impacts and risks can be avoided, or lessened to or below acceptable levels.
Control Measure	A system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks of an activity. (OPGGS (Environment) Regulation 5).

Term	Definition
Environmental Performance Standard	A statement of the performance required of a control measure.
Environmental Management System	For an activity, includes the responsibilities, practices, processes and resources used to manage the environmental aspects of the activity.

1.3 ALARP Concept

ALARP is a core element of environmental management in the Regulations. It recognises that while environmental impacts and risks can often be further reduced, not all potential measures are reasonably practicable. ALARP is not a simple cost-benefit exercise — it requires a balanced judgement of the level of risk or impact against the sacrifice involved in implementing further control measures.

The goal of an ALARP assessment is to determine whether additional impact and risk reduction is achievable without incurring sacrifices that are grossly disproportionate to the environmental benefit. To support this, Table F2-1 outlines the key conceptual parameters that influence ALARP assessments.

Table F2-2 - Conceptual parameters in assessing whether ALARP has been reached.

Impact or Risk Reduction Achievable (Intrinsic Effectiveness)	Sacrifice Required for Adoption
Reduced Occurrence: This includes decreasing the occurrence (either likelihood or uncertainty) (E.g., of emissions and discharges).	Financial Cost: The most obvious sacrifice is the direct financial cost of implementing a control measure. This includes the cost of purchasing equipment, technology, or services, as well as any ongoing maintenance and operational costs.
Reduced Severity: This includes decreasing the effect or consequence (E.g., of emissions and discharges).	Time and Effort: Implementing new processes or technologies often requires significant time and effort. This can include the time taken for research and development, training staff, and integrating new systems into existing workflows.
Compliance with Regulations: Meeting or exceeding environmental regulations can improve environmental outcomes and avoid legal penalties.	Operational Disruption: Introducing new control measures can disrupt regular operations. This might mean downtime, reduced productivity, or the need to alter business practices temporarily or permanently.
Long-term Sustainability: Sustainable practices can ensure long-term viability and resilience of the business and the environment.	Resource Allocation: Resources, including human resources, might need to be reallocated. This could mean diverting staff from managing one impact or risk to managing a different or new impact or risk.
Ecosystem Preservation: Protecting natural habitats and biodiversity, which has intrinsic value and can support long-term ecological balance.	Opportunity Cost: Implementing a control measure might mean foregoing other opportunities. For instance, investing heavily in one area of environmental protection might limit a company's ability to invest in other areas.

Measures that offer risk or impact reduction *commensurate with the sacrifice* must be adopted. Further, even measures involving *disproportionate sacrifice* may be required, provided the sacrifice is not *grossly* disproportionate. Only in cases of gross disproportionality can a control measure be justifiably excluded.

This makes it essential that the levels of risk and impact are well understood before the ALARP process begins. These levels were determined through the environmental assessment process outlined in Appendix B3 and applied in the Preliminary Environmental Impact and Risk Assessment, Appendices D1–D4 and E1–E9. Together, they provide the foundation for evaluating which control measures can be considered reasonably practicable.

2 Scope of the ALARP Assessment

The ALARP assessment for the Regia MSS forms a key part of CGG's approach to ensuring that environmental impacts and risks are reduced to a level that is as low as reasonably practicable. The assessment considers each identified risk and impact and evaluates the adoption or rejection of additional, alternative, or improved control measures. The process begins from a realistic baseline, already incorporating all legally required measures and activity constraints.

The scope of the assessment includes:

- Establishing baseline levels of impact/risk and sacrifice using the outcomes of the environmental assessments (Appendices D1–D4 and E1–E9).
- Evaluating discretionary control measures beyond those mandated by legislation or company policy.
- Assessing the environmental benefit of adopting a control measure in terms of additional risk or impact reduction.
- Comparing the benefit to the cumulative sacrifice required to adopt and maintain the control measure (e.g. cost, time, disruption, opportunity cost).
- Determining whether the control measure is reasonably practicable or grossly disproportionate.
- Documenting the rationale for adopting or rejecting each measure.

This structured approach ensures the assessment supports a transparent and traceable demonstration that the environmental risks and impacts of the activity have been reduced to ALARP in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023.

2.1 Exclusions from Scope

The ALARP assessment focuses on the decision-making process for adoption/rejection of control measures only. Several other elements of the broader environmental management system are excluded from this assessment, as explained below.

2.1.1 Activity Limitations

Activity limitations are not control measures and are therefore excluded from the ALARP assessment. These limitations form part of the baseline definition and the environmental context in which control measures are assessed. They cannot reasonably be considered in ALARP decisions because:

- Their costs are variable and context-specific, arising from survey design and environmental constraints rather than implementation choices.
- They relate to the activity's scope and objective, not the cost of adopting a control measure.
- They are either complied with or not, lacking a performative or measurable management component.
- They eliminate or substitute risks (at the top of the hierarchy of controls), rather than managing them.

- They are used to set the boundaries of the assessment, forming the baseline against which ALARP can be argued.
- They do not serve as discretionary control measures subject to cost-benefit evaluation.

2.1.2 Environmental Management System

Similarly, supporting measures that are part of the Environmental Management System (found in the Implementation Strategy (Appendix B3)) are part of establishing baselines for the ALARP assessment and excluded from the ALARP assessment. These elements are designed to support the effectiveness of all control measures, not act as control measures themselves. For example, an oil pollution emergency plan or an induction program does not directly protect the environment it is the performance of personnel and the availability of equipment, rather than the plan itself, that delivers environmental protection.

While these measures are essential for ensuring the effectiveness of adopted control measures, they do not form part of the ALARP decision-making process. Rather, they form part of the baseline sacrifice required to manage environmental impacts and risks and are addressed separately in the implementation and performance monitoring framework.

3 Consultation Input

CGG carried out the consultations required by the regulations to:

- Improve the predictive quality of this assessment by seeking relevant person input into the preparation of the EP.
- To verify the description of the environment that CGG produced as part of its environmental assessment process through information provided to CGG by relevant persons.
- Receive objections or claims about the adverse effects of the activity on a relevant person's functions, interests, or activities.

The information received from relevant persons can be found in each relevant person consultation report. It has been considered in the preparation of this assessment.

Objections or claims about the adverse of the effects of the activity can also be found in each relevant person's consultation report. They have been assessed for merit and CGG has written a statement of its response to each objection or claim. Any objection or claim relevant to this assessment and subsequently considered in its preparation can be found in Annex 2 - Objections and Claims Raised from Consultation.

4 Establishing ALARP Baselines

The starting point for an ALARP assessment is never assumed to be zero sacrifice or maximum (inherent) impact or risk. This is because:

- Titleholders are legally required to implement certain environmental management measures (e.g. under the EPBC Act or maritime law).
- These measures already incur sacrifice in the form of time, effort, and financial cost.
- They have already contributed to reducing the unmitigated impact or risk associated with the activity.

The ALARP assessment must therefore begin from a realistic and regulated baseline, which includes all legally required measures, and any activity limitations or constraints already committed to that shape how the activity is carried out. It is the combined effect of these measures on residual impact or risk that form the baselines.

4.1 Baseline for Risk and Impact

The baseline level of impact or risk is drawn directly from the outcomes of the environmental assessments (see Appendices D1–D4 and E1–E9), which apply all relevant legislative requirements and activity limitations as the starting point. The ranking values are derived from the risk and impact assessment matrices provided in Annexes 1 and 2 of Appendix B3.

While the nominal values assigned to each impact or risk level originate from these matrices, the subsequent reductions resulting from the adoption of additional control measures are used for relative comparison only. They do not correspond to absolute values in the original matrices but instead support a semi-quantitative and transparent tracking of progress lower toward ALARP.

4.2 Baseline for Sacrifice

The baseline level of sacrifice is defined as the total cost of meeting all relevant legislative requirements and activity limitations for undertaking the activity relevant to each aspect.

This includes:

- The cost of preparing the Environment Plan (EP).
- The cost of complying with environmental management legislation.
- Costs associated with undertaking consultation to gather input into the EP.
- The time value of regulatory engagement and approvals.

This combined sacrifice is expressed in the assessment as a unit value of 1 at the commencement of each individual assessment. All subsequent discretionary control measures are evaluated as proportionate increases above this baseline. Each assessment shows the incremental sacrifice per control measure, or group of control measures, and the cumulative sacrifice as a ratio above the baseline of 1. For example, if the baseline was equal to $100 (ratio = 1) and the cost of the first additional control measure is $50 (ratio = 0.5) then the cumulative total is $150 (ratio 1.5).

4.3 Why This Approach Was Adopted

This method of establishing baselines was selected to ensure that the ALARP assessment does not compare discretionary controls to a hypothetical “do nothing” case, which is inconsistent with regulatory obligations. Further, this approach ensures the marginal benefit of each control measure is evaluated against the actual residual impact/risk reduction it achieves. This reflects accepted good practice that environmental legislation sets the minimum standard, and that each control measure is assumed to be functioning and in place before assessing whether additional reduction is reasonably practicable.

4.4 Consideration of Alternative Approaches

Following feedback during the consultation process, CGG considered several alternative methods for calculating baselines and comparisons. These included:

- Absolute cost comparisons between control measures and total project profit. This approach was not adopted, as it would have required the disclosure of commercially sensitive pricing and contract terms, which is not in CGG’s interests nor a legislative requirement.
- A strict monetary valuation of environmental benefit. This was also rejected, as it fails to consider the effectiveness of control measures and assumes a linear relationship between cost and environmental value, which often does not hold in practice.
- Proportional cost methods, in which additional control measures would be assessed as a percentage of total project costs. This method was considered but ultimately set aside because it risks over-simplifying the ALARP assessment. For example, a low-cost control could be highly effective, while a high-cost control may offer little additional benefit.

CGG's adopted method ensures that the ALARP assessment reflects the context of the project, recognises existing commitments, and applies a balanced, defensible and repeatable framework for assessing the reasonableness of further risk or impact reduction.

5 ALARP Process

The purpose of this process is to assess whether an environmental impact/risk has been reduced to ALARP by progressively evaluating the effectiveness and cost of control measures.

5.1 Assigning Subjective Values

The ALARP process relies on the application of professional judgement and expertise within a structured and calculated method. It is a semi-qualitative process that will vary depending on the participants and the context in which the assessment is made. There follow instructions on how to assign values in this process which aim to reduce subjectivity.

5.1.1 Assigning Intrinsic Effectiveness

A central element of ALARP assessments is determining the degree to which a control measure provides an environmental benefit. This can be otherwise stated as degree to which a control measure reduces environmental impact or risk. For the purposes of this ALARP process, ***intrinsic effectiveness*** is used as a suitable and practical proxy for measuring environmental benefit.

Intrinsic effectiveness refers to the degree to which a control measure, on its own merits, is expected to reduce the impact or risk it is designed to address. In this process, this is expressed as a percentage reduction in the residual impact or risk. A control measure that is 90% intrinsically effective is considered to reduce 90% of the remaining impact/risk for that specific pathway.

This makes intrinsic effectiveness an ideal proxy for environmental benefit because it:

- Quantifies the marginal gain achieved by the control measure.
- Allows comparability across different measures and impact pathways.
- Provides a basis for calculating the residual impact/risk after each step.
- Enables the plotting of environmental return on sacrifice using the ALARP graphs.

Intrinsic effectiveness is not a generic rating but rather a context-specific estimate based on the following attributes:

- Functionality – How well does the measure perform its intended role?
- Availability – Is the measure accessible or deployable when and where needed?
- Reliability – Does it perform consistently in real-world conditions?
- Survivability – Can it maintain its function under expected stressors?
- Independence – Can it operate effectively without relying on other measures?
- Compatibility – Does it integrate well with existing activity design and systems?

The collective baseline measures, and each control measure considered thereafter in the ALARP process, is assigned an intrinsic effectiveness rating based on these characteristics. This rating serves as the quantified expression of its environmental benefit.

5.1.2 Assigning Sacrifice in ALARP Assessments

In the context of this ALARP process, sacrifice is the cumulative burden incurred by adopting the baseline measures and each control measure. Sacrifice is considered in the broadest sense, encompassing not only direct financial costs but also time requirements and broader operational or environmental complications collectively understood as money, time, and trouble.

Sacrifice = Money + Time + Trouble

Each component of sacrifice should be considered and described in qualitative terms in the discussions, as relevant, to underpin the semi-quantitative output required for the assessment.

Money

This refers to any direct or indirect financial outlay associated with the adoption of the measure, including:

- Equipment purchases or hire
- Additional staffing or consultancy costs
- Fuel, maintenance, or other operational expenses
- Cost of training, onboarding, or coordination
- Data processing, integration, or analysis costs

Time

This refers to any extension to the activity duration or any increase in lead time or delay caused by the adoption of a measure. Time-based impacts often carry a compounding effect, as they may extend environmental exposure periods, inflate operational costs, or affect coordination with third parties. Examples include:

- Longer vessel deployment periods
- Delay in acquisition
- Administrative time required to gain approvals or permits
- Increased mobilisation or demobilisation time

Trouble

This refers to all other burdens or trade-offs that may not be directly financial or time-based but still influence the overall cost of adoption. “Trouble” is especially relevant where a control measure increases other environmental impacts or risks, creates practical implementation issues, or introduces uncertainty that itself becomes a risk. This includes:

- Cross-pathway environmental trade-offs (e.g. increased emissions from an additional whale spotter vessel that provides increase protections for whales)
- Operational complexity or safety risks (e.g. deploying gear in tight conditions)
- Regulatory, stakeholder, or reputational risks
- Technical reliability and compatibility issues (e.g. new technologies introducing uncertainty)
- Burden of coordination, logistics, or collaboration

5.2 Step-by-Step Process

1. Identify the environmental impact / risk pathway for consideration.
2. To establish the baseline sacrifice:
    a. Start by identifying (and consider grouping) the:
        i. mandatory mitigation measures already required (by law, regulation, or standards).
        ii. relevant activity limitations.
        iii. management system elements that will contribute to the management of impacts and risks.
    b. Record the results in tabular form using the template at Table F2-3 adding rows for each mitigation measure (or group) that form the baseline. Explain why this measure has been included and what makes it effective. The baseline table should now be completed.
    c. Consider the incremental sacrifice (cost, time, effort) required to comply with all baseline measures in a dollar value where possible and note for later use. This value is not included. Do not record this value in the assessment.
3. Set the baseline impact / risk level using the conclusion of the relevant impact or risk assessment, enter the value in Table F2-4 at both locations with an 'X'.
4. Determine the first measure to be assessed and:
    a. Assign intrinsic effectiveness percentage and enter the value into Table F2-4 at 'Y' and justify this scoring in Table F2-4 (See Section 5.1.1 for instruction).
    b. Consider the incremental sacrifice (cost, time, effort) in a dollar value where possible and using the baseline sacrifice value convert to a ratio for publication. Enter that the ratio value in Table F2-4 at 'Z' and justify this scoring in Table F2-4. Create a running total in the cumulative sacrifice column.
5. Once the estimated intrinsic effectiveness percentage has been assigned calculate the marginal reduction (MR) and residual impact / risk after adoption (Res_{After}) using the formulas:

$$MR = Res_{Previous} \times IE\ (\%)$$

$$Res_{After} = Res_{Previous} - MR$$

Where:

MR = Marginal Reduction (of an impact or risk).

Res (Previous) = Residual impact or risk after the adoption of the previous control measures.

IE = Intrinsic effectiveness of a control measure or group of control measures in the context of the previously considered baseline and additional control measures.

Res (After) = Residual impact or risk after the adoption of the control measure under consideration.

The first measure row should now be completed and the Res $_{After}$ value can be carried down a row to become the Res $_{Previous}$ value for the next control measures to be assessed.

6. Identify the most effective control measure, or group of control measures and in the next row of the table:

    a. Estimate its additional benefit by assigning a percent to its intrinsic effectiveness (IE) in the context of the residual impact / risk of previous control measures (Res $_{Previous}$).

    b. Record the result in Table F2-4 and separately document why the percent of effectiveness has been assigned by discussing the control measures functionality, availability, reliability, survivability, independence, and/or compatibility.

    Note: The next most effective measure doesn't necessarily mean the one with the next highest intrinsic effectiveness. It is preferred that professional judgement is used to attempt to fill gaps in impact / risk management. This may or may not be the control measure attributed with the highest percentage intrinsic effectiveness.

7. Estimate the incremental additional sacrifice (money, time, or trouble) on a monetary basis that it would take to adopt the measure and record the result in the table. Enter the cumulative sacrifice by calculating the running total as the sum of all sacrifices for previously considered and adopted control measures.

8. Keep adding rows to the table, detailing the next most effective control measure, or group of control measures, and assigning its intrinsic effectiveness and incremental sacrifice as done previously. Keep considering additional control measures until the Res $_{Previous}$ is less than a value of 0.5.[1]

9. Plot the data from Table F2-4 (Res Previous and Cumulative Sacrifice) graphically including an order two polynomial trendline. Find the point of inflection on the trendline which is the point at which there are diminishing returns (i.e. there is no amount of sacrifice that is going to reduce the risk or impact further). This is typically the point where the trendline is nearly horizontal. Then, draw in the vertical ALARP threshold line using the point of inflection as the coordinates. Control measures on the left of the ALARP threshold line should be adopted and control measures on or beyond the vertical line can be justifiably rejected.

10. Plot the same data on another graph showing the cumulative sacrifice (line) and reduction achieved (bar) and check that the measure adopted closest to the point of inflection shows that the cumulative sacrifice is clearly grossly disproportionate to the benefits gained. This would be shown by a large and comparatively significant gap between the cumulative sacrifice and the resultant benefit reduction show for the control measure being considered.

[1] This value is justified later.

Table F2-3 - Example Baseline Measures Table

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Measure 1 Title	*Explain why this measure is included, how it managed the impact/risk, and reference its origins.*	*Explain why this measure is effective considering the instructions in Section 5.1.1*
Measure 2 Title		
Measure 3 Title		
Measure 4 Title		

Table F2-4 – Example Step-by-step ALARP Assessment Table

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See previous tables.	-	-	-	'X'	1.0	1.0	See Table F2-2	
2	First measure		'X'	'Y'			'Z'			
3	Second measure									

5.3 Endpoint of the ALARP Assessment

The ALARP assessment reaches its endpoint when it can be demonstrated that any further control measures would require a sacrifice that is grossly disproportionate to the environmental benefit (i.e. risk or impact reduction) that could be achieved. This does not mean that all risk or impact has been eliminated, nor that every conceivable control has been considered. Rather, ALARP requires that all reasonably practicable measures have been identified, assessed in context, and either adopted or justifiably rejected.

Figure F2-1 and Figure F2-2 illustrate this principle. As control measures are progressively adopted, residual risk or impact is reduced and cumulative sacrifice increases. Over time, the environmental benefit gained from each new measure typically diminishes, while the associated sacrifice rises. The point at which this trade-off becomes grossly disproportionate marks the practical and conceptual endpoint of the ALARP process.

5.3.1 Justification for Residual Impact/Risk Threshold of 0.5

A residual impact or risk value of 0.5 has been used as the cut-off point for further assessment in this ALARP process. This value reflects a logical and proportionate threshold based on two key principles:

- A threshold of 0.5 ensures that even relatively low residual values (e.g. 1) must still demonstrate a reduction by at least half before being considered ALARP. For higher residuals, the process requires consideration of multiple control measures to achieve this low level, reinforcing a structured and progressive reduction. This reinforces that greater effort is put towards higher residual levels of impact or risk.
- If the residual level has been reduced to less than 0.5, especially from a higher starting point, this shows a significant and measurable reduction has occurred. Coupling this with the use of a polynomial trendline to identify the point of diminishing returns provides a practical and evidence-based end to the assessment — once the line flattens and residuals are <0.5, enough has been done to reduce the risk or impact to a level that is demonstrably as low as reasonably practicable.

This approach supports transparent decision-making while ensuring the focus remains on material reductions with genuine environmental or safety benefit.

5.3.2 Cost of Further Analysis Endpoint

In accordance with this approach, it is not necessary to assess every potential variation or emerging technology to demonstrate that ALARP has been achieved. Control measures must be assessed relative to the current baseline, which already includes legally mandated and previously adopted measures. The remaining risk or impact must then be weighed against the additional sacrifice required to reduce it further.

A control measure may be considered not reasonably practicable, and therefore rejected for any of the following reasons:

- **Marginal Reduction**: The residual impact or risk is already low, and the additional reduction achievable is minor, offering limited environmental benefit.
- **High Cost**: The measure imposes a high financial or operational burden for only a slight improvement in impact or risk reduction, resulting in diminishing returns.
- **Limited Effectiveness**: The control is unlikely to significantly reduce the relevant risk or impact, and the cost or disruption cannot be justified.

- **Better Alternatives Exist**: More effective or less costly options are available to achieve a similar or greater outcome.
- **Unacceptable Trade-offs**: The measure would interfere with other critical business, safety, or environmental functions in a way that outweighs its benefits.
- **Risk Transfer Without Net Benefit**: The measure shifts the risk or impact without reducing its overall significance, undermining the value of the sacrifice.

These criteria support a structured and transparent conclusion that ALARP has been reached. Justification for the rejection of any control must be documented and linked to the existing risk profile, anticipated effectiveness of the measure, and the scale and nature of the associated sacrifice.

This progressive, contextual method ensures that the ALARP standard is met without turning the assessment into an open-ended or speculative exercise. It aligns with both the regulatory intent of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* and the practical realities of managing environmental impacts and risks in offshore petroleum activities.

5.4 Process Outputs

5.4.1 Tables

Each ALARP assessment includes structured tabular outputs that provide transparency and traceability in the stepwise evaluation of control measures. These tables complement the graphical outputs and discussion points by clearly presenting the rationale, sequence, and comparative value of each control measure assessed. Two key tables are included in each assessment:

1. **Baseline Measures Table**

Table F2-3 is an example table that will be reproduced for each ALARP assessment. This table documents the measures included in the baseline for each specific impact or risk. It identifies the activity limitations, and mandatory measures that are already in place due to regulatory requirements, company standards, or previous design decisions. The purpose of this table is to:

- Establish a clear and consistent starting point for the ALARP assessment.
- Demonstrate that legally required measures and activity limitations have already been applied.
- Show that the residual impact/risk level being assessed is not the unmitigated or inherent level, but rather the level remaining after baseline measures are adopted.

Each entry in the table includes the name of the measure (or group of measures), the reason for its inclusion (e.g. legislative obligation, internal policy), and its intrinsic effectiveness on reducing impact or risk. This ensures clarity in how the baseline was derived and provides a defensible foundation for evaluating additional control measures.

2. Step-by-step ALARP Assessment Table

Table F2-5 is an example table that will be reproduced for each ALARP assessment where each column has the following meanings:

Step	Sequence of control application (starting from baseline)
Short Title	Name of the measure (or group of measures) under consideration
Details of Control Measures	Summary of the measure (or group of measures) under consideration
Res $_{\text{Previous}}$	Impact or risk level before applying this control measure.
Intrinsic Effectiveness (IE):	Estimated % reduction if applied to the baseline.
Marginal Reduction (MR)	Actual reduction achieved from the baseline.
Res $_{\text{After}}$	New impact or risk level after the control measure is applied.
Incremental Sacrifice	Cost or burden added by this control shown as a ratio of cost from the baseline.
Cumulative Sacrifice	Total sacrifice including previous controls shown as a ratio of cost from the baseline
Intrinsic Effectiveness	As described in Section 5.4.3.
Sacrifice Quantum	As described in Section 5.4.3

This table presents the core of the ALARP assessment and captures the progressive evaluation of additional, alternative, or improved control measures. It lists each control measure (or group of control measures) considered and shows:

- The incremental reduction in impact or risk it would achieve relative to the baseline.
- The sacrifice required to implement it, including financial, time, operational, and opportunity costs.

This stepwise format allows the reader to follow the logic of the assessment in a transparent, structured manner. It also enables comparisons across measures and supports the conclusion of whether the final residual level of risk or impact has been reduced to ALARP.

Together, these tables demonstrate that each measure has been considered in context, with due regard to its contribution to impact/risk reduction, its relative sacrifice, and the existing baseline from which it is assessed.

Table F2-5 - Example ALARP Assessment Table (Grey text is instructional and/or should be replaced by the assessor)

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	*4*	1	1	See Baseline Measures Table	*The sacrifice quantum for baseline measures is always 1. Any justification or context that is useful for later comparisons can be included here.*
2	*Next Most Effective Measure*	*Detail of the control measures or group of control measures.*	*4*	*90%*	*3.6*	*0.4*	*0.6*	*1.6*	*Describe and justify the scoring (%) assigned for intrinsic effectiveness highlighting any gaps or uncertainties and following the instructions in Section 5.1.1*	*Describe and justify the scoring for the incremental sacrifice assigned highlighting any assumptions and following the instructions in Section 5.1.2.*
3	*Next Most Effective Measure*	*Detail of the control measures or group of control measures.*	*0.4*	*50%*	*0.2*	*0.2*	*0.2*	*1.8*		
4	*Next Most Effective Measure*	*Detail of the control measures or group of control measures.*	*0.2*	*75%*	*0.15*	*0.05*	*0.8*	*2.6*		

5.4.2 Graphs

Two graphs are used to show the results of each ALARP assessment. They are described below.

1. **Residual Impact/Risk vs Cumulative Sacrifice (Scatter Plot)**

In concept, these graphs are about establishing a rate of return on environmental benefit. This graph shows the progressive adoption of control measures, beyond baseline measures, that reduce impact/risk plotted against the cumulative sacrifice it takes to adopt each subsequent control measure. Once plotted, an order two polynomial line-of-best-fit can be used to show how residual impact/risk decreases as more sacrifice is invested. This helps to identify the point of inflection where additional effort no longer results in proportionate benefit. Once the point of inflection is found, an ALARP threshold can be plotted as a vertical line at that point of inflection. These graphs focus on the efficacy of each control measure as it is confirmed as adopted and helps with the decision such as: *Have you done enough?*

A second-order polynomial trendline is used in preference to linear or exponential trendlines because it best reflects the real-world behaviour of cumulative environmental benefit relative to incremental investment. In the context of ALARP assessments, control measures tend to show non-linear returns: initial actions often yield large reductions in impact or risk with relatively low sacrifice, while later measures offer progressively smaller reductions for greater sacrifice. This creates a natural curve rather than a straight-line relationship.

A linear trendline assumes a constant rate of reduction per unit of sacrifice, which oversimplifies the decision-making process and can misrepresent when grossly disproportionate sacrifice is reached. An exponential trendline, on the other hand, implies a continuously accelerating or decelerating trend, which does not align with the plateau effect typically observed once the most effective measures have been adopted.

The second-order polynomial (a parabolic curve) allows for both the initial steep reduction and the subsequent flattening of the curve, making it ideal for identifying the point of diminishing returns shown by the vertical line originating at the point of inflection of the curve. This is a useful visual cue for determining when ALARP has been achieved. This makes it a more appropriate and defensible choice for evaluating the proportionality of environmental benefit to sacrifice across a range of control measures.

2. **Combined ALARP Chart**

In concept, these graphs are about validating the point of inflection (from the previous scatter plot graph) as a point at which the costs of adopting further measures are grossly disproportionate (not just disproportionate) and providing a visual aid to communicate the stepwise ALARP process. The combined ALARP charts combine a bar chart showing residual impact/risk in discrete steps (i.e. how much each control measure reduces impact/risk) based on its effectiveness and a line chart showing cumulative sacrifice. The visual effect contrasts the size of the benefit each control measure gives (bar height drop) with the amount of sacrifice required to achieve it. These graphs focus on the direct effect of each control measure and highlight the cost-benefit trend. It makes it easy to point out which control measures had the most benefit versus cost and confirms that the point of inflection in the first graph is at a grossly disproportionate level.

5.4.3 Discussions

Each ALARP assessment includes three structured discussion components that accompany the tables and graphs. These discussions are essential to documenting how values were assigned, providing justification for key assumptions, and supporting the interpretation of outputs.

Baseline 'Inclusion Rationale'

A column in Table F2-3 includes a discussion that should explain how the baseline residual impact or risk and baseline sacrifice were established. It provides the context for the first row of the assessment table and ensures transparency in defining the starting point for all subsequent evaluation. The baseline cost established also sets the relevant baseline sacrifice ratio for that assessment.

Intrinsic Effectiveness Discussion

This discussion, detailed in each impact and risk ALARP Assessment table, justifies the percent effectiveness assigned to each control measure (or group of measures) in the context of the residual impact or risk remaining at that point in the assessment. It is linked directly to Step 4b of the process and supports the calculation of marginal reduction and residual values.

For each measure considered, the discussion should address:

- How the measure functions to reduce the impact or risk (i.e. mechanism of effect),
- One or more of its intrinsic characteristics that influence effectiveness, such as:
  - Functionality (how well it performs).
  - Availability (how accessible or deployable it is).
  - Reliability (how consistently it performs).
  - Survivability (its robustness under expected conditions).
  - Independence (whether it operates effectively without relying on other measures).
  - Compatibility (whether it works well with previously adopted measures or the baseline activity design).

This qualitative explanation supports the numerical effectiveness percentage and helps show that values were assigned with technical judgement and context-specific reasoning.

Sacrifice Quantum Discussion

This discussion, detailed in each impact and risk ALARP Assessment table, justifies the estimated additional sacrifice associated with adopting each control measure. It supports the value entered in the process and ultimately feeds into the cumulative sacrifice curve used in graphing and inflection point analysis.

The discussion will:

- Identify the nature of the sacrifice — whether it relates to financial cost, additional time, increased effort, or other opportunity costs (e.g. lost data, reduced survey efficiency).
- Where a dollar estimate is used, explain what is included in the estimate and whether it represents one-off or ongoing costs and be converted to a ratio.
- Discuss any non-monetary trade-offs, such as:
  - Increased exposure to different environmental risks.
  - Reduced safety margins.
  - Disruption to core activity objectives.

This discussion ensures that the sacrifice values are understood not just numerically, but in terms of real-world implications and helps the reader evaluate whether a control measure's cost is reasonably proportionate to the benefit achieved.

Alternative, Additional, or Improved Control Measures Discussion

As part of each ALARP assessment, a structured and systematic process is applied to ensure that all reasonably practicable control measures are identified and evaluated. This includes consideration of additional, alternative, or improved measures before, during, and after the stepwise assessment of control measures. The intent is to ensure that the assessment demonstrates that current control measures adopted are the most effective in the circumstance and that no viable opportunities for further reduction have been overlooked.

Before beginning the stepwise ALARP assessment, a feasibility scan is undertaken to identify the full range of potentially applicable control measures for the impact or risk pathway under consideration. This includes measures that are:

- Additional to those already included in the baseline.
- Alternative to proposed measures that may offer a different approach to risk reduction.
- Improved versions of existing measures that could increase effectiveness or efficiency.

This feasibility search is not limited to measures previously implemented by the titleholder. It also includes emerging technologies, peer-reviewed recommendations, relevant person suggestions, and relevant guidance or regulatory instruments. Importantly, identification at this stage does not imply that the measure must be implemented or fully assessed, but rather that it has been acknowledged and will be considered through the assessment process.

Throughout the step-by-step ALARP assessment, each control measure or group of measures is considered in order of effectiveness. At each step, the opportunity to substitute in additional, alternative, or improved control measures is explicitly evaluated before proceeding to the next step. This may result in refinement of the control measure selection, modification of grouping, or comparative evaluation to determine whether the current selection represents the best practicable approach at that stage. This ongoing consideration ensures that the process is adaptive and incorporates the best available information as the assessment progresses.

After the primary assessment has been completed and the point of diminishing returns has been reached, the final step is to review any remaining additional, alternative, or improved control measures not already addressed. These are evaluated to determine whether their adoption would result in any material benefit to impact or risk reduction, or whether the cost and effort associated with their implementation would be clearly grossly disproportionate.

5.5 Ensuring Integrity in ALARP Assessments

ALARP assessments rely on structured judgment, evidence-based reasoning, and transparency. However, the method is also inherently susceptible to manipulation if not undertaken with discipline and integrity. Two common avenues of manipulation include:

- **Overestimating Intrinsic Effectiveness**: Assigning a control measure a higher-than-warranted effectiveness score can artificially reduce the residual impact/risk early in the process. This can result in fewer subsequent control measures being assessed or adopted and may falsely suggest that risks or impacts have been reduced to ALARP levels.

- **Overestimating Sacrifice**: Similarly, inflating the estimated cost, time, or operational burden (i.e. sacrifice) of adopting a control measure can lead to the premature rejection of otherwise reasonable measures by classifying them as grossly disproportionate.

To avoid these pitfalls, the assessment should be guided by a disciplined and conservative approach:

- **Underestimate Intrinsic Effectiveness Where Justifiable**: Wherever a level of uncertainty exists in the functional performance of a control measure, it is appropriate to conservatively assign a slightly lower effectiveness score. This helps ensure that the assessment does not overstate environmental benefit and that opportunities for further improvement are not prematurely excluded.
- **Strengthen Sacrifice Justifications**: Sacrifice estimates should be clearly documented with transparent assumptions, references to comparable costs or operational experience, and a clear distinction between incremental and baseline effort. Conservative framing should be avoided unless supported by evidence, and vague estimates should not be used to dismiss measures without adequate rationale.

Those completing and reviewing ALARP assessments should be alert to signs of these manipulations. An overly rapid drop in residual impact/risk, repeated rejection of measures based on loosely justified sacrifice, or a pattern of assigning very high effectiveness scores with minimal explanation may indicate that the assessment is not being applied rigorously.

Maintaining a disciplined and transparent approach ensures that ALARP decisions genuinely reflect environmental performance that is ALARP, rather than merely defensible on paper. Annex 3 - Ensuring Integrity in ALARP Assessments provides the guidance that CGG gave its ALARP assessors and ALARP reviewers to ensure the integrity of the process.

6 ALARP Assessment – Impacts

Following the completion of the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4), and the subsequent full impact assessments (Appendices E1-9), this ALARP assessment covers the following impact pathways:

- Change to benthic habitat from anchoring.
- Change to local air quality, climate, or ecosystem dynamics from atmospheric emissions.
- Change to water quality, fauna behaviour, or physical condition from planned discharges.
- Change to the functions, interests, and activities from physical presence.
- Change in fauna behaviour, hearing capacity, or physical condition from underwater sound.
- Change in fauna behaviour from artificial light

The following sections of this document assess each impact pathway in turn.

6.1 Benthic Disturbance

This impact was assessed in the PEIRA. Initially, the following measure was adopted to remove this cause effect pathway: no anchoring permitted within the activity planning area. However, due to the possible deployment of anchored acoustic monitoring buoys as part of the Fauna Management Plan, this pathway re-emerged following updates to regulatory guidelines.

The nature and scale of this impact is so small and necessary for protection of an important species that an abbreviated demonstration is applied in this case.

The possible deployment of up to three anchored acoustic monitoring buoys is expected to result in localised, minor, and reversible disturbance to the seabed, with each anchor and associated gear occupying approximately 2 square metres. This scale and type of interaction is comparable to routine demersal fishing practices (e.g. lobster potting) already occurring in the area and does not involve dragging, excavation, or long-term placement.

Sensitive benthic habitats that would be unable to tolerate this extremely small disturbance are not expected to occur and routinely experience these impacts from fishing activities and vessel anchoring prolific in the areas the buoys are expected to be located.

The only control measure reasonable to adopt is a procedure to select deployment locations such that mapped features of ecological significance are avoided.

Given the very limited footprint, temporary nature of the interaction, the tolerance of the benthic habitat to these small-scale effects, and the benefits gained for marine fauna protection, no further control measures are reasonably practicable to reduce the environmental impact of anchoring. Alternative buoy designs (e.g. free-floating or mid-water) are not viable due to the need for positional stability in offshore conditions and would introduce operational reliability risks without meaningfully reducing environmental impacts. On this basis, the impact of benthic disturbance is ALARP.

6.2 Atmospheric Emissions

6.2.1 Baseline

Table F2-6 specifies the activity limitations, legislative requirements, and components of the implementation strategy elements have been considered in the establishment of a baseline impact level and baseline quantum of sacrifice.

Table F2-6 - Baseline Measures - Atmospheric emissions

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Exclusive Use of Marine Diesel Oil (MDO)	MDO is a low-sulphur fuel (<0.5% sulphur by mass) that complies with MARPOL Annex VI and Australian law. It avoids the need for exhaust gas cleaning systems and provides cleaner combustion than residual fuels.	High. This measure eliminates most sulphur oxide emissions and significantly reduces particulate and other noxious emissions. It is highly functional and reliable.
MDO-specific bunkering, fuel sampling, and quality verification	Ensures that only compliant fuel is used throughout the operation, minimising the risk of non-compliance and environmental breaches.	High. Provides independent verification of compliance and ensures emission reductions are consistently achieved across the duration of the survey.
Maintenance of compliant engines and emission control systems	Required to support the use of MDO and maintain combustion efficiency and emissions performance.	High. Enables consistent emissions reduction through proper engine function and compatibility with low-sulphur fuel.
Emissions recordkeeping and compliance verification	Administrative burden required to demonstrate compliance with MARPOL Annex VI. Forms part of legal obligations and ensures transparency and auditability.	Moderate. While indirect, this measure supports ongoing compliance and enhances the effectiveness of other baseline measures.

The outcome of the impact assessment (conducted in the PEIRA) for atmospheric emissions was that the effect was ranked as negligible (1) and the uncertainty ranked as low (2). Therefore, the residual impact after the application of baseline measures is 3.

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- The commitment to use Marine Diesel Oil (MDO) as the sole fuel type throughout the survey, which meets the requirements of Regulation 14 of MARPOL Annex VI and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983. This fuel contains no more than 0.5% sulphur by mass, in accordance with the International Maritime Organization's global sulphur cap and eliminates the need for exhaust gas cleaning systems. While MDO is significantly more expensive than higher-sulphur residual fuels, its exclusive use represents a necessary and unavoidable cost to comply with Australian law and international obligations.
- Additional costs included in the baseline sacrifice include MDO-specific bunkering, fuel sampling and quality verification, and the maintenance of compliant engine systems and emission controls. These measures are mandatory for lawful operation in Australian waters and form part of the base level of sacrifice.
- The administrative burden associated with emissions recordkeeping and compliance verification under MARPOL Annex VI is also included.

These combined costs and efforts form the cumulative baseline sacrifice, which is assigned a unit value of 1.0 in the ALARP assessment. This allows subsequent discretionary control measures to be evaluated proportionally.

6.2.2 Assessment

Table F2-7 shows the step-by-step process followed for the ALARP assessment of atmospheric emissions. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-7.

6.2.3 Consideration of Alternative, Additional or Improved Control Measures

In accordance with the ALARP assessment process, CGG has considered a range of additional, alternative, and improved control measures that might reduce atmospheric emissions beyond those already adopted in the baseline. While these measures were technically feasible in some instances, each was assessed in the context of the small residual impact remaining after implementation of the legally mandated baseline measures. As such, all were found to involve grossly disproportionate sacrifice relative to their marginal environmental benefit and were therefore rejected.

Advanced Emission Reduction Technologies

This option included the potential use of exhaust gas cleaning systems (commonly known as scrubbers), selective catalytic reduction (SCR) systems, and the retrofit of more environmentally advanced engines. These systems are proven in the maritime industry and can reduce emissions effectively when used with heavy fuel oils. However, in the context of this activity—where Marine Diesel Oil (MDO) is already in use and compliant with the 0.5% sulphur limit—the additional emissions reductions offered by such technologies are negligible. Retrofitting costs, downtime, integration risks, and increased operational complexity were assessed, and the measure sacrifice was estimated at 100.0, far exceeding any potential incremental benefit.

Alternative Fuels

The use of alternative fuels such as liquefied natural gas (LNG) or hydrogen was also considered as a substitution for MDO. These fuels can deliver cleaner combustion and reduced atmospheric emissions, especially when replacing residual or bunker fuels. However, the environmental benefits compared to already low-sulphur MDO are marginal in this context. Further, the technical and logistical challenges of adapting a seismic survey vessel to run on LNG or hydrogen—including lack of supply infrastructure, vessel compatibility, and regulatory hurdles—render this option technically unfeasible at present. The measure sacrifice was estimated at 200.0, due to the need for substantial capital investment and operational redesign.

These evaluations support the conclusion that no further practical control measures exist that could meaningfully reduce atmospheric emissions from the Regia MSS without incurring clearly excessive cost, effort, or operational compromise. The residual impact has therefore been reduced to ALARP.

Table F2-7 - Step-by-step ALARP Assessment - Atmospheric Emissions

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	3	1	**1**	The baseline measures collectively provide a comprehensive and enforceable framework for minimising emissions. The use of low-sulphur Marine Diesel Oil (MDO) ensures compliance with MARPOL Annex VI and significantly reduces sulphur oxide and particulate matter emissions. Mandatory bunkering controls, fuel sampling, and maintenance of compliant engine systems ensure these reductions are reliably achieved. Recordkeeping and verification measures add an administrative compliance layer, ensuring transparency and auditability. These baseline measures are highly effective and have little to no dependency on other systems. Their effectiveness is primarily driven by their legal status.	The baseline sacrifice includes the higher cost of MDO relative to residual fuel oils, expenses associated with fuel sampling and quality verification, and the ongoing maintenance of compliant engine systems. These costs are substantial and unavoidable, as they represent legal minimum standards for operation in Australian waters. The administrative burden associated with emissions recordkeeping under MARPOL Annex VI also adds time and resource requirements. These baseline costs are assigned a unit value of 1.0 and reflect a significant proportion of total emissions mitigation expenditure.
2	CGG Marine Assurance System	Company-wise system that ensures all emissions-related compliance processes and vessel audits are completed.	3	90%	2.7	0.3	0.1	**1.1**	This system supports emissions management by ensuring that environmental requirements are embedded within vessel selection, auditing, and operational readiness procedures. It includes pre-survey OVID-style inspections, vessel vetting, crew briefings, and assurance reviews. Its functionality is high because it enhances implementation of already effective control measures. It is	The Marine Assurance System is part of CGG's existing operational framework, meaning much of its structure is already established. While not insignificant, the incremental cost of applying it to this specific emissions context is relatively low. It involves internal auditing and oversight rather than the deployment of new systems or equipment. However, the measure requires experienced personnel and

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
									reliable and compatible with all baseline measures, ensuring that procedural and technical standards are upheld consistently across the operation. However, the marginal benefit is small due to the already low residual impact following baseline compliance.	planning effort. Given the minimal remaining impact to be reduced (Res = 1.0), even this relatively small additional cost is proportionally significant—but it remains reasonable. This justifies its adoption.
3	Energy Efficiency Operating Procedures	Procedures to reduce emissions through fuel-efficient operations (e.g., speed optimisation, load balancing).	0.3	30%	0.09	0.21	1.5	**2.6**	Energy Efficiency Operating Procedures (EEOPs) are rated at 30% effectiveness due to their capacity to reduce emissions further by lowering fuel consumption. They improve operational efficiency during transits, standby, and low-activity phases. Their performance is functional, available, and highly compatible with existing baseline measures.	The cost of implementing EEOPs is minimal however a seismic survey relies on keeping a true heading at a given speed to improve data quality. Therefore, implementing these procedures for the duration of the survey is of high cost and so is given a sacrifice score of 1.5.

6.2.4 Results

Figure F2-1 displays the progressive ALARP assessment for the impact pathway of atmospheric emissions, plotting impact reduction against cumulative sacrifice. Each point on the graph represents a control measure (or group of measures), beginning with baseline compliance and progressing through discretionary enhancements.

The baseline measures achieve most of the impact reduction and are plotted at a cumulative sacrifice of 1.00. These are considered essential for lawful operations and establish the starting point of the assessment.

The next control measure, CGG Marine Assurance System, adds oversight and enforcement capacity, resulting in a modest additional reduction in residual impact. Its low cost and functional compatibility with existing systems place it well before the ALARP threshold, indicating that it is a proportionate and reasonable measure.

A third measure, Energy Efficiency Operating Procedures (EEOPs), adds minimal cost and further reduces emissions by optimising vessel operations (e.g. speed adjustments and load balancing). However, due to the already low residual impact after baseline mitigation measures, and the high relative sacrifice, the environmental benefit of this control measure is beyond the ALARP threshold drawn at the point of diminishing returns and thus has not been adopted.

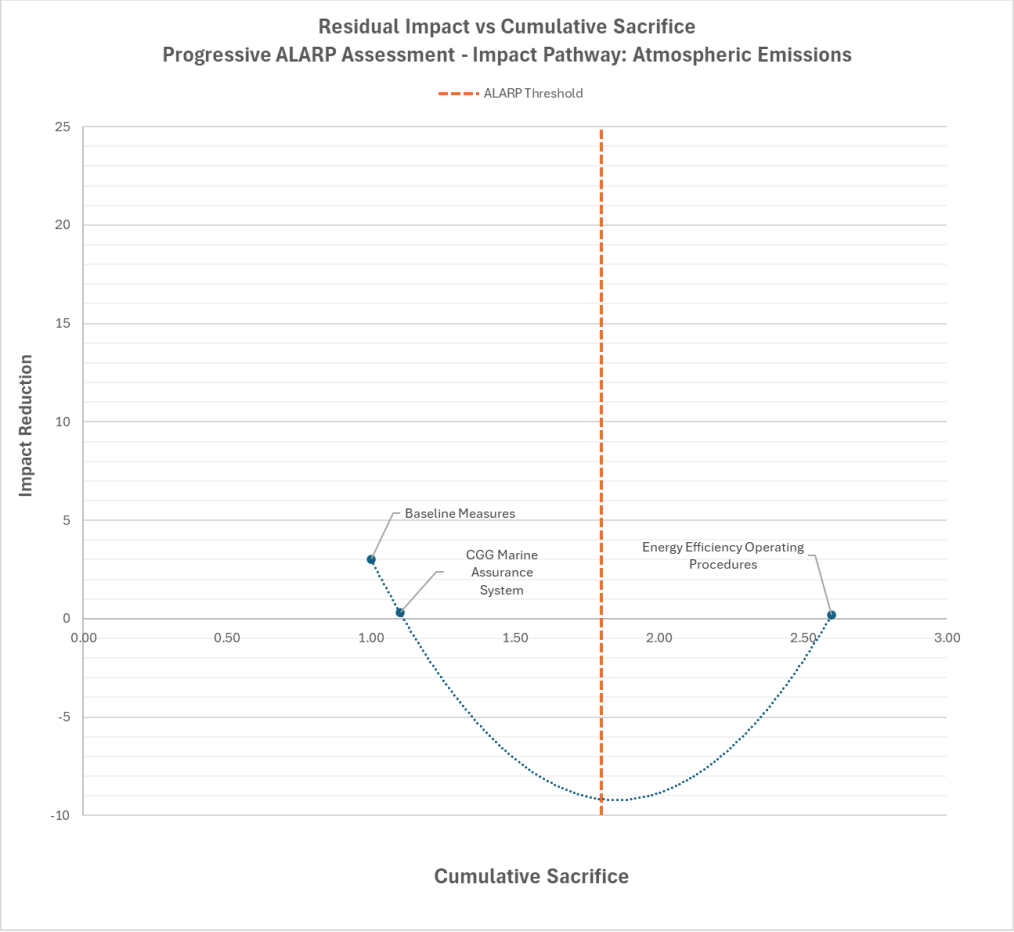


Figure F2-1 - Residual Impact vs Cumulative Sacrifice for Atmospheric Emissions. This chart illustrates the diminishing environmental benefit of additional control measures as cumulative sacrifice increases.

Figure F2-2 presents a combined view of the residual impact reduction (bar) and cumulative sacrifice (line) associated with each control measure or group adopted or considered in the ALARP assessment for atmospheric emissions.

The baseline measures, shown as the first and tallest bar, deliver the greatest reduction in atmospheric emissions, with a residual impact reduction value of 3.0. The CGG Marine Assurance System, reflected as the second bar, contributes a modest additional environmental benefit by ensuring that emissions-related protocols are consistently implemented and audited. The associated sacrifice is small relative to the benefit, resulting in a proportionate and adopted control measure.

The third measure considered aims to reduce emissions further by optimising vessel operation (e.g. speed adjustments and fuel usage efficiency). However, this measure provides only marginal benefit in the context of already low residual emissions and incurs a relatively high cumulative cost. As indicated by the steep rise in the cumulative sacrifice line with little corresponding impact reduction, EEOPs were rejected as grossly disproportionate.

This chart provides visual confirmation that most of the emissions reduction is achieved through baseline compliance, with only one additional discretionary measure adopted, and further options confirmed to show gross disproportion.

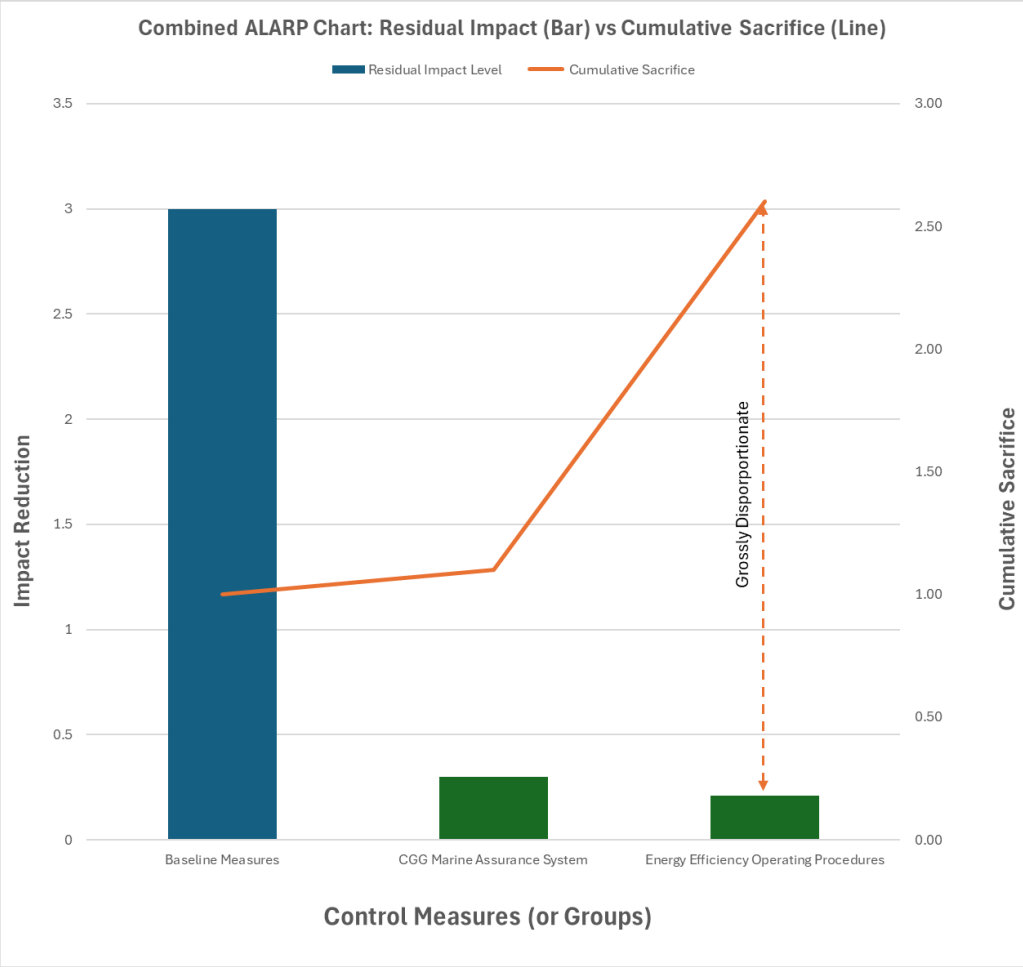


Figure F2-2 - Combined ALARP Chart: Residual Impact (Bar) vs Cumulative Sacrifice (Line) for Atmospheric Emissions. Most impact reduction is achieved through baseline measures.

6.3 Planned Discharges

6.3.1 Baseline

Table F2-8 specifies the activity limitations, legislative requirements, and components of the implementation strategy elements have been considered in the establishment of a baseline impact level and baseline quantum of sacrifice.

Table F2-8 - Baseline Measures – Planned Discharges

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
CGG Marine Assurance System	Ensures compliance with all relevant maritime discharge standards including MARPOL and Marine Orders. Includes vessel vetting, pre-survey inspections, and operational assurance processes.	High. This measure ensures planned discharges such as bilge and wastewater are managed in accordance with international law. It is functional, reliable, and compatible with all vessel operations.

The outcome of the impact assessment (conducted in the PEIRA) for planned discharges was that the effect was ranked as negligible (1) and the uncertainty ranked as low (2). Therefore, the residual impact after application of baseline measures is 2.

The quantum of sacrifice for complying with the baseline has been calculated and includes:

- The implementation of the CGG Marine Assurance System, which includes vessel audits, discharge protocol reviews, and contractor pre-qualification requirements.
- Administrative oversight to ensure discharge equipment and handling procedures meet legal standards.
- Ongoing operational effort to maintain vessel discharge performance in compliance with regulatory expectations.

These measures are embedded into CGG's broader management system and are well established. Accordingly, the cumulative baseline sacrifice is assigned a value of 1.0 to enable proportional comparison with subsequent measures.

6.3.2 Assessment

Table F2-9 shows the step-by-step process followed for the ALARP assessment of planned discharges. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-9.

Table F2-9 - Step-by-step ALARP Assessment – Planned Discharges

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	2	1	**1**	The CGG Marine Assurance System ensures that all discharges are compliant with international maritime discharge standards (e.g. MARPOL). It is functional, reliable, and fully integrated with CGG's existing assurance processes, including vessel audits, inspections, and contractor pre-qualifications.	Assigned a value of 1.0 to reflect the normal cost of prequalification, discharge compliance verification, and vessel inspection protocols. These are routine and embedded company practices and not seen as discretionary expenditure.
2	Enhanced Wastewater Treatment	Advanced filtration or chemical treatment systems to reduce pollutants in discharged water.	2	5%	0.1	1.9	8	**9**	Enhanced wastewater treatment systems offer marginal additional reductions in trace pollutant concentrations but provide negligible environmental benefit due to already low-volume and regulated discharges. The systems are technically feasible but redundant in this context.	These systems are expensive to retrofit, especially for seismic support vessels, and involve increased maintenance costs. With little added environmental benefit, the sacrifice is grossly disproportionate and is assigned a value of 8.0.
3	Zero Discharge Systems	Full containment and post-survey disposal of wastewater and bilge.	1.9	5%	0.095	1.805	8	**17**	Zero discharge systems eliminate planned discharges by capturing and storing all waste fluids for later disposal. However, given the small volumes and low risk, the environmental benefit of this approach is negligible.	These systems are proven in other industries but require costly modifications and space onboard. The operational burden and poor cost-benefit ratio render the measure grossly disproportionate, with a sacrifice rating of 8.0.

6.3.3 Consideration of Alternative, Additional or Improved Control Measures

In accordance with the ALARP assessment process, CGG considered a range of additional, alternative, and improved control measures that might reduce the impact associated with planned discharges beyond those already achieved through the baseline. Given the low level of residual impact, all measures considered were determined to offer negligible benefit or involve grossly disproportionate sacrifice.

Recycling and Reuse

This option explored the potential for onboard water recycling systems to reduce the volume of planned discharges. However, due to the low discharge volumes associated with this activity and the complexities involved in installing and maintaining such systems aboard seismic vessels, the net benefit was found to be negligible. The measure sacrifice was estimated at 0.8. Additionally, human health and hygiene considerations added complexity and risk. The measure was rejected.

These evaluations support the conclusion that the residual impact from planned discharges during the Regia MSS has been reduced to ALARP.

6.3.4 Results

Figure F2-3 illustrates that the residual impact after applying the baseline measures is already low (assigned a value of 3). Two additional control measures were evaluated to determine whether further reductions could be justified. However, these measures provide only marginal environmental benefit while introducing substantial additional cost and complexity.

Despite their technical feasibility, the environmental benefit curve clearly flattens after the baseline, and both additional measures fall well beyond the ALARP threshold indicated on the graph. This shows that the cumulative sacrifice required to adopt these measures is grossly disproportionate to the limited improvement in environmental outcome they would deliver. As such, no further measures are warranted, and the impact of planned discharges is considered reduced to ALARP.

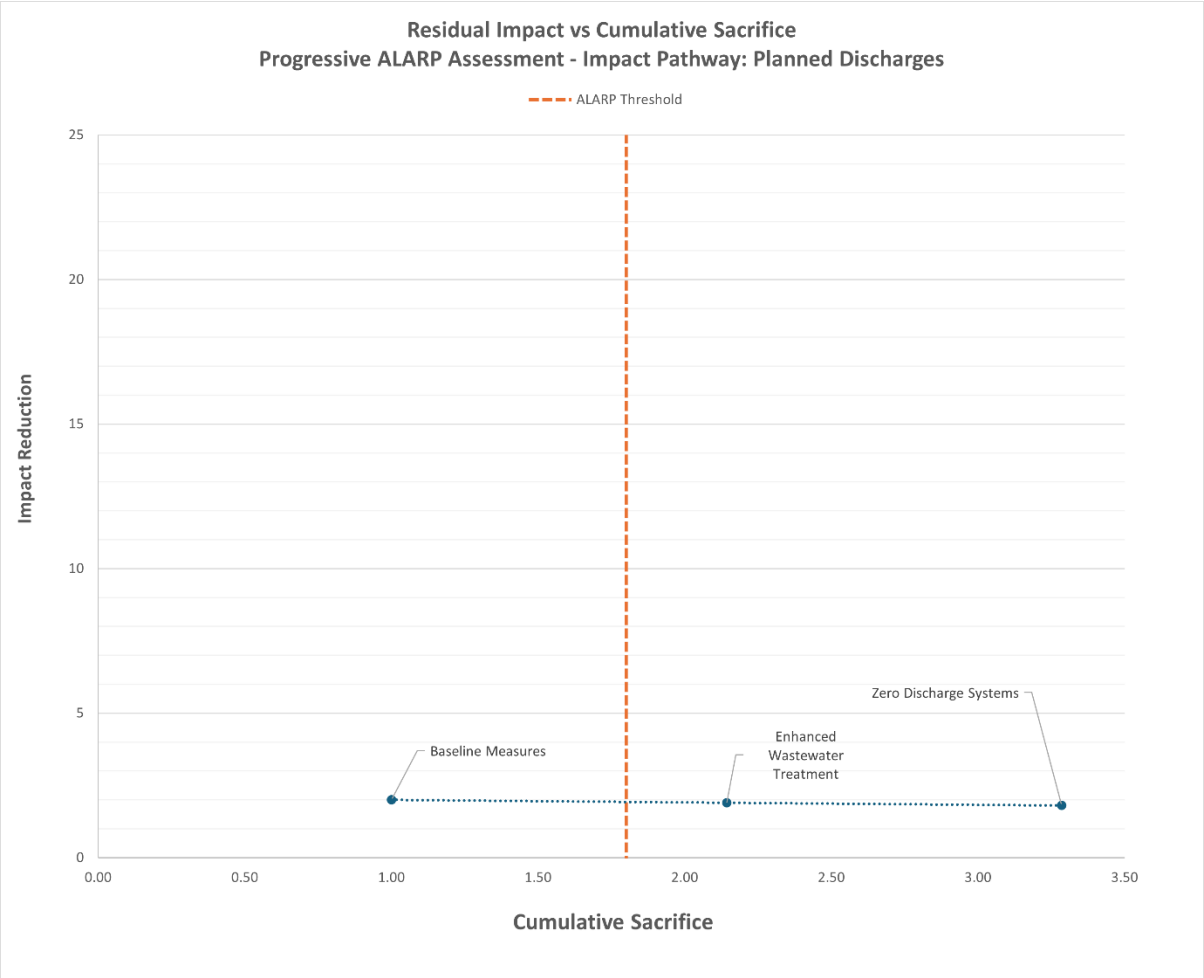


Figure F2-3 -Residual Impact vs Cumulative Sacrifice – Planned Discharges. The graph illustrates the progressive reduction in impact from planned discharges as control measures are considered, plotted against the cumulative sacrifice required to implement each measure.

Figure F2-4 is a combined ALARP chart which presents both the residual impact reduction (bars, left axis) and the cumulative sacrifice (line, right axis) for control measures addressing planned discharges. The baseline measures achieve a substantial reduction in impact with minimal sacrifice. The next two measures offer almost no additional reduction in impact (as they target discharges already reduced to minimal levels) but incur increasingly significant costs. The graph confirms that both control measures clearly exceed the point of gross disproportionality. This graph reinforces that, for this impact pathway, environmental outcomes are best managed through compliance with baseline maritime discharge standards and oversight mechanisms, without the need for more extreme and costly measures.

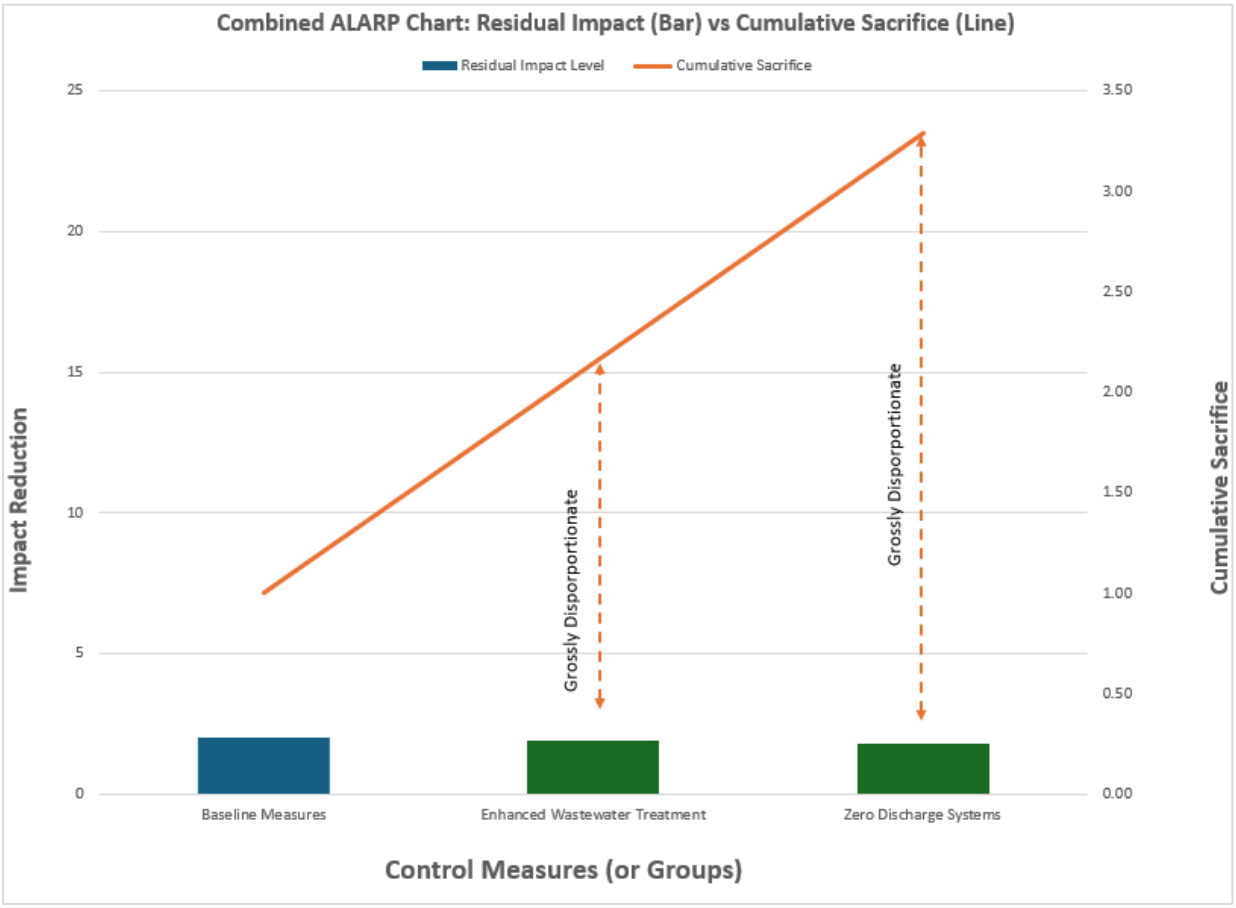


Figure F2-4 - Combined ALARP Chart – Planned Discharges. This chart overlays residual impact levels (bars) with cumulative sacrifice (line) across control measures.

6.4 Physical Presence

6.4.1 Baseline

Table F2-10 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline impact level and baseline quantum of sacrifice.

Table F2-10 - Baseline Measures - Physical Presence

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Activity limitations	The activity limitations derived through consultation have ensured that it is possible for the survey to be undertaken in a manner that minimises interference with other marine users.	These commitments provide certainty to other marine users and keep the impacts of physical presence to a minimum.
CGG Marine Assurance System	This measure includes the CGG Technical Operations Manager and the Quality Control Representative along with all the practices and processes required to safely undertaken the activity. It is considered by CGG as integral to undertaking any activity.	It is in CGG's interests to cooperate with other marine users and CGG's and its contractors are experienced in marine operations.
Support Vessel	The support vessel is another company minimum standard and works to remove obstructions and communicate with other marine users. It'll be partly responsible for implementing the On-Water Communications Plan.	This measure ensures the uncertainty levels associated with this impact are kept at low levels through communications on the water and forward planning with other marine users.
Consultation Management System	The CMS ensures that multiple forms of communication are used to compliment the on-water comms efforts. This measure provides forward operations look ahead notifications to those who requested it.	This measure increases the number of communications channels and provides forward notifications, adding to the effectiveness of the other measures.
Streamer Tail Buoys	This measure ensures that the ends of the submerged towed streamers can be detected.	This measure means that other marine users know which areas to avoid after the survey vessel has passed an area of interest and when it may be safe to return to the area.
Sail Line Plan	This document governs and coordinates the activity on the water and is agreed by CGG and all contracted parties prior to the commencement of the survey.	This document provides alignment between different vessels and contractors and therefore reduces impacts.

The outcome of the impact assessment for physical presence was that the effect was ranked as moderate (3) and the uncertainty ranked as low (2). Therefore, the residual impact after the application of baseline measures is six (6).

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- While the baseline measures adopted to manage physical presence are demonstrably effective, their present-day cost to CGG is relatively low. The activity limitations (such as exclusion zones, depth constraints, and block restrictions) are the result of design

compromises made through consultation. These limitations do not represent a direct financial outlay, but they restrict survey coverage and reduce the area of interest available to CGG, effectively diminishing potential data yield and commercial flexibility. This trade-off forms part of the embedded sacrifice.

- The other systems and plans included in the baseline—such as the Marine Assurance System, Consultation Management System, Sail Line Plan, and associated on-water procedures—are the product of years of operational experience. While they no longer carry high implementation costs, their effectiveness today reflects historical investment in systems development, staff training, and lessons learned through previous campaigns. In this sense, the cost has already been borne and is embedded in CGG's standard practice, even though the marginal cost of applying them to the Regia MSS is little.

As a result, while these measures significantly reduce residual risk and contribute to the credibility of the baseline, only a small proportion of their historical cost is allocated to the baseline sacrifice in this ALARP assessment. The cumulative baseline sacrifice is therefore assigned a conservative unit value of 1.0, with the understanding that the cost-efficiency of these measures is high due to CGG's prior experience and integration of these processes into standard operations. These combined costs and efforts form the cumulative baseline sacrifice, which is assigned a unit value of one (1) in the ALARP assessment. This allows subsequent discretionary control measures to be evaluated proportionally.

6.4.2 Assessment

Table F2-11 shows the step-by-step process followed for the ALARP assessment of physical presence. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-11.

Table F2-11 - Step-by-step ALARP Assessment – Physical Presence

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness Section 5.4.3 Disc	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	6	1	1	The baseline measures include a combination of activity limitations and procedural systems designed to minimise interference with other marine users. This includes spatial restrictions developed through consultation, CGG's Marine Assurance System, the use of a support vessel, tailored on-water communications protocols, and notification systems via the Consultation Management System. Collectively, these controls are highly effective due to their compatibility, availability, and the way they operate as integrated standard procedures.	The baseline sacrifice reflects the accumulated investment CGG has made in operational systems, consultation processes, and support infrastructure over time. While the marginal cost of their implementation on any single project is relatively low, they represent years of refinement and are treated here as the foundational cost of doing business responsibly.
2	Adjustment Protocol	This procedure ensures monetary adjustment for any unreasonable interference with other marine users.	6	90%	5.4	0.6	2	3	The Adjustment Protocol provides financial assurance to other marine users in the event of unreasonable interference. Its functionality, availability, and compatibility make it highly effective at mitigating conflict and maintaining good faith with stakeholders. By offering a transparent and pre-agreed resolution pathway, it significantly reduces the impact of spatial overlaps and conflict escalation.	This is primarily an administrative measure, requiring upfront development of a protocol and internal commitment to follow through. Its costs are minor relative to the overall activity budget and are more than offset by the value of resolving disputes efficiently without recourse to litigation or lengthy negotiation.
3	Fisheries Liaison Officer (FLO)	This is a dedicated competent person available in a local port able to be responsive to any immediate concerns, provide a focal point for queries, and support	0.6	90%	0.54	0.06	0.05	3.05	The FLO serves as a direct point of contact for fishers and other marine users. Its functionality, availability, and independence make it a highly responsive and effective control measure. The ability to provide real-time support, local presence, and continuity across interactions contributes to strong stakeholder confidence and early resolution of concerns.	The measure has a low financial footprint—generally requiring part-time engagement of a locally based professional—but delivers high returns in maintaining relations and avoiding unnecessary delays. Its incremental sacrifice is minimal and fully justified by its stakeholder-facing role.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness Section 5.4.3 Disc	Sacrifice Quantum
		compensation claims.								
4	Petroleum SIMOPS Plan	Ensures coordination of activities with other titleholders in the region to minimise interference.	0.06	90%	0.054	0.006	0.025	3.10	The SIMOPS plan ensures operational coordination with other offshore petroleum activities, reducing the risk of conflict or safety issues. Its functionality, compatibility, and survivability in complex operating environments make it a trusted tool for managing shared marine spaces. It formalises what might otherwise be ad hoc communications, preventing misalignment or unintentional interference.	This control is primarily procedural, building on existing industry practice. It requires updates to project documentation and alignment with third-party operational schedules. The cost is minor and primarily borne during planning, making it a low-burden but high-value measure.
5	Sea Country Protection Plan	This measure facilitates the identification and management of new information, relevant to the activity, through collaboration of First Nations people who decide to be part of the program.	0.006	50%	0.003	0.003	0.10	3.2	The Sea Country Protection Plan provides a culturally appropriate pathway for Traditional Owner groups to engage with CGG regarding marine access or presence. It reflects availability, independence, and compatibility with other stakeholder management processes. While not a control measure, it meaningfully reduces potential social impact.	This program is modest in cost, generally involving coordination with internal or contracted community engagement professionals. It strengthens CGG's social licence to operate and ensures marine access issues are managed respectfully and constructively.

6.4.3 Consideration of Alternative, Additional or Improved Control Measures

Given the inherent nature of marine seismic surveys, the physical presence of vessels and equipment in the marine environment cannot be eliminated. As such, a comprehensive suite of control measures has already been adopted to minimise the impact of this unavoidable presence on other marine users. These include spatial planning commitments, dedicated consultation systems, real-time communications, and commercial resolution mechanisms. The adopted measures are well-established, operationally proven, and tailored to the survey context, providing high levels of intrinsic effectiveness with relatively low sacrifice. Because physical presence is not a variable that can be managed away — only managed better — there are no reasonable additional, alternative, or improved control measures that could further reduce this impact without introducing significant duplication, operational inefficiency, or grossly disproportionate cost. Consequently, no further control measures have been considered in this assessment.

6.4.4 Results

Figure F2-5 illustrates the stepwise reduction in residual impact from the physical presence of the seismic survey, plotted against the cumulative sacrifice associated with each adopted control measure. The downward-sloping polynomial trendline indicates that successive measures continue to achieve meaningful reductions in impact up to a clear point of diminishing returns. Notably, the *Adjustment Protocol* provides the most significant marginal reduction following the baseline measures, highlighting its critical role in managing and resolving interference with other marine users. This measure alone substantially decreases the residual impact through a transparent and proactive compensation mechanism, enabling early resolution of conflict. The *Fisheries Liaison Officer*, *Petroleum SIMOPS Plan*, and *Sea Country Protection Plan* each provide incremental benefits that fine-tune engagement with different stakeholder groups. All adopted measures fall well within the ALARP threshold, demonstrating that each contributes proportionate benefit in exchange for relatively low sacrifice. The assessment confirms that impacts from physical presence have been reduced to ALARP through targeted, effective, and reasonably practicable controls.

Figure F2-6 presents the residual impact reductions (bar graph) and the associated cumulative sacrifice (line graph) for control measures adopted to manage the impact pathway of physical presence. The baseline measures provide the largest single reduction in impact, with the *Adjustment Protocol* contributing the next most significant improvement through clear, functional mechanisms for resolving interference with other marine users. With baseline measures adopted and the adjustment protocol in place there is almost no residual impact to manage.

Subsequent measures — including the *Petroleum SIMOPS Plan* and *Fisheries Liaison Officer (FLO)* — provide smaller but still meaningful reductions, with relatively low additional sacrifice. Notably, the final two measures — the *Sea Country Protection Plan* and the *FLO* — sit beyond the point of diminishing returns, where cumulative sacrifice begins to exceed proportionate environmental benefit. Although these final measures may be considered grossly disproportionate by standard ALARP thresholds, they have been adopted regardless to reflect commitments made through consultation and to ensure environmental performance outcomes can be easily achieved.

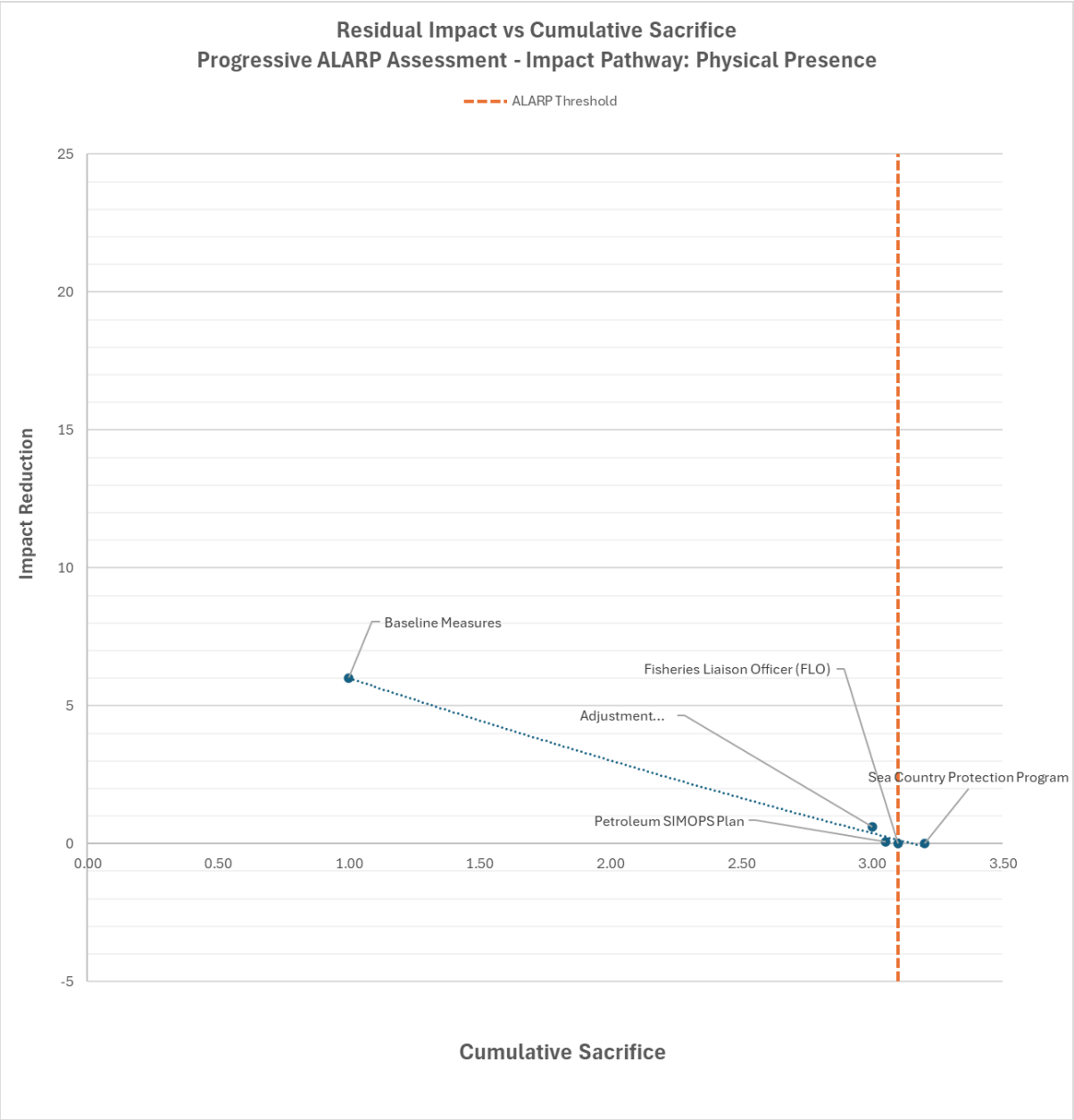


Figure F2-5 - Residual Impact vs Cumulative Sacrifice – Physical Presence: This graph presents the progressive reduction in residual impact from the survey's physical presence against the cumulative sacrifice required to implement each adopted control measure. The curve demonstrates meaningful stepwise reductions, with the Adjustment Protocol providing the largest marginal improvement following baseline commitments. All measures were adopted prior to reaching the ALARP threshold, confirming that the impact has been reduced as low as reasonably practicable.

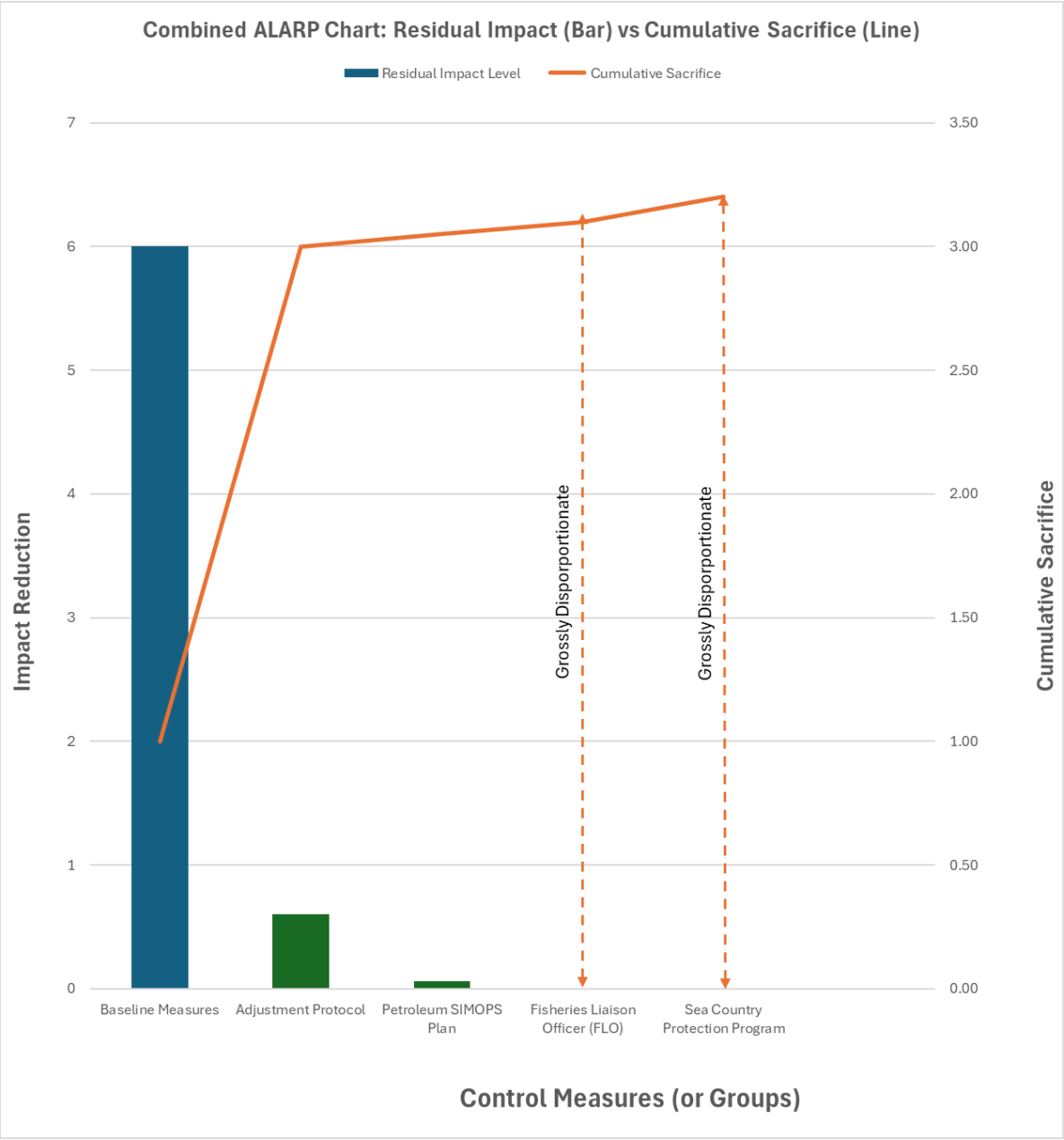


Figure F2-6 -Combined ALARP Chart – Physical Presence: This chart displays the residual impact reductions (bars) and cumulative sacrifice (line) associated with each adopted control measure. It highlights the dominant role of baseline measures and the substantial benefit of the Adjustment Protocol. Despite providing only marginal additional reduction in impact, the final two measures were adopted to support equity, responsiveness, and stakeholder inclusion beyond the point of strict cost-benefit proportionality.

6.5 Underwater Sound

The impact assessment for sound was separated into seven (7) individual impact assessments due to the complexity of the pathway between sound and each receptor category. The outcome of the impact assessments for underwater sound were as follows:

Table F2-12 - Impact Assessment Rankings - Underwater Sound

Receptor	Effect	Uncertainty	Predicted Impact Level
Plankton	Minor (2)	Low (2)	Low (4)
Fish	Minor (2)	Medium (3)	Medium (6)
Invertebrates	Minor (2)	Medium (3)	Medium (6)
Birds	Minor (2)	Medium (3)	Medium (6)
Turtles	Minor (2)	Low (2)	Low (4)
Marine Mammals	Moderate (3)	High (4)	High (12)
Diving, Surfing, & Swimming	Negligible (1)	Low (2)	Low (3)

While each of these receptors has different sensitivities and modes of exposure, a detailed ALARP analysis for each individual receptor group is neither practical nor proportionate – particularly when the control measures adopted for marine mammals provide a conservative and encompassing form of impact reduction for all others.

Marine mammals have been selected as the representative or surrogate receptor group for this assessment because they are both the most acoustically sensitive and the most legislatively protected. The impact pathway for marine mammals was assessed as carrying the highest residual impact ranking (12). As such, control measures required to reduce impacts to marine mammals are more stringent than those that would be warranted for less sensitive receptors. Further supporting this approach, the control measures act at the source-pathway level, reducing the intensity, timing, and proximity of acoustic emissions in a way that inherently reduces exposure for all other receptor groups.

By addressing the highest impact pathway to the most sensitive receptor group and demonstrating that these control measures achieve ALARP for marine mammals, it is reasonable to infer that impacts to all other receptors from underwater sound have also been reduced to ALARP.

6.5.1 Baseline

Table F2-13 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline impact level and baseline quantum of sacrifice.

Table F2-13 - Baseline Measures – Underwater Sound

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Avoided core Blue Whale and SRW seasons through shoulder-period scheduling	Seasonal timing selected to avoid overlap with peak presence of either species while maximising survey efficiency.	Shoulder-season scheduling reduces overlap with both Southern Right Whale and Blue Whale peak periods. This activity design element avoids the need for active mitigation during known high-risk periods. Independent of equipment-based controls and highly compatible with operational efficiency.
EPBC Act Policy Statement 2.1 (Part A) Procedures	Mandatory under national policy; includes pre-start, start-up, and shut-down procedures to minimise acoustic impacts on whales.	Reduces the likelihood of auditory injury and behavioural disturbance through procedural controls. Implements structured pre-start, soft-start, and shutdown procedures that directly interrupt the acoustic exposure pathway during sensitive periods. High functionality and reliability, as procedures are well-defined, tested, and incorporated into national policy. Compatible with vessel operations and implemented independently through Fauna Management Plans.
EPBC Regulations Part 8: Vessel and Operating Procedures	Legal requirement; governs vessel behaviour around cetaceans to minimise disturbance.	Provides physical buffer zones around cetaceans that reduce proximity risk and behavioural disturbance. These requirements are mandatory and standardised, ensuring reliability and compatibility across vessel types. Functional and easily implemented by vessel crew.
Fauna Management Plan (FMP)	Industry standard and operational document that ensures detection, classification, and response protocols are implemented for marine mammals.	Serves as the core implementation document for species detection and mitigation. Ensures standardised response protocols are in place and followed. High functionality and compatibility with marine operations. Reliable framework supporting consistent performance.
Marine Fauna Observers (MFOs)	Highly trained observers ensure continuous real-time monitoring of whale presence to inform adaptive mitigation measures.	Ensures real-time detection and behaviour monitoring. Visual detection range is typically up to 5 km under good conditions but limited at night or in poor weather. MFOs are experienced and trained, offering high reliability and independent verification. Functionality is high during daylight but reduced during dark hours.
Application of DMAC 12 Guidelines – Management of Seismic Survey Interactions with Diving Operations	Adopted to ensure diver safety during seismic operations by avoiding acoustic interference with known commercial or scientific diving activities. This measure reflects international best practice for managing sound-related interactions with divers and aligns with CGG's duty of care obligations.	This measure functions by providing pre-survey notification and real-time coordination with known diving operations in the area. The DMAC 12 guidelines are well-established and widely recognised across the industry, offering high functionality and reliability. They are also independent of other mitigation measures. Because divers are not present in large numbers and most areas of operation are far offshore, the application of this measure provides a highly effective safeguard at relatively low operational cost.

The quantum of sacrifice required to implement the baseline control measures for underwater sound is the most substantial of any impact pathway considered in the ALARP assessment. These measures reflect both legislative obligations and adopted standards that significantly shape the design, duration, and conduct of the survey. The Fauna Management Plan (FMP), which operationalises EPBC Policy Statement 2.1, includes detailed pre-start, soft-start, and shut-down procedures. These procedures require continuous monitoring and, when triggered, lead to temporary cessation of the seismic source, introducing vessel downtime and potential delays to the survey. Each shutdown and start-up cycle can result in the loss of optimal acquisition conditions and increased total survey duration.

The requirement for MFOs demands the deployment of trained personnel and adds direct labour, training, and compliance monitoring costs. Additionally, the shoulder-season scheduling to avoid peak presence of Blue Whales and Southern Right Whales limits the available acquisition window, increasing the risk of weather-related disruption and reducing scheduling flexibility. These constraints translate to higher operational costs due to narrowed survey windows and increased likelihood of weather-induced downtime.

Collectively, these measures form a baseline that carries a significant cumulative sacrifice, not just in financial terms, but in terms of lost efficiency, reduced flexibility, and constrained survey design. However, they also deliver a high degree of effectiveness and reflect CGG's commitment to regulatory compliance and environmental protection. This baseline is assigned a unit value of 1.0 in the ALARP assessment, representing the minimum necessary sacrifice to meet legal and industry standards while setting the platform for evaluating discretionary additional controls.

6.5.2 Assessment

To support the ALARP assessment for underwater sound emissions, a dedicated review of potential mitigation technologies and practices was conducted and documented in Appendix F5 – Marine Mammal Detection Technology Assessment. The purpose of that appendix was to ensure that a wide range of available, emerging, and alternative control measures were identified and considered as part of the overall ALARP assessment.

The inclusion of Appendix F5 in the submission does not imply that all listed technologies or methods require detailed assessment within the ALARP process. Rather, the appendix served as a scoping and input tool, informing the structured, step-by-step ALARP process by ensuring that no obvious or commonly cited mitigation approach was overlooked without consideration.

It is important to clarify that an ALARP assessment does not require exhaustive analysis of every conceivable control measure. Instead, the process is intended to identify and adopt those measures that provide clear, demonstrable reductions in impact – unless the cost, time, or effort required to implement them would be grossly disproportionate to the environmental benefit they offer. Once the assessment shows that diminishing returns have been reached, and that further mitigation options provide no material improvement or involve clearly disproportionate sacrifice, then the ALARP threshold has been satisfied.

Table F2-14 shows the step-by-step process followed for the ALARP assessment of underwater sound. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-14.

Table F2-14 - Step-by-step ALARP Assessment – Underwater Sound

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	12	1.00	1.00	Baseline measures represent the full suite of mandatory controls under law and guidance, including implementation of exclusion zones, shutdown procedures, and seasonal timing restrictions. These controls act directly at the source and through procedural intervention. They are highly functional, independently applied, and broadly compatible across the vessel systems. Their consistent use over multiple surveys and refinement through experience provides high reliability. As such, the baseline effectiveness is considered high.	This baseline includes significant embedded costs such as downtime from shutdown procedures, additional personnel for MFOs and implementation of legislative compliance systems. The cumulative effort to design, coordinate, and deliver baseline measures is taken as a unit value of 1.00, representing substantial but unavoidable cost of compliance.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
2	Towed PAM	Towed PAM equipment and PAM detection monitors	12	50%	6	6	0.19	1.19	Towed PAM enables continuous underwater acoustic monitoring for marine mammal vocalisations, especially in low-visibility conditions or at night. Its effectiveness may be limited by background noise, vocalisation behaviour of species, and operational interpretation. However, the extended range of >10 km from the sound source makes it a valuable addition to the suite of detection lines of evidence. To add to its efficacy, it functions independently from visual observation, is available and widely deployed in the industry, and is compatible with vessel systems. A 50% effectiveness rating reflects its supplementary but imperfect contribution alongside the baseline.	Towed PAM involves acquisition, calibration, and maintenance of acoustic arrays and analysis systems. Monitoring requires a dedicated operator. Compared to baseline systems, it adds a specialised capability with moderate effort and cost, estimated at 0.19 sacrifice units, reflecting modest additional investment relative to operational cost.
3	Night-time Procedures	Additional procedures associated with startups and shutdowns.	6	20%	1.2	4.8	0.13	1.31	Night-time start-up and shutdown procedures add precautionary steps when visibility is reduced, functioning by increasing the likelihood of avoiding interactions with undetected fauna. However, the absence of visual verification limits their reliability. They are procedural, compatible, and independently implemented, justifying a modest 20% effectiveness rating due to the inherent uncertainty they address.	Night-time procedures involve increased procedural checks, potential delays, and crew attention during hours of reduced visibility. Compared to the baseline, this measure has a minor cost impact but reduces operational flexibility. A sacrifice of 0.13 reflects time costs and complexity added to survey scheduling.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
4	Spotter Vessel	Additional vessel in the field with marine fauna observers and associated procedures	4.8	50%	2.4	2.4	0.58	1.90	A dedicated spotter vessel extends detection range spatially and provides redundancy to onboard MFOs. It increases visual coverage and facilitates early detection of whales at greater distances. The measure is highly functional and independent, and its reliability depends on weather and observer performance. MFO's onboard are still only effective during daylight hours and in good visibility. Given its increased surveillance capacity, a 50% effectiveness score is justified.	Operating a second vessel requires significant expense for chartering, crew, and fuel. It introduces logistical complexity and coordination challenges. However, the added coverage and redundancy make this one of the more expensive discretionary measures, assigned a sacrifice of 0.58, which is more than half the baseline cost.
5	Pre-start aerial overflight	Prior to commencing survey, a clearance survey of the starting line and the adjacent SRW BIA	2.4	5%	0.12	2.28	0.01	1.90	One gap in the measures considered so far is the need to understand the broader abundance of marine mammals prior to starting the survey and reliance on behavioural avoidance may occur. A pre-start aerial overflight allows a one-time broad area scan of the start location and SRW BIA. It is independent and functional but only offers a snapshot view, with limited duration of effectiveness. It is compatible with vessel-based procedures but overlaps with visual and acoustic systems. As such, its marginal contribution is rated at 5%.	Aerial overflights require aircraft, crew, and coordination. The pre-start flight is short-duration and planned, so the cost impact is minimal. The one-time cost is low, with a sacrifice unit of 0.01 though this is only justified because of the specific need identified.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
6	Acoustic Detection Units	3 x tethered buoys	2.28	40%	0.912	1.368	0.16	2.06	Acoustic detection buoys provide passive monitoring in fixed locations (e.g., adjacent to BIAs). They will be used specifically for protections for Southern Right Whales. They function independently from other control measures and enhance detection where vessel systems have gaps. Their effectiveness depends on placement, detection range, and interpretation. They are reliable under good conditions and compatible with existing detection processes. Whilst the PAM technology being used is tried and tested, the application of the equipment on a tethered buoy is relatively untested. There are questions about the accuracy of detections in the presence of seismic sound. Overall, a 40% effectiveness score is a fair estimation of the gap filled by this measure.	Deployment and retrieval of three acoustic detection buoys involve equipment leasing, positioning planning, and monitoring by trained personnel. The measure introduces a high cost and resource burden, but compared to baseline costs, a sacrifice of 0.16 reflects that it is a targeted and limited additional layer of protection.
7	Relief PAM/MFO	Additional person to manage fatigue across observers	1.368	5%	0.0684	1.2996	0.04	2.10	The relief PAM/MFO role addresses fatigue and performance sustainability, following consultation with stakeholders. It ensures uninterrupted coverage and supports consistent quality in observations. Though it doesn't extend detection range, it increases reliability. For this reason, it is rated at 5%, reflecting its indirect but important contribution.	The relief observer role adds to crew numbers and logistics, increasing accommodation and scheduling demands. However, it directly responds to consultation feedback and supports implementation quality. The cost is modest (0.04) relative to the entire program and delivers resilience in staffing.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
8	Support personnel	Whale expert panel, Environment Officer, Survey Environment Advisor	1.2996	80%	1.03968	0.25992	0.09	2.20	The whale expert panel, Environment Officer, and Survey Environment Advisor contribute to strategy, compliance, and real-time decision-making. They enhance implementation quality and adaptiveness of measures. These roles operate independently and are compatible with all other systems. Their support significantly boosts effectiveness of procedural measures, justifying an 80% effectiveness rating.	Support personnel are already part of broader environmental and safety programs, so costs are shared across compliance efforts. Still, dedicated environmental roles and expert panels require coordination, meetings, and operational availability. A 0.09 sacrifice unit captures this indirect but meaningful cost.
9	Additional overflights	A weekly overflight	0.25992	5%	0.012996	0.246924	0.08	2.27	Additional weekly overflights provide periodic updates on whale locations and may support a broader view of the departure of SRW and/or the arrival of PBW. They cannot verify previous detections and can only operate when weather conditions allow reducing their availability. Overflights also overlap with PAM and MFO functions. Their effectiveness is constrained by timing and redundancy, justifying a 5% score.	By this point in the ALARP assessment, the cumulative sacrifice has already surpassed the point at which further investments yield only marginal environmental benefit. The accumulated cost of multiple flights, along with the logistical burden of scheduling and weather dependency, outweighs the minimal incremental risk reduction. As such, the cost—although moderate on its own—is considered grossly disproportionate when viewed in the broader context of measures already adopted.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
10	PAM on the spotter vessel	Towed PAM equipment and PAM detection monitors on the spotter vessel	0.246924	50%	0.123462	0.123462	0.19	2.46	Deploying PAM on the spotter vessel extends passive acoustic coverage and improves detection in the survey area. It functions independently and adds resilience to the PAM system. However, it duplicates an existing function already integrated into the towed PAM system. A 50% effectiveness score is used to reflect improved coverage but not novel capability.	Adding PAM to the spotter vessel introduces a parallel monitoring system already available through towed PAM and static acoustic buoys. While it would improve redundancy, the benefit is marginal given the effectiveness of previously adopted measures. The cost—comparable to the original PAM system—adds significantly to the cumulative sacrifice without providing commensurate risk reduction. At this stage of the assessment, where the residual impact is already low, this duplicated capability represents a grossly disproportionate sacrifice.

6.5.3 Consideration of Alternative, Additional or Improved Control Measures

In accordance with good environmental practice and this ALARP process, a range of additional, alternative, and improved control measures were considered beyond those already included during stepwise assessment. Each control measure was evaluated in terms of its potential to further reduce impacts associated with underwater sound emissions, and its corresponding level of sacrifice. The following discussions outline the reasons why specific measures were either rejected, partially adopted, or deemed infeasible. In each case, consideration was given to the measure's functionality, availability, reliability, independence, compatibility with existing systems, and its cost-effectiveness relative to its environmental benefit.

Frequency Reducing Sound Source Technologies

The Bluepulse (©SERCEL) is a purpose-built acoustic source that is available as a 'new' installation or as an upgrade to existing systems. Its key innovation is minimizing high frequency emissions without compromising accurate and dependable results for seismic acquisition, hence reducing environmental noise impacts.

When comparing the source signature to a conventional airgun array the following can be observed:

- Source signatures are similar in the main seismic frequency band (~ 1-100Hz).
- The Bluepulse frequency spectrum is slightly more oscillatory (ringy) in the low frequencies which would be of concern for a high-end broadband seismic image.
- The Bluepulse frequency spectrum is flatter out to 80Hz not reflecting the traditional signature of a conventional source.
- The Bluepulse frequency spectrum is attenuated outside of the main seismic bandwidth (0-200Hz) which is deemed the (environmental) advantage of this method.

Bluepulse generates considerably less energy with each shot compared to a conventional source. Hence peak-to-peak energy for the Bluepulse is half that of a conventional array and the peak-to-bubble ratio is also significantly less. This suggests the Bluepulse is not as efficient, and the seismic pulse not as clean as a conventional source.

These performance characteristics are the major concern when considering the amplitude supported play of the Otway Basin in general, where high resolution, accurate imaging of the seismic amplitude is required, even more so into the deeper plays expected in the Regia area. Processing complexities in the Otway Basin stem from the hard carbonate seabed and shallow lithologies along with shallow Tertiary canyons.

Adequate energy from the seismic source is required to penetrate these shallow layers to image the zone of interest. Particular seismic attributes are needed to accurately characterise the gas prospect including far angle stacks which require more energy for imaging, especially with the longer streamer length needed to image under the shallow zones. Conventional air gun arrays have an evidentiary track record of meeting all the objectives required of seismic acquisition in the Otway Basin, including successful mitigation of environmental impacts.

A typical contractual standard for a conventional seismic source would be:

- A primary amplitude (peak) of ≥ 50.0 bar-m, a peak-to-peak amplitude of ≥ 100.0 bar-m, and a peak-to-bubble ratio of at least 25

Compare this with the Bluepulse;

- A primary amplitude (peak) of ≥ 30.0 bar-m, a peak-to-peak amplitude of ≥ 60.3 bar-m and a peak-to-bubble ratio of at least 12.3.

To utilise the Bluepulse in the Otway with a required degree of confidence it would need to be qualified against a conventional source. Multiple test lines would need to be shot with a full conventional source array and a full Bluepulse array so a direct comparison could be made to determine whether the final seismic image acquired by the Bluepulse contains all necessary information from the zone of interest. Without this qualification the seismic data would be sub-par and would need to be reacquired with all the issues that would ensue. The risk on the geophysical imaging side of utilizing this new technology is too high without more comprehensive testing to better understand the risk-reward outcomes. Environmental problems associated with conventional seismic have been previously addressed through a range of mitigation methods. If the Bluepulse technology is more extensively tested against industry standards and demonstrates equivalent outcomes it will likely become a system of choice going forward.

However, at this point-in-time the Bluepulse remains a new and relatively untested technology whose outcomes need to be more fully documented and tested. If the seismic source is unreliable it will lead to increased downtime, increased infill shooting and generally more time with the vessel in the field and more shots. A known, reliable conventional seismic source will lead to efficient acquisition with the vessel in field for the shortest time possible and the fewest shots. Therefore, Bluepulse technology has been rejected.

Alternative Acquisition Technology (Marine Vibrosis)

The use of marine vibrosis and other emerging alternatives to conventional airgun technology was also evaluated. These systems may emit lower peak sound levels and offer potential environmental benefits; however, they are not yet commercially mature or widely used in offshore seismic operations. More importantly, their long-term environmental impacts – particularly those associated with particle motion – are not well understood. As such, adopting these technologies would require significant further research, environmental assessment, and investment before they could be demonstrated to offer a net reduction in environmental impact. In this context, it is more prudent to manage the known risks of conventional acoustic sources using well-established and effective control measures. The option was therefore rejected as unfeasible/impracticable.

Bubble Curtains and Acoustic Blankets

Bubble curtains and acoustic blankets are widely used to attenuate underwater noise in point-source construction activities such as pile driving. However, their effectiveness depends on stationary deployment and consistent geometry, making them unsuitable for mobile activities such as seismic surveying. The moving nature of the Regia MSS sound source renders these technologies infeasible from both an operational and effectiveness standpoint. This measure was considered technically infeasible and excluded from further consideration prior to Step 2 of this assessment.

PAM via Third-Party Vessels

The option of utilising third-party or non-dedicated vessels to deploy PAM systems was assessed at Step 2 and again at Step 10 of this assessment. While these vessels may extend geographic coverage, their operational independence and the variability of equipment make the reliability and integration of detection data less certain. When compared to CGG's dedicated and well-integrated PAM installations, the marginal improvement was minimal. This measure was rejected based on reduced reliability and elevated uncertainty.

Infra-red Cameras

Infra-red (thermal) cameras were considered as an alternative and/or additional option at Step 2 for extending marine fauna detection into low-visibility and night-time conditions. However, their detection range—particularly for low-frequency cetaceans—is limited compared to PAM, and their performance offshore remains largely unproven. CGG has ongoing discussions with technology developers who acknowledge the technology is not yet commercially viable. Given the availability of more effective and established technologies already adopted in the baseline and in the steps that follow (e.g. PAM and trained MFOs), the marginal benefit of this equipment was not sufficient to justify its cost.

Drone Technology (Offshore)

Offshore drone platforms were reviewed as a possible enhancement to detection and identification capabilities of marine fauna, particularly during daylight hours. However, drones launched from the survey vessel are limited in range and do not offer significant gains beyond what trained MFOs already provide from elevated vantage points. Their added complexity and limited benefit rendered them a poor investment relative to existing detection systems. This measure was considered as an alternative at Step 3 and rejected.

Satellite Imagery for Whale Detection (Partial Adoption)

The use of satellite imagery to support whale detection was considered for inclusion as an additional line of evidence to inform pre-survey planning at Step 6. While satellite-based observation is not suitable for real-time mitigation due to limitations in spatial resolution, revisit frequency, and weather dependency, it may offer value as a pre-survey tool to identify areas of likely whale presence or absence in the weeks leading up to activity commencement and/or commencement of southerly migration out of the reproductive BIA. As such, CGG has chosen to partially adopt this measure by supporting a trial of satellite-based whale detection prior to the survey. The aim of this trial is to assess whether near real-time imagery, when combined with validated detection algorithms, can offer useful intelligence on whale distribution patterns. This information may assist in refining the initial sail line selection and pre-start procedures. The use of this technology will not replace existing mitigation measures but will complement them where feasible and subject to satellite availability and data quality. The limited cost and potential utility of this measure support its inclusion as a low-sacrifice, trial-based enhancement.

Drone Technology (Onshore)

Drone deployment from onshore positions near the Southern Right Whale Reproduction BIA presents an opportunity to supplement visual monitoring through behavioural observation and wider-area coverage.

Unmanned aerial vehicles (UAVs), drones, have rapidly emerged as an effective tool for marine mammal research, complementing traditional visual observation techniques for assessing whale abundance and distribution. UAVs can conduct large-scale aerial image-based surveys at a fraction of the cost of manned aircraft and without many of the associated safety risks (Koski et al., 2009; Hodgson et al., 2017). Their low operating cost also enables flexible survey designs, including simultaneous multi-UAV coverage. Although UAVs remain subject to aviation regulations and earlier models were range-limited, ongoing technological developments continue to expand their operational capacity.

Recent applications demonstrate their utility. Drone-based surveys in New South Wales covered 23 sites spanning 1,000 km and were found to be a cost-effective method for marine megafaunal assessments under suitable conditions (Kelaher et al., 2023). In South Australia, UAVs have been used to examine spatial relationships between SRW mothers and calves, providing insights into maternal behaviour (Nielsen et al., 2019). For small cetaceans, drone surveys have produced more accurate

population and behavioural data than traditional vessel-based approaches, including for Bottlenose Dolphin (*Tursiops truncatus*) (Fettermann et al., 2022).

Available evidence indicates that UAVs cause minimal disturbance to baleen whales, with studies showing very little drone-generated sound penetrates the water (Christiansen et al., 2016; Christiansen et al., 2020), and that any disturbance is likely minor compared to crewed aircraft or nearby vessels (Raoult et al., 2020). Drone-based observation therefore represents a less invasive alternative for monitoring marine mammals.

Operational challenges remain in sub-optimal weather, low light, high winds, and rough seas. A study in Norway evaluating UAV performance across 12 missions found that detection certainty varied between cetacean groups and was influenced by sea state, glare, and luminance, though overall UAVs were effective when environmental variability was considered (Aniceto et al., 2018).

As flight range, stability, and camera resolution improve, UAVs are becoming an increasingly reliable component of marine mammal monitoring programs. Integrated with traditional methods, UAVs can enhance detection reliability, broaden spatial coverage, and improve the overall effectiveness of marine mammal research and conservation.

Drones offer an alternative to traditional fixed-wing aerial surveillance. The following factors have been considered by CGG in the adoption of this control measure:

- **Cost Effectiveness:** Drone operations deliver substantially lower costs compared with fixed-wing aerial surveys. Traditional aerial monitoring requires aircraft charter fees, pilot and observer wages, fuel, and maintenance, all of which are costly and inflexible.
- In contrast, drone operations involve a small two-person crew and rechargeable batteries, with no airfield or refuelling requirements. The same budget that might fund a single weekly aircraft flight can typically support multiple drone sorties per day, resulting in increased observation hours and improved statistical reliability. Lower mobilisation and maintenance costs also make it feasible to extend the monitoring season or add additional sites without exceeding project budgets.
- **Flexibility in Short Weather Windows:** Drone crews can mobilise within minutes when short calm periods arise - conditions typical of southern coastal environments. Unlike fixed-wing aircraft, drones do not require prior aircrew scheduling or flight slot coordination. This rapid-deployment capability allows operators to take advantage of limited weather windows, maintaining continuity of observations that would otherwise be lost to forecast uncertainty.
- **Launch Site Adaptability:** Drones can be deployed from a wide range of accessible coastal vantage points - such as cliffs, beaches, or headlands - eliminating the need for distant take-off locations or transit over water. Launching near target habitats reduces flight time, increases efficiency, and enables adaptive survey coverage in response to dynamic whale distributions.
- **Station-Keeping and Behavioural Documentation:** Unlike aircraft, which must maintain forward motion and often circle targets, drones can hover motionless above sightings. This allows stable, repeatable documentation of individual animals, group interactions, or calf-cow pairs without causing disturbance. The ability to hold position enhances data quality by removing motion blur and maintaining consistent geometry for photo-identification and behavioural recording.
- **Enhanced Visual and Thermal Detection:** Modern multi-sensor payloads, such as the Zenmuse H30T, integrate high-resolution RGB, thermal, and zoom imaging on a single

gimbal. Thermal sensors can detect whale blow plumes or body heat at extended distances and under low-visibility conditions, while optical zoom enables detailed examination of morphology, scarring, and fine-scale behaviour. Combined, these capabilities deliver a level of visual and thermal fidelity that far exceeds that obtainable from crewed aircraft operating at higher altitudes and speeds.

- **Reduced Disturbance and Acoustic Footprint:** Drones operate quietly and at lower altitudes than manned aircraft, producing minimal acoustic disturbance. This allows for recording of surface behaviour, social interaction, and resting activity, improving behavioural accuracy and welfare outcomes for observed animals. All UAV operations will comply with prescribed minimum separation distances, altitude restrictions, and marine fauna disturbance mitigation requirements.
- **Safety and Risk Reduction:** Uncrewed aerial systems remove the inherent risks associated with low-level flight over water. Operations can continue safely under marginal visibility or moderate wind conditions that would ground manned flights. Redundant telemetry links, automated return-to-home (RTH) functions, and built-in safety protocols provide predictable and secure system recovery, supporting Civil Aviation Safety Authority (CASA)-approved Beyond Visual Line of Sight (BVLOS) operations.
- **High Spatial and Temporal Resolution:** Drone surveys enable concentrated effort within key nearshore nursery zones (e.g., 2-5 km offshore), where whale aggregations are most frequent. Their ability to operate repeatedly across consecutive days provides continuous temporal coverage rather than isolated transects, producing finer-scale mapping of distribution, movement, and habitat use relative to environmental conditions.
- **Data Quality and Integration:** All imagery and telemetry are captured digitally with embedded GPS, UTC timestamp, altitude, and camera parameters, ensuring traceability and repeatability. 4K video and still imagery is immediately suitable for GIS integration and spatial analysis. Drones can also operate in conjunction with coastal observers, enabling real-time triangulation and verification of sightings.
- **Environmental and Regulatory Advantages:** Drone operations have a minimal environmental footprint - no aviation fuel use, reduced noise, and low emissions. They comply with CASA BVLOS regulations designed to mitigate risk to crewed aviation in sensitive coastal airspace. Field teams typically consist of only two personnel, reducing both logistical complexity and site disturbance.
- **Rapid Redeployment and Multi-Site Coverage:** Drone systems can be rapidly redeployed between nearby sectors - such as The Craggs, Narrawong Beach, and Cape Nelson - within a single operational day. Mission parameters are pre-programmed , ensuring consistent transect replication and efficient daily re-tasking in response to whale movements or changing weather conditions.

Drone-based BVLOS monitoring provides a safer, more flexible, and cost-effective alternative to manned aerial surveys for whale observation. It allows adaptable launch points, stable hover-based behavioural recording, enhanced visual and thermal detection, and efficient utilisation of short weather windows. The approach maintains high spatial and temporal data resolution, minimises environmental impact, and adheres to strict aviation safety and regulatory requirements. All operations remain under the discretion of the pilot-in-command, who retains final authority on flight safety and operational limits.

While this technology is still developing, early consultation and engagement with authorities has indicated that trials could be conducted ahead of the survey period. As such, this option has been

partially adopted as a complementary measure to Step 3, subject to appropriate permits and operational viability.

Unmanned PAM Craft

The deployment of unmanned surface vessels equipped with PAM technology was explored as an alternative platform for acoustic monitoring. While potentially extending coverage, these systems offer similar detection capabilities to static buoys already adopted. It is important context that the need in the case of the Regia MSS is to improve detections of Southern Right Whales within and migrating from their reproductive BIA. This, coupled with their higher cost based and limited improvement in effectiveness led to the conclusion that they did not represent a cost-effective addition. This measure was considered during Step 6 of the ALARP assessment and rejected.

Unmanned PAM Gliders

The deployment of autonomous underwater gliders equipped with PAM systems was investigated as an alternative monitoring platform; however, their operational characteristics do not align with the requirements of the Regia MSS. Gliders provide periodic, rather than continuous, detection and reporting because data are only transmitted when the vehicle surfaces, typically every few hours. This results in delayed or batch reporting cycles. This stands in contrast to the near real-time, continuous telemetry achievable with static tethered buoys, which is essential for the Regia MSS because the primary objective is to monitor received sound levels at fixed, defined locations, not to conduct broad-area whale detection. Static buoys remain at known coordinates, maintain stable hydrophone depth, and provide uninterrupted acoustic measurements and near real-time transmission, making them far more suitable for validating sound source levels during the activity.

Gliders also introduce functional limitations that reduce their utility for this application. Their movement through the water column creates flow noise and wave-wash noise, which can significantly degrade low-frequency signal quality—precisely the band relevant to both Southern Right Whale frequencies and anthropogenic impulsive sound monitoring.

Performance testing of acoustic gliders shows that while glider-based PAM is useful for broad-scale presence/absence assessments, it exhibits substantially higher missed-detection rates for low-frequency baleen whale calls compared to fixed, stationary systems. Baumgartner et al. (2020) report missed-detection rates of 26–62% for right, humpback and fin whales when gliders operate in automated mode, along with data latency inherent to glider design because detections can only be transmitted when the glider surfaces. Their mobility also makes it challenging to maintain consistent monitoring points because the Regia MSS requires fixed-point sound-level verification, a platform that moves tens of kilometres over a deployment cycle cannot fulfil this role with the required precision or repeatability.

Although gliders can extend horizontal spatial coverage, the Regia MSS monitoring strategy already achieves that coverage through a network of strategically placed static PAM buoys. Gliders therefore provide no additional detection benefit relevant to the management measures in this EP. Their higher capital and operational cost mean they do not offer a material improvement in environmental impact reduction. For these reasons, gliders were assessed at Step 6 of the ALARP assessment and rejected on the basis that static buoys provide a more reliable, more direct, and more cost-effective means of meeting the defined monitoring objectives of the Regia MSS.

Citizen Science Observations

Within Step 7, CGG considered incorporating citizen science observations into the Fauna Management Plan was considered as a means of enhancing real-time awareness of Southern Right Whale presence, particularly in the coastal reproduction BIA. While such observations can sometimes

provide useful insights, the data is not validated in real-time reducing reliability and their integration into formal mitigation procedures raises concerns around data quality and verification. Additionally, the existing suite of detection measures already ensures that Southern Right Whales can utilise their BIA's and HCTS and behavioural disturbance is minimised. However, CGG notes that citizen science programs can be effective because observations are occurring all the time and not just for a defined (and likely limited) science program. CGG does not control the program as the data goes to the Arthur Rylah Institute and has confirmed that CGG would be given unvalidated sightings data on request. Therefore, this control measure has been partially adopted as the benefit was sufficient to justify even the relatively low cost of coordination.

Plankton/Larval Krill Dispersion Modelling

This measure was suggested through consultation. It requested further analysis of impacts to planktonic organisms and larval krill through additional dispersion modelling. However, the Regia MSS environmental assessment already includes a detailed evaluation of the Bonney Upwelling and its biological significance. Moreover, current scientific understanding supports those behavioural impacts on larger taxa (e.g. whales) are an appropriate surrogate for impact management across trophic levels. This idea was deemed a supplementary input to the environmental assessment, not a control measure, and was rejected as unnecessary to inform ALARP decisions.

Plankton/Larval Krill Detection and Avoidance

This measure was suggested through consultation. Direct observation or detection of larval krill during the survey was explored but ultimately found to be infeasible. Krill are neither directly observable during operations nor spatially predictable to a sufficient degree to inform real-time mitigation. Given that the survey avoids peak upwelling periods and already incorporates broader area and timing restrictions, this measure was rejected as an unviable additional control.

Additional PAM detection systems of contracted vessels

Passive acoustic monitoring (PAM) has consistently been shown to be a reliable tool for detecting vocalising cetaceans across multiple platforms, environments, and spatial scales. Numerous studies demonstrate that baleen whale calls propagate over substantial distances, allowing detection ranges from several kilometres to tens of kilometres, depending on species, water depth, and ambient noise. For right, humpback and sei whales, moored buoy systems typically achieve instantaneous detection ranges of 9–15 km, with fin whale calls detectable over several tens of kilometres due to their low-frequency, high-source-level signals (Baumgartner et al. 2019). Right whale upcalls have been recorded up to 30 km in shelf basins and, in favourable sub-Arctic conditions, North Pacific right whale calls have propagated to 100 km from the source (Soldevilla et al. 2014). In deep ocean systems, pygmy blue whale calls may be detected at ranges approaching 200 km, depending on frequency band, ambient noise, and propagation conditions (Gavrilov & McCauley 2012). Across calving grounds, feeding areas, and migratory corridors, PAM consistently outperforms visual methods in temporal coverage—often yielding 2–10 times more detection days than aerial or shipboard surveys —and provides continuous monitoring in darkness, poor weather, and remote locations (e.g., Antarctica's PALAOA observatory) (Van Parijs 2009). The capacity for real-time transmission from autonomous buoys further supports mitigation, as demonstrated by reliable near-real-time right whale detections used for vessel-strike risk reduction off the United States east coast (Van Parijs 2009).

While PAM is highly effective for *detecting the presence* of cetaceans, its performance in estimating *distance* and *bearing* depends heavily on the configuration of the monitoring system. Single-hydrophone systems—common in mitigation buoys—detect occurrence but cannot estimate caller range or bearing without additional propagation modelling or opportunistic use of multipath arrivals, and these methods are generally unreliable for operational decision-making (Soldevilla et al. 2014).

Accurate localisation requires hydrophone arrays with precise time synchronisation, as implemented in fixed seabed arrays, bottom-mounted tetrahedral systems (e.g., PALAOA), and towed arrays (Van Parijs 2009). Towed arrays allow bearing estimation and, with vessel motion, full localisation, although performance can be reduced by vessel noise, animal avoidance behaviour, and the left–right ambiguity inherent in linear arrays (Van Parijs 2009). Glider-based systems equipped with onboard detection algorithms (e.g., DMON/LFDCS) can provide reliable near-real-time detections, but localisation remains limited unless multiple gliders or fixed buoys operate as a network (Baumgartner et al. 2020). Overall, PAM localisation accuracy is highest when using multi-sensor arrays and lowest when relying on single sensors.

Across all studies, the reliability of PAM is influenced by ambient noise, calling behaviour, and detector performance. High ambient noise—including wind, rain, vessel noise, fish choruses, and snapping shrimp—can significantly reduce detection ranges, as demonstrated in South Australia's Fowlers Bay where wind-driven noise varied by 30 dB above 100 Hz, thereby constraining baleen whale detectability during poor weather (Ward et al. 2019). Automated detectors must balance false positives and missed detections: conservative right whale detectors deployed on real-time buoys achieved near-zero false detections at the cost of higher missed-call rates (Baumgartner et al. 2019), while automated glider detectors showed species-specific missed-detection rates ranging from 18–67%, depending on call type and analyst review protocol (Baumgartner et al. 2020). PAM performance also depends on the species' vocal behaviour—obligate vocalisers (e.g., sperm whales) are detected reliably, whereas facultative vocalisers may remain silent for extended periods. Despite these limitations, the evidence across all studies shows PAM is a robust, proven, and operationally mature method for detecting cetaceans, particularly when integrated with visual monitoring and deployed using arrays or multi-platform networks.

During Step 10 of the ALARP assessment, CGG evaluated the use of passive acoustic monitoring (PAM) systems on the spotter vessel. At that stage, PAM was rejected on ALARP grounds because the incremental reduction in impact or risk was not proportionate to the additional cost, complexity, and operational burden. However, subsequent further assessment of key environmental values and sensitivities (Appendix F3) identified a critical constraint: the effective detection range of Marine Fauna Observers (MFOs) is typically limited to ~5 km under ideal conditions, substantially less during low visibility, and no visual detections at night. These limitations became highly material when the detection distances to be achieved are >15 km.

To ensure impacts and risks remain at ALARP levels, and to provide extended detection capability during low-visibility conditions where MFO effectiveness is degraded, CGG will adopt PAM technology on the spotter vessel wherever practicable. PAM will operate supplementary to visual monitoring or as a primary trigger for shutdown decisions at night. For detections of Blue Whales during November and December, CGG will require all contracted vessels to undergo a PAM-readiness assessment to confirm whether they can safely and effectively support PAM operations. PAM-ready vessels will be preferentially selected and mobilised where commercially and operationally feasible. Where full PAM deployment is not possible, CGG will implement alternative monitoring arrangements to ensure environmental performance outcomes are met.

Further control measures identified and not assessed

There was further control measures identified in Appendix F5 that were in mind during the ALARP assessment, including:

- Fibre Optic Distributed Acoustic Sensors (DAS)
- Dual Camera Detection Systems (e.g., WhalePOD, SVDS)
- AI-Enhanced Satellite Monitoring (e.g., SpaceWhale)

These measures were identified and considered during the Marine Mammal Detection Technology Assessment as potential supplementary control options. However, they were not assessed in detail within the ALARP process. In each case, the likely effectiveness of the measure was limited by its technical maturity, feasibility, or relevance to real-time seismic survey operations. Furthermore, the primary pathways for impact have already been effectively addressed through an extensive suite of adopted controls, including visual observers, PAM systems, aerial surveys, and scheduling strategies.

Given this strong baseline, any additional environmental benefit from the above-listed measures would be marginal, speculative, or redundant. As such, the cost of conducting detailed analysis for each measure was itself clearly grossly disproportionate to the potential environmental benefit that might be realised. No further action was taken, and this approach is consistent with the principle of focusing detailed ALARP assessments on measures that are either practicable or offer credible additional benefit.

6.5.4 Results

Figure F2-7 presents the progressive ALARP assessment for the impact pathway of underwater sound. Each point on the chart represents a control measure or group of measures applied sequentially, plotted by their associated cumulative sacrifice (x-axis) against the residual impact reduction achieved (y-axis).

The green dotted line is a second-order polynomial trendline fitted to the sequence of adopted measures, representing the declining efficiency of control measures as more are added. The shape of the curve illustrates the concept of diminishing returns, where early measures provide significant benefit per unit of sacrifice, while later measures achieve less additional benefit at increasing cost.

The vertical dashed red line represents the ALARP threshold—the point at which further measures become grossly disproportionate in cost relative to the incremental benefit they offer. Measures falling to the left of this line are adopted, as they provide meaningful impact reduction at reasonable or proportionate cost. Measures to the right of this line (i.e. “Additional overflights” and “PAM on the spotter vessel”) are rejected, as the cost of implementation exceeds what can reasonably be justified given the small additional environmental benefit.

This graph visually supports the decision-making process and demonstrates that ALARP has been achieved, with additional measures considered and transparently excluded based on their cost-benefit profile.

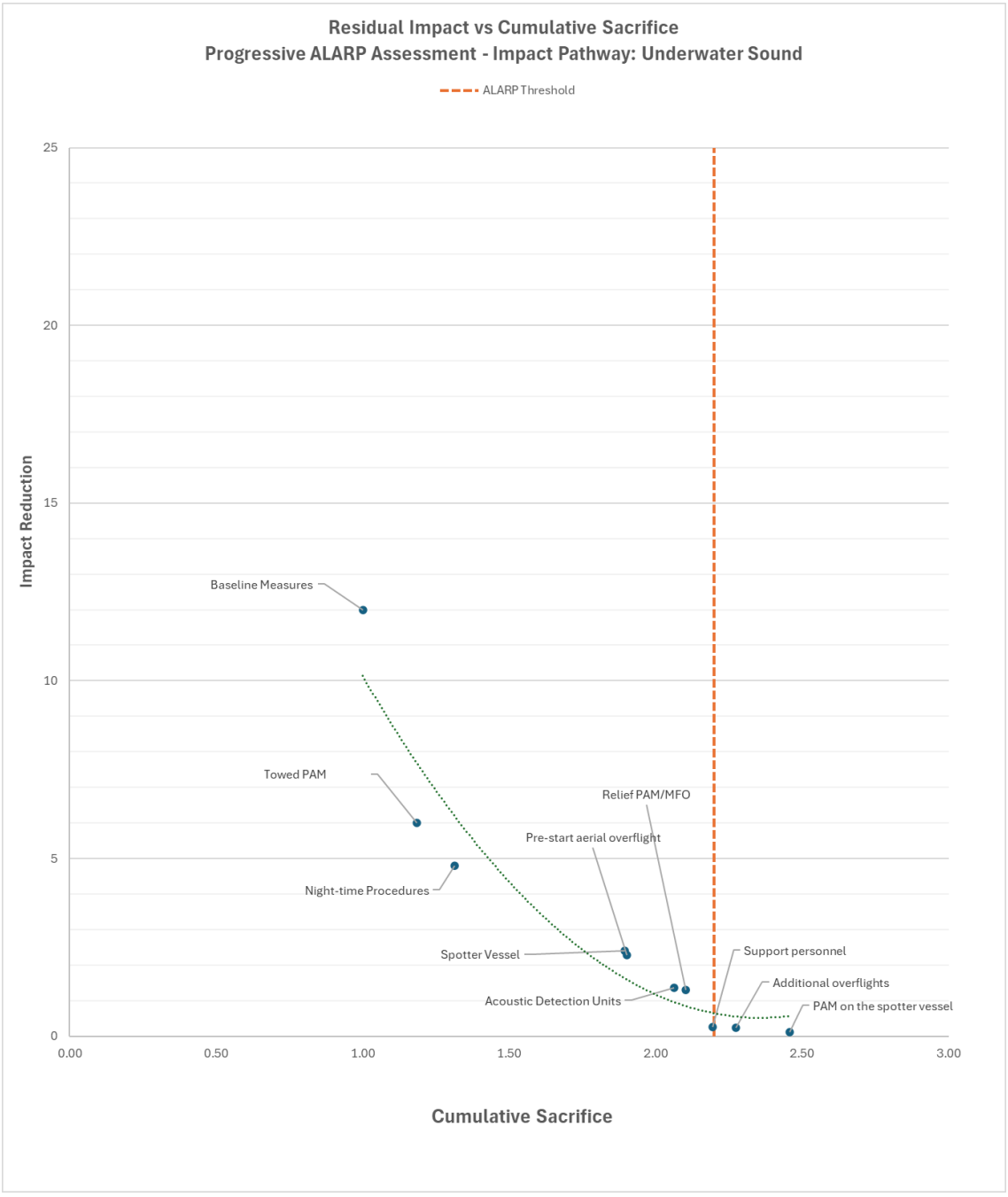


Figure F2-7 - ALARP Assessment Results - Underwater Sound: Residual Impact vs Cumulative Sacrifice for Underwater Sound Control Measures. A progressive ALARP assessment showing the impact reduction achieved by each control measure relative to the cumulative sacrifice required. The second-order polynomial trendline illustrates diminishing returns, and the dashed red line marks the ALARP threshold beyond which further measures are considered grossly disproportionate and therefore rejected.

Figure F2-8 presents a combined bar and line graph to validate the ALARP threshold identified in the residual impact vs cumulative sacrifice analysis. The bars represent the marginal reduction in residual impact or risk delivered by each individual control measure, showing the relative effectiveness of each step in the sequence. The line graph plots the corresponding cumulative sacrifice, illustrating how the total cost or effort increases with the adoption of each additional measure.

This format allows a direct visual comparison between the size of the environmental benefit (bar height) and the cost of achieving it (line slope). Early control measures show large reductions in impact for relatively small investments, while later control measures deliver diminishing benefits for greater cumulative sacrifice. The flattening of the bars combined with the steepening line demonstrates that the rate of return on environmental investment is decreasing.

The turning point, where bars become marginal and the line continues to rise sharply, supports the conclusion that the final adopted measure is at the threshold of gross disproportionality. The two rejected measures clearly fall beyond this threshold, providing confirmation of the ALARP decision made in the preceding graph.

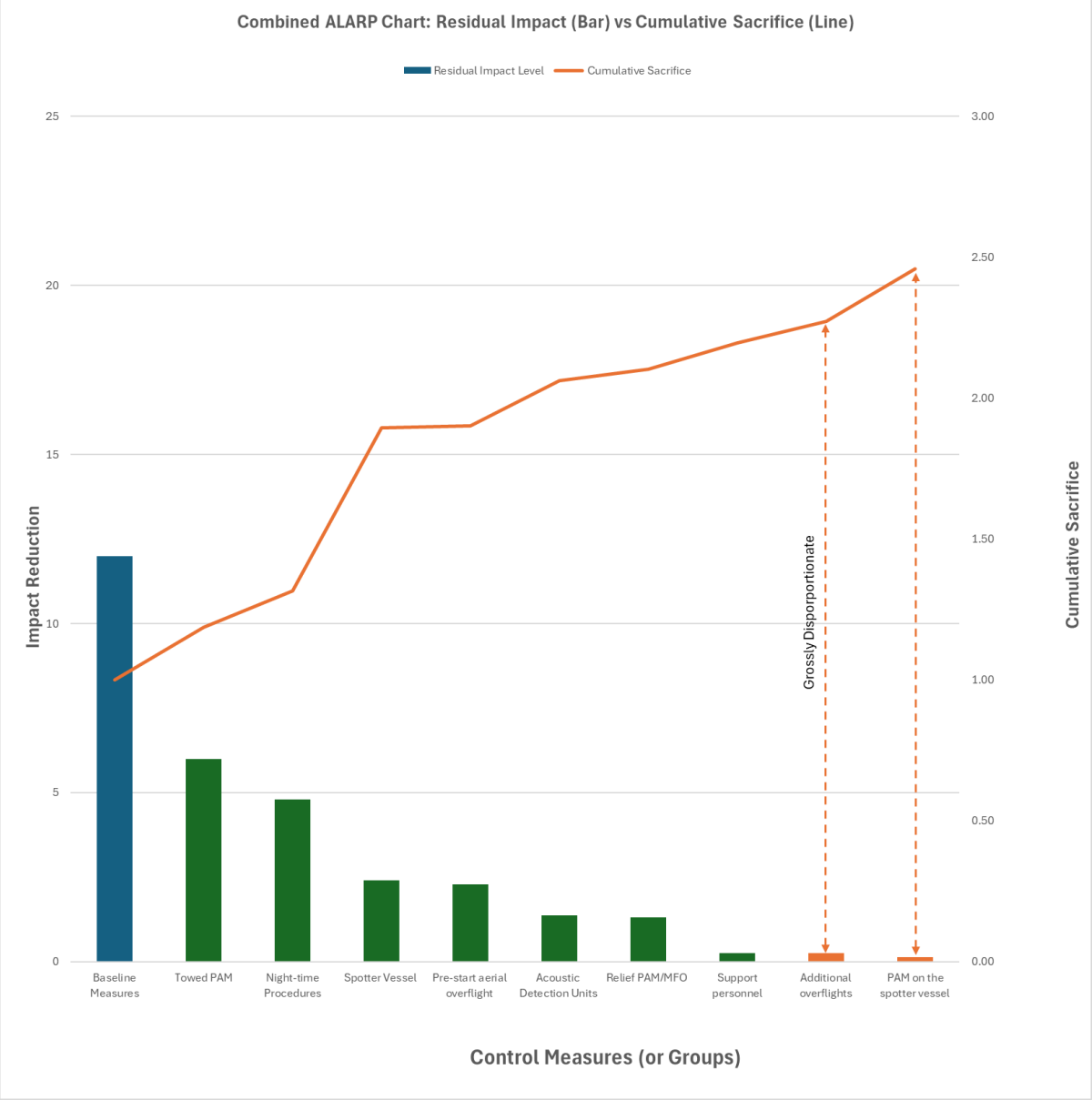


Figure F2-8 - ALARP Assessment - Underwater Sound: Marginal Impact Reduction and Cumulative Sacrifice for Underwater Sound Control Measures. Bars show the impact or risk reduction provided by each control measure; the line indicates cumulative sacrifice. This graph validates the ALARP threshold by illustrating where the marginal benefit becomes negligible relative to the rising cost of additional measures.

6.6 Artificial Light

6.6.1 Baseline

Table F2-15 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline impact level and baseline quantum of sacrifice.

Table F2-15 – Baseline Measures – Artificial Light

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Navigational lighting	Required under maritime safety regulations.	Not reducible due to safety obligation; sets baseline.
Vessel exclusion zone (4nm from coast)	Activity limitation to reduce overlap with recreational users also limits light exposure to the coastline.	Not reducible due to safety obligation; sets baseline.
Lighting Management Plan (LMP)	Company standard to minimise unnecessary light emissions with OVID-Style inspections checking all vessels have a LMP in place.	Minimises attraction/disruption to light-sensitive fauna.

The outcome of the impact assessment for physical presence was that the effect was ranked as minor (2) and the uncertainty ranked as low (2). Therefore, the residual impact after the application of baseline measures is four (4).

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- Navigational lighting is required under international maritime safety regulations and is therefore a non-negotiable obligation for safe operation at sea. The commitment to maintain a 4 nm exclusion from the coastline—though primarily an activity limitation designed to reduce overlap with recreational users—has the added benefit of reducing coastal light exposure. However, this constraint limits the survey area and restricts CGG's ability to collect data in potentially high-interest nearshore zones. While not a direct financial cost, this represents a compromise in operational scope.
- The Lighting Management Plan (LMP), required for all vessels, is a company standard developed over time through internal systems and inspections, including OVID-style pre-deployment assessments. As this plan is now a mature part of CGG's operating procedures, its implementation no longer imposes significant operational costs. However, the development of the systems, experience, and refinements required to reach this level of maturity represents a historical investment that has contributed to its current effectiveness.

Overall, the baseline measures reflect a high level of intrinsic effectiveness with relatively low current cost or effort, though they are underpinned by earlier organisational investments and operational trade-offs. These combined costs and efforts form the cumulative baseline sacrifice, which is assigned a unit value of one (1) in the ALARP assessment. This allows subsequent discretionary control measures to be evaluated proportionally.

6.6.2 Assessment

Table F2-16 shows the step-by-step process followed for the ALARP assessment of artificial light. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-16.

6.6.3 Consideration of Alternative, Additional or Improved Control Measures

As part of the ALARP assessment for artificial light, CGG considered additional or improved control measures beyond those already adopted. One such measure was the use of advanced light filters designed to further narrow the spectral output of onboard lighting systems. These filters can reduce visibility to certain marine fauna by removing wavelengths known to trigger behavioural responses. However, when applied on top of existing lighting controls – such as shielded fittings, dimming technologies, and blackout curtains – the additional reduction in light-related impact is minimal. Furthermore, implementing this measure would require retrofitting lighting systems across multiple vessels, introducing substantial procurement, installation, and maintenance costs. These costs include not only hardware but also operational downtime and compatibility assessments. While technically feasible, the sacrifice required (0.125 units) was assessed as grossly disproportionate to the marginal reduction in residual impact, and the measure was therefore rejected.

Other potential improvements, such as the deployment of active light detection sensors or automated brightness adjustment systems, were also considered. While conceptually interesting, these systems introduce complexity into vessel operations and present a risk of malfunction or false responsiveness in the offshore environment. Their benefit would also be marginal considering the existing effectiveness of CGG's Lighting Management Plan and onboard procedures. As such, no further control measures were identified that would provide substantial risk reduction without grossly disproportionate sacrifice.

This assessment confirms that the control measures already adopted represent a point where additional environmental benefit is outweighed by the cost, complexity, or operational risk of implementation, and that the residual impacts from artificial light have been reduced to ALARP.

6.6.4 Results

Figure F2-9 illustrates the outcome of the ALARP assessment for the artificial light impact pathway, showing how progressively adopted control measures reduce residual impact in relation to cumulative sacrifice. Each data point represents a control measure or group of measures that was assessed for its intrinsic effectiveness and corresponding cost, time, or operational effort. The plotted curve uses a second-order polynomial trendline to demonstrate the diminishing returns of environmental benefit as increasing sacrifice is invested.

In this assessment, the baseline measures (including required navigational lighting and exclusion zones) were followed by the adoption of dedicated light minimisation technologies and practices. These early measures provided substantial impact reduction at low to moderate sacrifice. Subsequent measures, such as CGG's Marine Assurance System and the appointment of a Survey Environment Advisor, continued to improve risk management but with increasingly marginal gains relative to their cost. The ALARP threshold, represented by the vertical dashed line, indicates the point at which further sacrifice would be considered grossly disproportionate to the environmental benefit gained. The final measure plotted exceeds this threshold, confirming that ALARP has been demonstrably achieved for this impact pathway.

Table F2-16 - Step-by-step ALARP Assessment – Artificial Light

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	4	1	1	Baseline measures include legally required navigational lighting and a Lighting Management Plan. These measures set a foundational level of impact reduction and are not subject to modification due to their safety-critical nature. Their effectiveness is high in defining the minimum controllable level of light emissions.	Baseline measures involve no additional financial cost to CGG, as they represent legal requirements and company standards already embedded into routine operations. Their historical development involved significant investment, but their marginal cost is low.
2	Light Minimisation Measures	Shielded lighting, dimming technologies, and blackout curtains.	4	90%	3.6	0.4	5	6	The use of shielded lighting, dimming technologies, and blackout curtains directly reduces the intensity and spread of light emissions. These technologies interrupt the pathway between the source and light-sensitive fauna, making them highly effective in minimising impact. A 90% effectiveness rating has been applied to reflect this high performance without overstating precision - this value represents a well-established standard of effectiveness for measures targeting the light pathway directly.	These measures involve moderate upfront investment in technology and vessel outfitting, but they are well-established practices. Their high effectiveness justifies the cost, and the long-term operational burden is minimal.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
3	CGG Marine Assurance System	Ensures compliance with laws and requires an OVID-style inspection prior to the survey to check the light management plan onboard.	0.4	90%	0.36	0.04	4	10	The Marine Assurance System ensures compliance with internal standards and maritime regulations, verified via OVID-style inspections. Its effectiveness lies in ensuring all vessels implement appropriate lighting controls consistently and reliably. The 90% rating is used here to maintain consistency and transparency in evaluating operational systems that consistently deliver high compliance outcomes.	The Marine Assurance System is a company standard. While the inspections involve administrative and operational overheads, these are already incorporated into CGG's workflow and contribute to multiple areas of compliance, keeping incremental cost moderate.
4	Survey Environment Advisor	Ensures the compliance with the sail line plan, the light management plan, inductions for the crews.	0.04	90%	0.036	0.004	12	22	The onboard Survey Environment Advisor ensures the correct implementation of procedures and alignment with the Sail Line Plan. Their role provides operational assurance and continuous improvement, further refining light minimisation performance on the ground. A 90% effectiveness rating is assigned to reflect the Advisor's strong role in implementation assurance.	The Survey Environment Advisor is an added operational resource. While their inclusion adds staffing cost and coordination requirements, the role provides broader assurance benefits beyond lighting and supports overall environmental compliance. The incremental cost is justified by the added certainty in implementation.

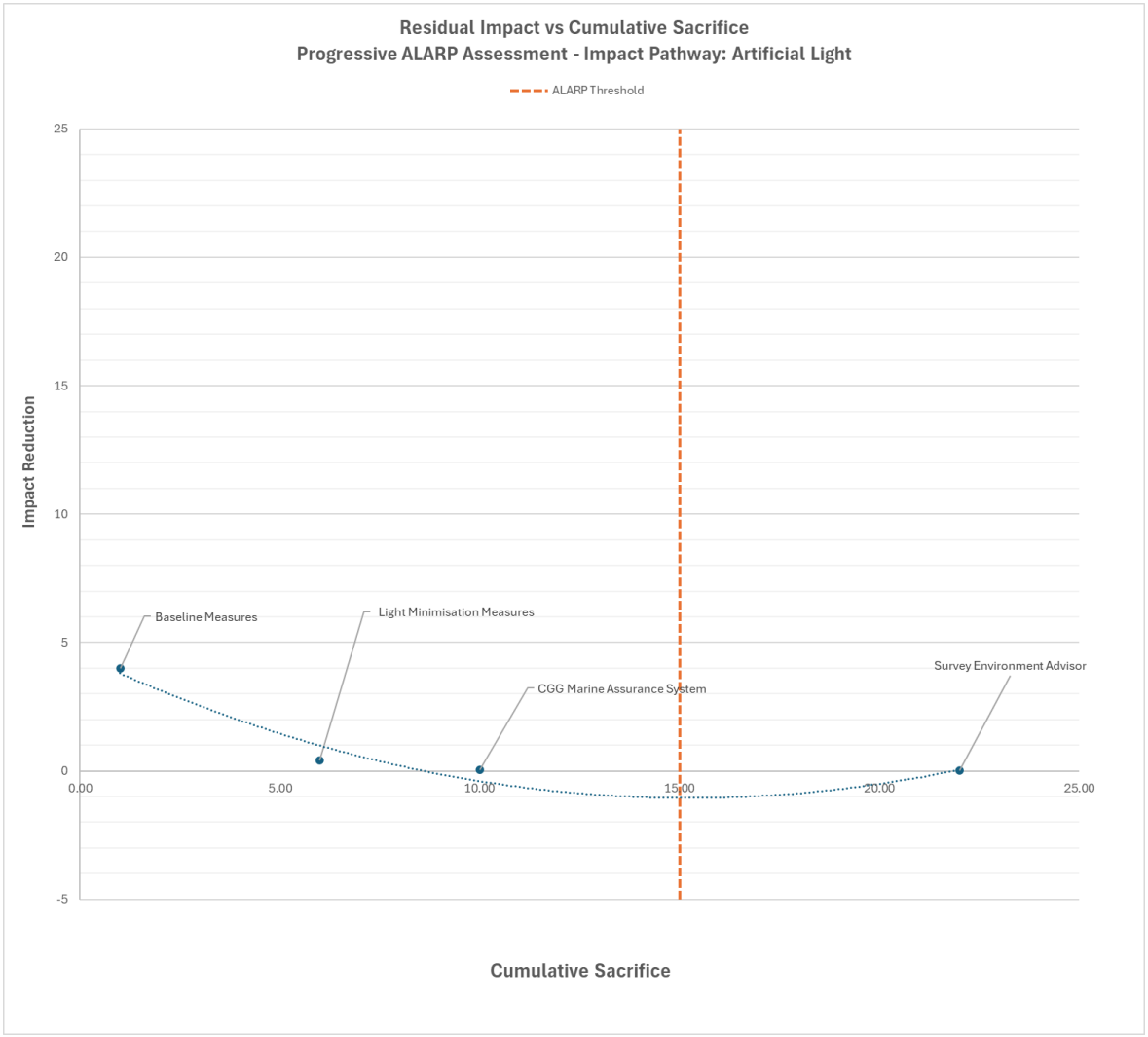


Figure F2-9 - Residual Impact vs Cumulative Sacrifice – Progressive ALARP Assessment for Artificial Light: The graph plots cumulative sacrifice (x-axis) against total impact reduction (y-axis), with a second-order polynomial trendline illustrating diminishing returns. The vertical dashed line represents the ALARP threshold, beyond which additional measures are rejected due to grossly disproportionate cost relative to benefit.

Figure F2-10 provides a combined visual summary of the ALARP assessment for artificial light, comparing the marginal environmental benefit of each control measure (bar graph) against the cumulative sacrifice required to adopt them (line graph). Each bar represents the level of residual impact reduction achieved by an individual or grouped control measure. The orange line tracks the total cost, time, or operational effort (sacrifice) accumulated with each successive measure. The graph illustrates that the greatest impact reduction was achieved through baseline measures, which include legally required lighting and spatial activity limitations. Additional measures, such as light minimisation technologies and procedural controls, yielded further reductions but at progressively higher cost for diminishing return. This contrast between bar height (benefit) and line steepness (cost) makes it visually clear where the balance between benefit and sacrifice begins to diverge — validating the point of inflection identified in the accompanying scatter plot. The chart therefore supports the conclusion that further measures, such as appointment of a dedicated Survey Environment Advisor, are grossly disproportionate and not required to reduce impact to ALARP. However, the Survey Environment Advisor is a measure already in place for other impact and risk mitigation and so remains an adopted control measure.

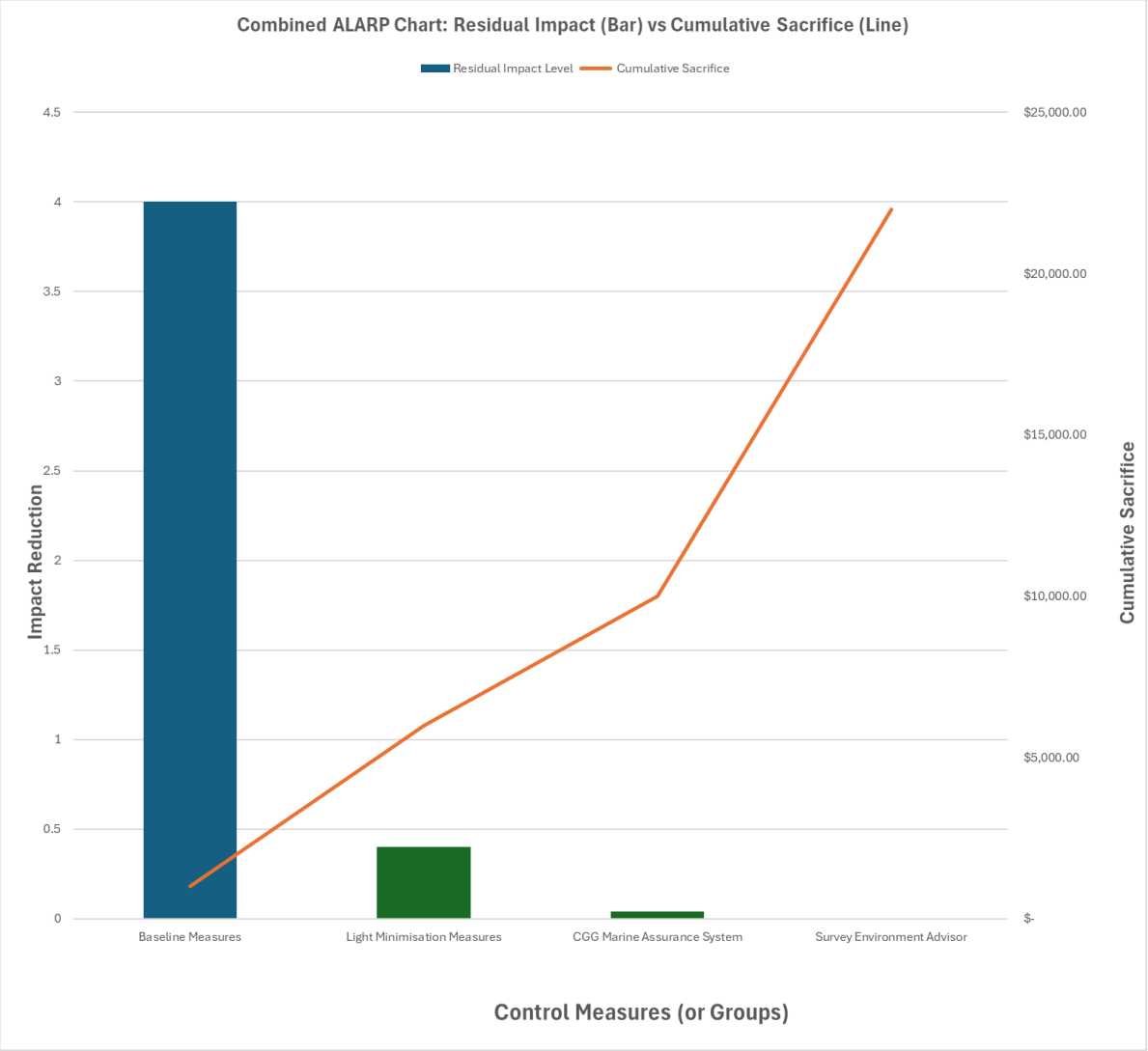


Figure F2-10 - Combined ALARP Chart for Artificial Light – Residual Impact Reduction (Bar) vs Cumulative Sacrifice (Line). The bar chart shows the impact reduction provided by each control measure or group, while the line chart illustrates the rising cumulative cost. This dual-axis visualisation highlights where diminishing returns occur and confirms that further sacrifice yields negligible environmental benefit beyond the ALARP threshold.

7 ALARP Assessment – Risks

Following the completion of the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4), and the subsequent full risk assessments (Appendices D1-4), this ALARP assessment covers the following risk pathways:

- Accidental release of materials or waste overboard.
- Collisions with marine fauna.
- Introduction of invasive marine species.
- Accidental release of fuel.

The following sections of this document assess each risk pathway in turn.

7.1 Accidental Release of Materials or Waste Overboard

7.1.1 Baseline

Table F2-17 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline risk level and baseline quantum of sacrifice.

Table F2-17 - Baseline Measures - Accidental release of materials or waste overboard

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Compliance with relevant legislation and MARPOL Annex V	This includes adherence to MARPOL Annex V, which sets strict rules on garbage discharge from vessels, including a complete ban on the discharge of plastics into the sea and specific controls on other types of waste. Vessels must maintain procedures for waste handling, install appropriate storage and disposal systems, and maintain records of all waste disposed. Regular inspections and audits are conducted to verify compliance.	High – Reduces the chance of illegal or accidental discharge and enforces consistent legal standards across operations.
CGG Marine Assurance System	The assurance system covers a range of practical measures to prevent waste from entering the marine environment. These include audits and inspection of contractors Garbage Management Plan, maintenance of a Garbage Record Book to log all disposals and transfers, use of clearly labelled and covered containers for segregated waste storage, and regular crew training.	High – Provides a structured and enforceable approach to prevent waste discharge through standardised procedures and oversight.
Support vessel recovery capacity	In the event of accidental loss of materials overboard, a dedicated support vessel is available to respond. The vessel is equipped with personnel and tools to assist in locating and retrieving floating or drifting materials, where recovery can be conducted safely. Operational procedures include communication protocols, response planning, and post-recovery documentation. Although reactive, this measure ensures that environmental harm can be reduced if an incident occurs.	Moderate – Helps reduce the consequences of accidental loss but does not prevent incidents from occurring.

The baseline sacrifice is set at 1.0 to provide a reference point for comparing other measures. This number does not mean the baseline is cheap or easy to implement. Meeting legal requirements and applying the CGG Marine Assurance System takes effort, resources, and planning.

- Compliance with relevant legislation and MARPOL Annex V requires vessels to maintain waste-handling systems, train crew, keep procedures up to date, and complete regular inspections.
- The CGG Marine Assurance System includes documentation, training, containment practices, and internal audits to ensure waste is handled correctly and in compliance with environmental standards.
- Support vessel recovery capacity involves maintaining readiness, equipment, and procedures to recover released materials safely and effectively if an incident occurs.

The outcome of the risk assessment for accidental release of materials or waste overboard was that the likelihood was ranked as minor (2) and the consequence ranked as unlikely (2). Therefore, the residual risk after the application of baseline measures is medium (4).

7.1.2 Assessment

Table F2-18 shows the step-by-step process followed for the ALARP assessment of release of waste. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-18.

7.1.3 Consideration of Alternative, Additional, or Improved Control Measures

Several potential control measures were considered during the assessment process but not adopted, either because they offered minimal additional benefit or because their cost or complexity was disproportionate to the risk.

Real-time onboard monitoring

Tracking of all potential debris-generating equipment was considered. This would involve installing sensors and GPS tags on disposable items or high-risk components. While this could improve detection of overboard loss events, the effectiveness would be limited unless paired with immediate recovery actions. This option was reviewed in relation to Step 2. It was not adopted due to its high complexity, cost, and the fact that similar functions are already provided by the streamer recovery units, which are more practicable and widely applicable.

Deploying a dedicated marine waste observer

This role would involve real-time observation of deck activities and waste handling practices. While this could offer incremental assurance, it overlaps heavily with existing crew responsibilities. It was considered during discussion of baseline effectiveness (Step 1) and rejected on the grounds that existing controls already provide similar assurance, and the additional role would likely create redundancy without proportionate benefit.

In each case, alternative measures were either already covered in the existing system or provided marginal benefits that did not justify their implementation. The current combination of baseline and additional controls was found to be both effective and proportionate.

Table F2-18 - Step-by-step ALARP Assessment – Accidental Release of Waste

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See previous tables.	-	-	-	4	-	1.0	The baseline is assigned high intrinsic effectiveness because it includes international legal compliance (MARPOL Annex V) and a structured corporate assurance system. These elements ensure all vessel waste is tracked, managed, and minimised, significantly reducing the chance of accidental release.	Assigned a unit value of 1.0 to represent the cumulative effort required to maintain compliance, implement controls, train personnel, and conduct audits. This reflects the total baseline burden rather than implying the measures are low cost or low effort.
2	Streamer Recovery Units	Streamers fitted with recovery units to prevent benthic disturbance and recover lost gear	4	60%	2.4	1.6	0.2	1.2	Streamer recovery units are moderately effective at reducing environmental harm by preventing gear loss and allowing for recovery. They reduce long-term seabed impacts and improve recoverability of materials. While they don't prevent releases, they enable quick response and clean-up.	An incremental sacrifice of 0.2 reflects the costs of installing, maintaining, and monitoring streamer recovery equipment across the spread. These systems add complexity but are manageable within existing marine operations.
3	Support Vessel	Provides capacity to recover released materials where safe and practicable	1.6	50%	0.8	0.8	0.2	1.4	The support vessel offers reactive risk reduction. It cannot prevent incidents but does lower residual impact by recovering waste after accidental release. Its effectiveness is dependent on conditions, crew availability, and time since release, so it is rated at 50%.	The incremental 0.2 rating accounts for operational planning, equipment checks, and readiness protocols. Since the support vessel is already part of operations, the added burden is considered moderate and proportionate.

7.1.4 Results

Figure F2-11 illustrates the reduction in residual risk achieved through successive control measures plotted against their cumulative sacrifice. The baseline measures provide the greatest risk reduction, reflecting established protocols and compliance with MARPOL and other maritime legislation. The addition of streamer recovery units and the deployment of a support vessel provide incremental risk reductions, though with increasing cost and complexity. The trendline clearly shows a flattening trajectory, indicating diminishing returns, and supports the conclusion that the most effective and proportionate measures have already been adopted. The ALARP threshold is shown at a cumulative sacrifice of 2.0, and all control measures fall below this, demonstrating they are proportionate.

Figure F2-12 is a combined ALARP chart that validates the assessment for the accidental release of materials or waste overboard risk pathway. It presents the residual risk reduction (bar) delivered by each control measure and the cumulative sacrifice (line) associated with implementing them. The baseline measures contribute the greatest reduction in risk, with additional benefits provided by streamer recovery units and support vessel deployment. While the incremental risk reductions are modest, all adopted measures remain within a reasonable sacrifice range. The steady rise in the cumulative sacrifice curve supports the conclusion that further measures would be grossly disproportionate relative to the low remaining risk.

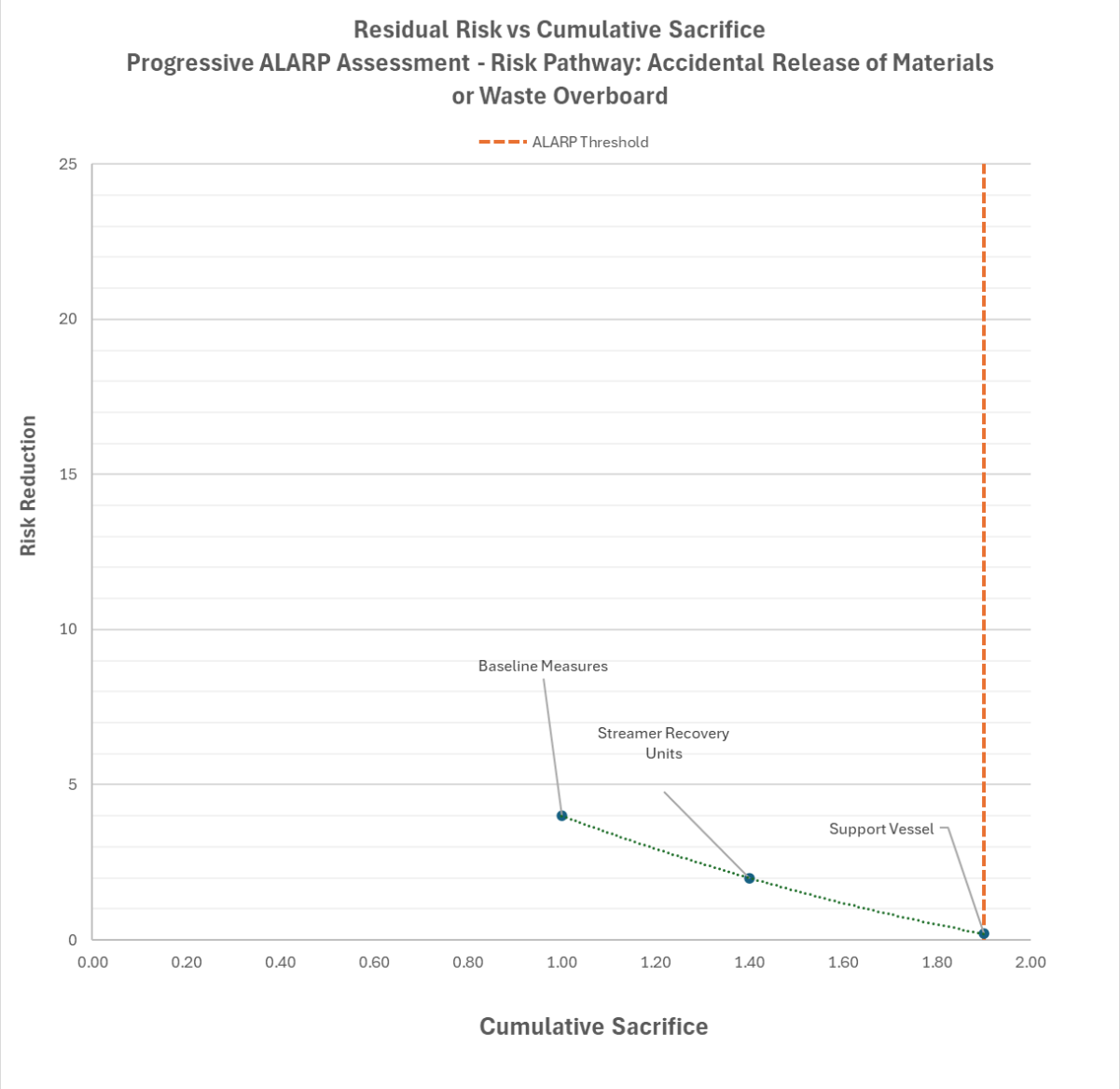


Figure F2-11 - ALARP chart showing residual risk reduction versus cumulative sacrifice for the Accidental Release of Materials or Waste Overboard risk pathway.

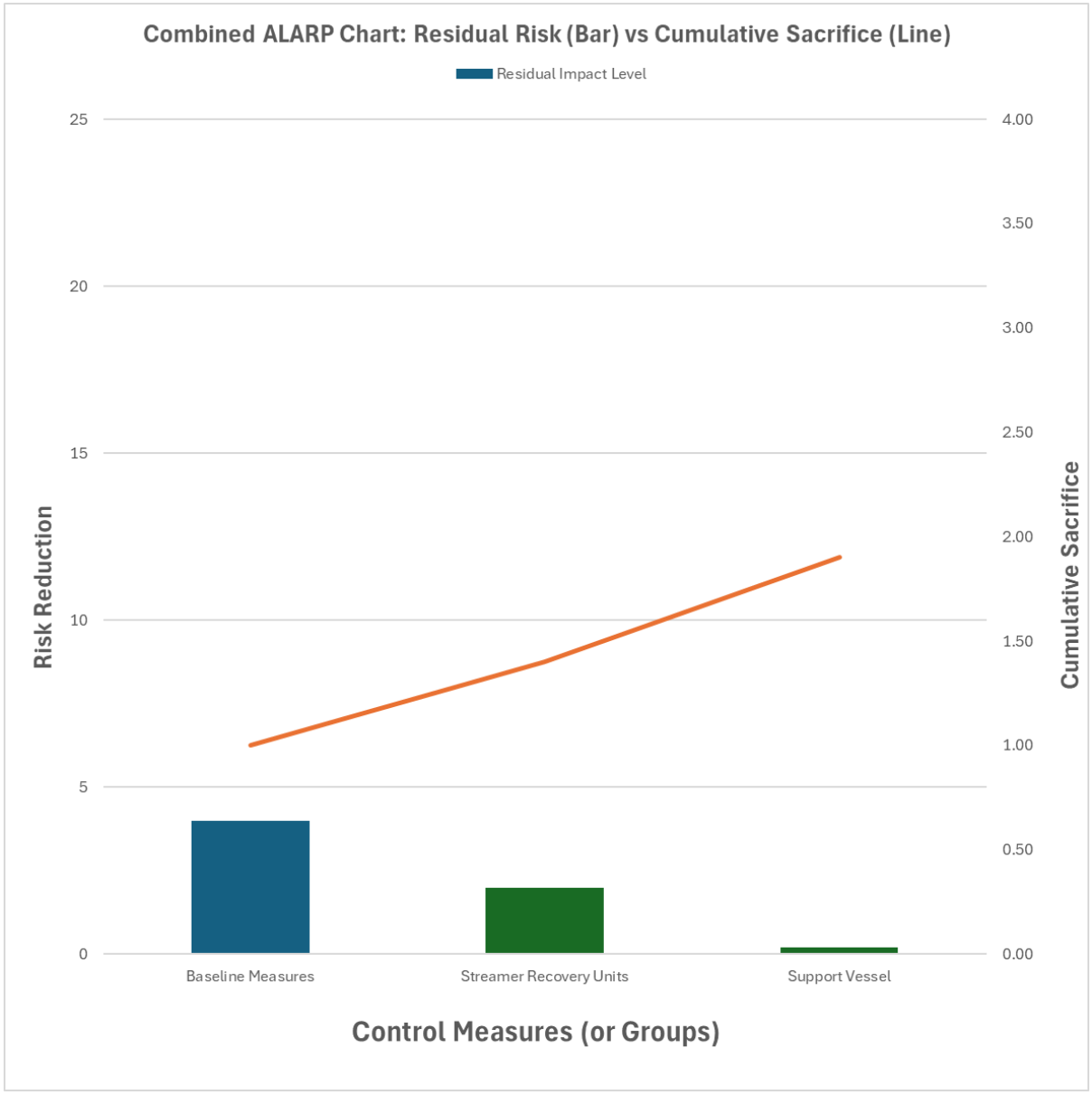


Figure F2-12 - Combined ALARP chart showing residual risk level (bars) and cumulative sacrifice (line) for the Accidental Release of Materials or Waste Overboard risk pathway.

7.2 Collisions with Marine Fauna

7.2.1 Baseline

Table F2-19 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline risk level and baseline quantum of sacrifice.

Table F2-19 - Baseline Measures – Collisions with Marine Fauna

Baseline Measure	Inclusion Rationale	Intrinsic Effectiveness
Vessel Speed Restriction	Seismic and support vessels limited to ≤6 knots during acquisition to reduce likelihood and severity of collisions with fauna, supported by national strategies and species-specific plans.	High – Lower vessel speed allows more time for fauna to detect and avoid the vessel, and for vessel operators to respond to sightings, reducing the probability and severity of collisions.
Fauna Management Plan	Implementation of Fauna Management Plan consistent with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans and EPBC Act Policy Statement 2.1.	High – Clearly defined legal requirements provide a structured, enforceable approach to avoid and manage interactions with marine fauna, particularly cetaceans.
Activity Limitations (Timing)	Acquisition planned in shoulder periods for most whale abundance times. Avoidance of summer months is key.	High – Spatial and temporal planning minimises overlap with migrating whales, significantly reducing the likelihood of interactions during sensitive periods.
Marine Fauna Observers (MFOs)	Use of Marine Fauna Observers (MFOs) to maintain visual detection during operations. This includes MFO's on the spotter vessel.	High – Real-time detection of fauna enables immediate response, including shut-downs or course changes, to prevent interactions.

The outcome of the risk assessment for collisions with marine fauna was that the likelihood was ranked as rare (1) and the consequence ranked as major (4). Therefore, the residual risk after the application of baseline measures is medium (4).

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- Operational speed limitation to ≤6 knots – This is the speed of the survey vessel as part of the acquisition; however, it does introduce some costs for other vessels fuel efficiency.
- MFO resourcing and training – Requires allocation of personnel with specialised skills, including pre-survey training and dedicated observer roles during acquisition, adding to staffing and operational expenditure.
- Compliance with separation zones under Fauna Management Plan – May necessitate course adjustments or activity pauses when fauna is detected within exclusion zones, potentially disrupting survey flow and efficiency.
- Seismic line planning and sequencing in high-risk seasons – Reduces scheduling flexibility and may require more complex operational planning to prioritise safer spatial-temporal windows.

The outcome of the risk assessment for accidental release of materials or waste overboard was that the likelihood was ranked as major (4) and the consequence ranked as rare (1). Therefore, the residual risk after the application of baseline measures is medium (4).

The cumulative quantum of baseline sacrifice is normalised to 1.0. All further control measures will be evaluated relative to this.

7.2.2 Assessment

Table F2-20 shows the step-by-step process followed for the ALARP assessment of collisions with marine fauna. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-20.

7.2.3 Consideration of Alternative, Additional, or Improved Control Measures

No further control options are considered necessary. The baseline includes all identified measures from the risk assessment that deliver high effectiveness with proportionate cost. This includes extensive mitigation to reduce impacts from underwater sound, which serves as a deterrent to marine fauna and decreases the likelihood of vessel interactions. These acoustic and procedural safeguards, along with visual and acoustic detection measures, ensure that the likelihood of collisions is already low. Therefore, no further practicable measures were identified that would lower the residual risk without incurring disproportionate sacrifice.

7.2.4 Results

Figure F2-13 presents the progressive ALARP assessment for the *Fauna Collisions* risk pathway, mapping residual risk reduction against cumulative sacrifice. The baseline measures account for most of the risk reduction and establish a strong initial risk profile. A turtle entrapment mitigation measure delivers a moderate additional benefit at a proportionate cost and is therefore adopted. A third measure, Passive Acoustic Monitoring (PAM), while technically feasible, offers only marginal improvement in this risk reduction relative to the increased sacrifice required. Despite being positioned well beyond the point of diminishing returns, it has been adopted due to is application to other impact pathways. The ALARP threshold is clearly defined, and the curve confirms that the accepted measures fall within the range of proportionality.

Figure F2-14 is a combined ALARP chart which validates the progressive assessment for the fauna collisions risk pathway by displaying both the residual risk reduction (bar graph) and cumulative sacrifice (line graph) for each control measure. Again, baseline measures deliver most of the risk reduction, establishing a low initial residual risk level. The turtle entrapment mitigation measure contributes additional reduction at a proportionate cost. Passive Acoustic Monitoring, while technically feasible, provides only a marginal further reduction at a sharply increased cumulative sacrifice, placing it beyond the range of proportionality and confirming the rationale for rejection in the progressive assessment, though it is adopted to manage other impact pathways and thus will be adopted anyway. The steady rise in the cumulative sacrifice curve supports the conclusion that further measures would be grossly disproportionate relative to the low remaining risk.

Table F2-20 - Step-by-step ALARP Assessment – Collisions with Marine Fauna

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	4	1.0	1.0	See individual ratings in previous tables.	1.0 (baseline normalised) – This represents the cumulative sacrifice across all baseline controls, including operational inefficiencies (e.g., low-speed transit), MFO labour and training costs, potential survey delays due to exclusion zones, and planning constraints.
2	Turtle Entrapment Mitigation	Tail buoys or streamers with no entrapment risk	4	60%	2.4	1.6	0.05	1.05	Addresses a rare but documented turtle entrapment risk by upgrading or modifying equipment that interacts with fauna near the surface. The 60% effectiveness rating reflects the ability of these equipment changes to eliminate a specific but low-frequency hazard. The rating is not higher because it is only one fauna group protected. The measure is targeted, effective in its narrow scope, and eliminates a known hazard when implemented correctly.	0.05 – This value is driven by the need to either retrofit or replace existing tail buoys with entrapment-safe alternatives. The cost is limited to equipment procurement or retrofit labour and applies only to vessels still using legacy buoys, making it low but not negligible.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
3	Passive Acoustic Monitoring	Use of PAM during periods of low visibility or night-time to detect vocalising cetaceans and trigger mitigation action	1.6	40%	0.64	0.96	0.15	1.20	Moderate – PAM provides valuable detection capability during low-visibility conditions when visual observers are ineffective. It enhances detection of vocal species like baleen whales but is less effective for non-vocalising or deep-diving species. The 40% effectiveness rating reflects this selective capability. While PAM does not detect all fauna types, it provides strong coverage in conditions where visual monitoring fails, making it a meaningful but partial addition to detection capacity.	0.15 – This includes costs associated with equipment rental or purchase, deployment and calibration on vessels, additional staff or training to operate the system, and data interpretation. Cost is considered moderate due to specialised hardware and integration requirements already being adopted to manage other pathways.

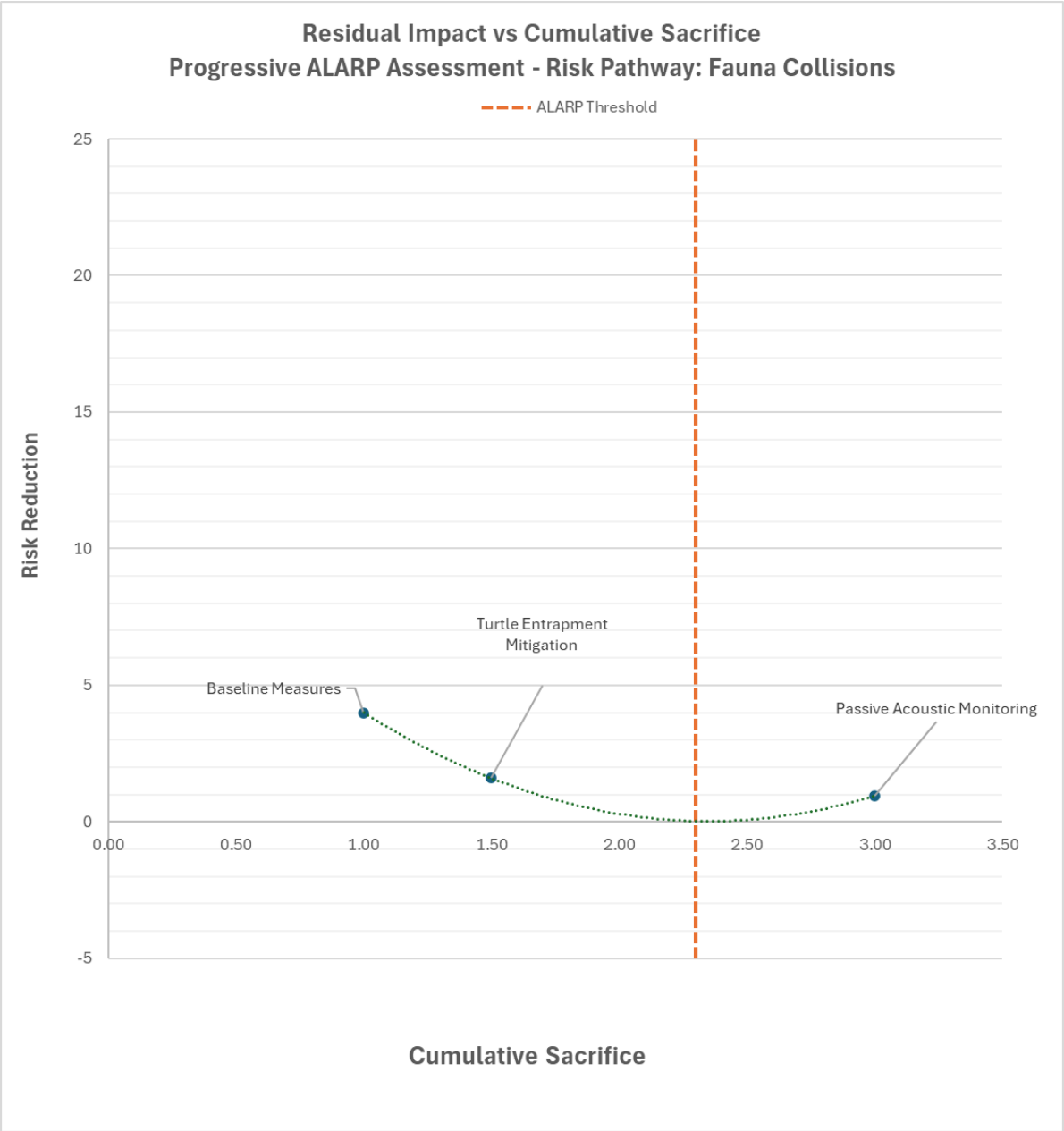


Figure F2-13 - Progressive ALARP assessment graph showing residual risk versus cumulative sacrifice for the Fauna Collisions pathway.

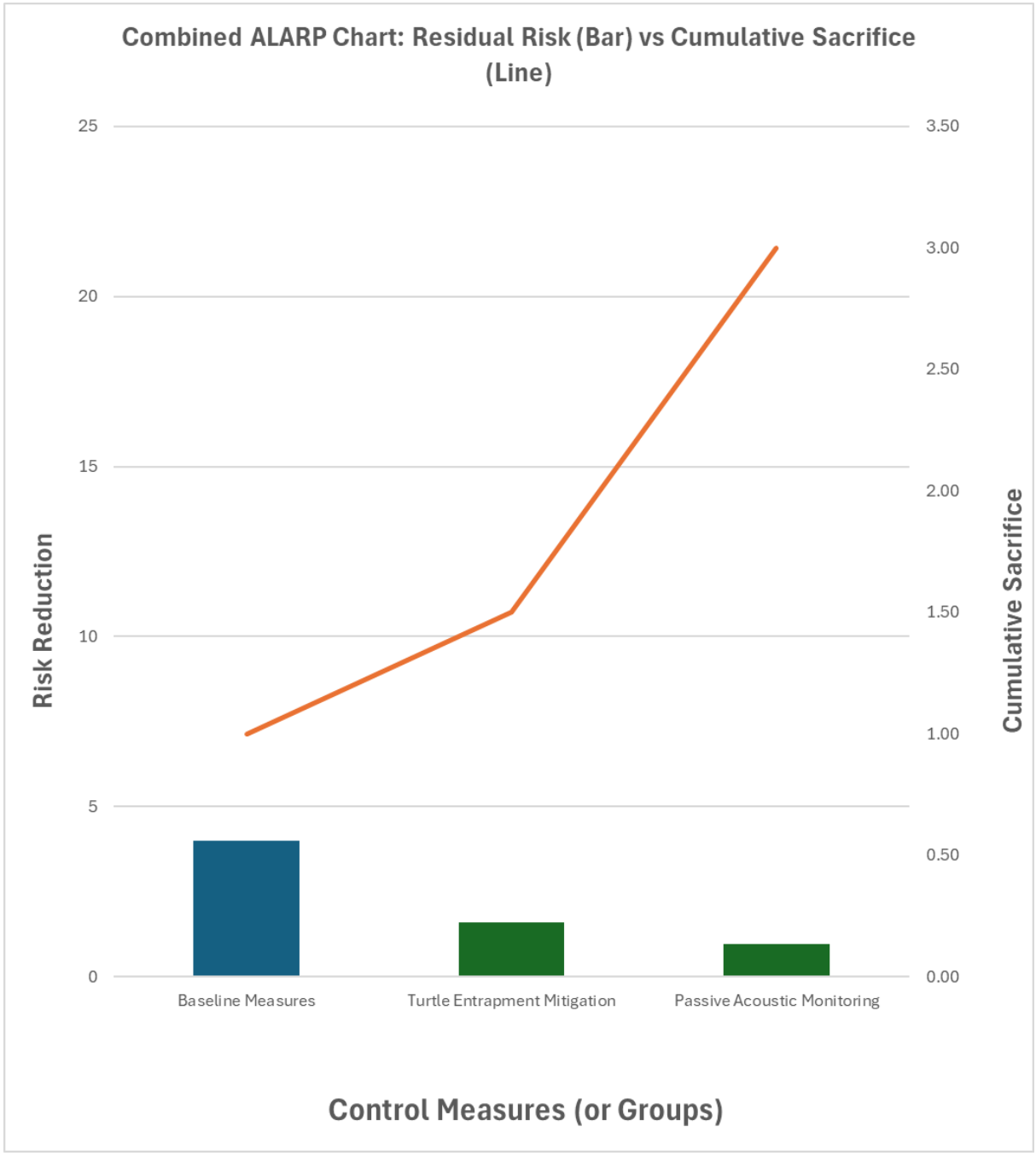


Figure F2-14 - Combined ALARP chart showing residual risk (bar) and cumulative sacrifice (line) for the Fauna Collisions risk pathway.

7.3 Introduction of Marine Pest Species

7.3.1 Baseline

Table F2-21 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline risk level and baseline quantum of sacrifice.

Table F2-21 - Baseline Measures – Invasive Marine Species

Baseline Measures	Inclusion Rationale	Intrinsic Effectiveness
Vessel contractor pre-qualification assessment	This measure ensures that only vessel contractors with acceptable biofouling management procedures and practices are considered for use. It aligns with internal environmental protection standards (GM-STD-MA-003) and acts as a proactive filter to reduce IMS risk at the earliest stages of planning and procurement. This pre-qualification assessment includes the preference for local vessels to reduce IMS risks.	This control ensures that only vessels with appropriate biofouling controls are used, reducing the risk of pest introduction by excluding unsuitable vessels at the planning stage.
OVID-style inspections	These inspections occur pre-port entry and provide assurance that marine pests are not present on vessels or associated subsea equipment. They include visual and documentary checks, cleaning verification, and adherence to vessel-specific mitigation procedures.	Real-time verification of vessel condition and cleanliness, including immersible equipment, significantly reduces the chance of live organisms being transported and introduced.
Operational Area Controls	Survey operations are excluded from zones of heightened sensitivity such as the Twelve Apostles Marine Park. Ballast water exchanges will be conducted outside of Marine Protected Areas. This reduces the potential for invasive species to enter high-value conservation areas and addresses specific concerns raised by regulators and stakeholders.	This measure eliminates the risk of IMS introduction into a nearby protected area and was adopted due to regulator and stakeholder concern.
Activity Design	The survey method avoids seabed contact by prohibiting anchoring and requiring all equipment to be stored on deck. This eliminates a major vector of pest translocation from vessel to marine habitat.	Equipment remaining on deck and absence of anchoring significantly reduces translocation opportunities for pests to reach the benthic environment.

The outcome of the risk assessment for invasive marine species was that the likelihood was ranked as Rare (1) and the consequence ranked as Major (4). Therefore, the residual risk after the application of baseline measures is Medium (4).

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- Pre-deployment and port inspections: These require scheduling vessel access and personnel time, conducting physical inspections, and reviewing documentation for all vessels prior to mobilisation. This draws on internal resources, introduces potential delays, and requires coordination with port authorities and contractors.
- Survey design restrictions and procedural controls to minimise IMS introduction risk: These include route planning that avoids sensitive areas, procedural limitations on anchoring and equipment deployment, and dry-deck stowage requirements. They result in operational

limitations, require pre-mobilisation planning effort, restrict flexibility during operations, and may extend overall survey duration.

- Contractor management overheads: Additional effort is required to vet, select, and liaise with contractors that meet marine pest mitigation expectations. This includes clarifying standards, managing compliance documentation, and enforcing pre-qualification requirements.
- Regulatory compliance checks and documentation: Ensuring all necessary documentation for ballast water, biofouling, and other marine pest-related compliance is obtained, validated, and stored imposes administrative burden and coordination time.
- Internal coordination and assurance: Interdisciplinary coordination across environmental, operations, and logistics teams is needed to implement and oversee baseline controls, adding planning and review hours.

These combined costs and efforts form the cumulative baseline sacrifice, which is assigned a unit value of 1.0 in the ALARP assessment. This allows subsequent discretionary control measures to be evaluated proportionally.

7.3.2 Assessment

Table F2-22 shows the step-by-step process followed for the ALARP assessment of invasive marine species. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-22.

Table F2-22 - Step-by-step ALARP Assessment – Invasive Marine Species

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion	-	-	-	4	1.0	1.0	See baseline table	See baseline discussion
2	Anti-fouling Systems	All contracted vessels must have properly maintained anti-fouling systems in compliance with international standards	4	80%	3.2	0.8	0.2	1.2	The 80% effectiveness rating reflects that anti-fouling systems, when properly maintained and certified, provide a significant barrier to marine pest settlement and survival on vessel hulls. This high rating accounts for their broad coverage of vessel surfaces and prolonged effectiveness in limiting fouling if regularly inspected and reapplied. The increased rating reflects confidence in newer technologies and the industry's maturity in applying them.	The sacrifice is rated moderate (0.2) because antifouling is already a regulatory requirement for international shipping and most petroleum vessels. Additional cost comes from ensuring records are up-to-date, maintenance is current, and periodic inspections and certifications are maintained beyond standard operating requirements.
3	CGG Marine Assurance System	Governance framework ensuring implementation and verification of vessel and operational biosecurity controls through prequalification, inspections, and record keeping	0.8	65%	0.52	0.28	0.2	1.4	The CGG Marine Assurance System provides a structured governance mechanism to confirm that vessel-based controls (e.g., biofouling management, inspection regimes) are being properly implemented. A 65% rating reflects its central role in verifying compliance and integrating assurance into the planning cycle, though its effectiveness depends on the quality of oversight and the willingness of contractors to comply.	The incremental sacrifice is moderate (0.2), reflecting the effort involved in administration, audits, documentation, and corrective actions. However, much of the infrastructure is already embedded in CGG systems and represents an extension of existing assurance functions.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
4	IMS Risk Assessment Procedure	Structured assessment aligned with national standards, ensures inspections of vessels and immersible equipment	0.28	70%	0.20	0.08	0.3	1.7	A 70% effectiveness rating is justified because the IMS Risk Assessment Procedure systematises checks across vessels and immersible equipment, ensuring compliance and reducing the likelihood of oversight or inconsistency. This structured process adds discipline and repeatability, particularly in complex multi-vessel operations.	A moderate sacrifice value of 0.3 is assigned, reflecting the resources needed to develop, administer, and audit the procedure across operations. While the cost is non-negligible, it delivers a proportionate benefit through improved assurance, documentation, and rigour.

7.3.3 Consideration of Alternative, Additional, or Improved Control Measures

A structured feasibility scan was conducted as part of the IMS risk review. Additional or alternative measures such as deploying IMS-detection technologies or stationing a dedicated marine pest observer onboard were considered but found to deliver negligible additional benefit relative to their cost and operational burden.

Ballast water and biofouling compliance checks were considered at Step 4 and have been adopted as part of the IMS Riak Assessment Procedure. These checks ensure vessels comply with national and international legislation (e.g., Ballast Water Management Convention). The inclusion ensures discharge and hull fouling risks are actively managed in line with regulatory obligations and industry best practice. These checks directly prevent common vectors of marine pest transmission, including ballast water discharge and unmanaged hull biofouling, and provide coverage across all key pathways.

Hull cleaning and/or new antifouling coat application to vessel hull and niche areas prior to the Regia MSS was also considered. While this measure offers some environmental benefit, it was rejected on the grounds that the benefit is marginal when extensive existing measures are already in place. The cost of undertaking inspections and hull cleaning could range from tens to hundreds of thousands of dollars, depending on vessel size and operational logistics. Implementing this requirement uniformly across all vessels was considered disproportionate to the residual level of risk, especially where vessels already demonstrate low IMS risk profiles. The sacrifice associated with this measure was estimated at 2.0, well beyond what is considered reasonably practicable given the minor additional effectiveness.

Improved IMS risk assessment procedure specific to the Regia MSS was also considered. The existing procedure already mandates that an IMS risk assessment be conducted on vessels and immersible equipment by a qualified IMS inspector prior to mobilisation to the operational area. As such, creating a procedure specific to the Regia MSS was assessed to provide no additional environmental benefit. The associated cost was modest, estimated at 0.01, but the measure was still rejected as unnecessary given the strength of the existing risk management process.

The control measures assessed were found to achieve an overall risk reduction from medium to low and were assessed as reasonably practicable. No further measures were found to offer proportionate environmental benefits to justify their adoption at the current residual risk level.

7.3.4 Results

Figure F2-15 presents the risk reduction achieved through the implementation of control measures for the invasive marine species risk pathway, plotted against the cumulative sacrifice incurred. The baseline measures deliver the largest initial reduction in risk and represent mandatory compliance with biofouling and ballast water management requirements. Additional control measures—including the CGG Marine Assurance System, use of anti-fouling systems, and an Invasive Marine Species (IMS) Risk Assessment Procedure—deliver smaller incremental improvements in risk reduction. However, all measures are adopted prior to the point of diminishing returns, with the IMS Risk Assessment Procedure sitting just before the ALARP threshold. The curve remains downward sloping, indicating continued effectiveness, though with reduced marginal gains per unit of sacrifice.

Figure F2-16 validates the assessment of the pathway by displaying residual risk reduction (bar) alongside the cumulative sacrifice (line) for each successive control measure. The greatest reduction is delivered by the baseline measures, while the incremental environmental benefit of anti-fouling systems, the CGG Marine Assurance System, and the IMS Risk Assessment Procedure is modest by comparison. The cumulative sacrifice increases with each additional measure, but all adopted controls remain below the ALARP threshold, confirming their proportionality and value in further

reducing risk. This is despite a significant disproportion between the final measure and the cumulative sacrifice.

Based on this evaluation, and considering the high cumulative effectiveness of baseline and adopted control measures, the pathway is assessed to be reduced to ALARP.

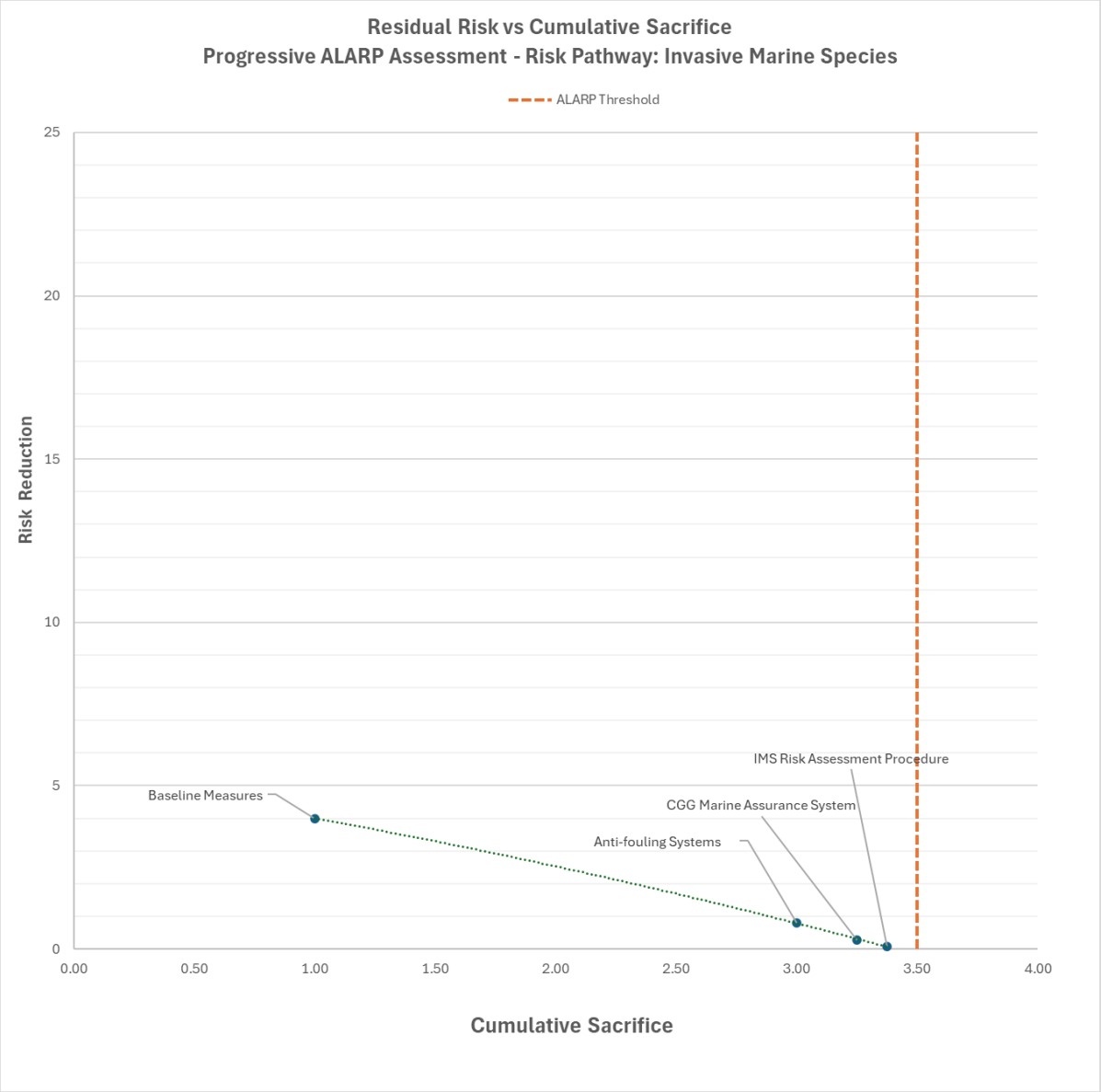


Figure F2-15 - Progressive ALARP assessment for the Invasive Marine Species risk pathway showing residual risk reduction versus cumulative sacrifice.

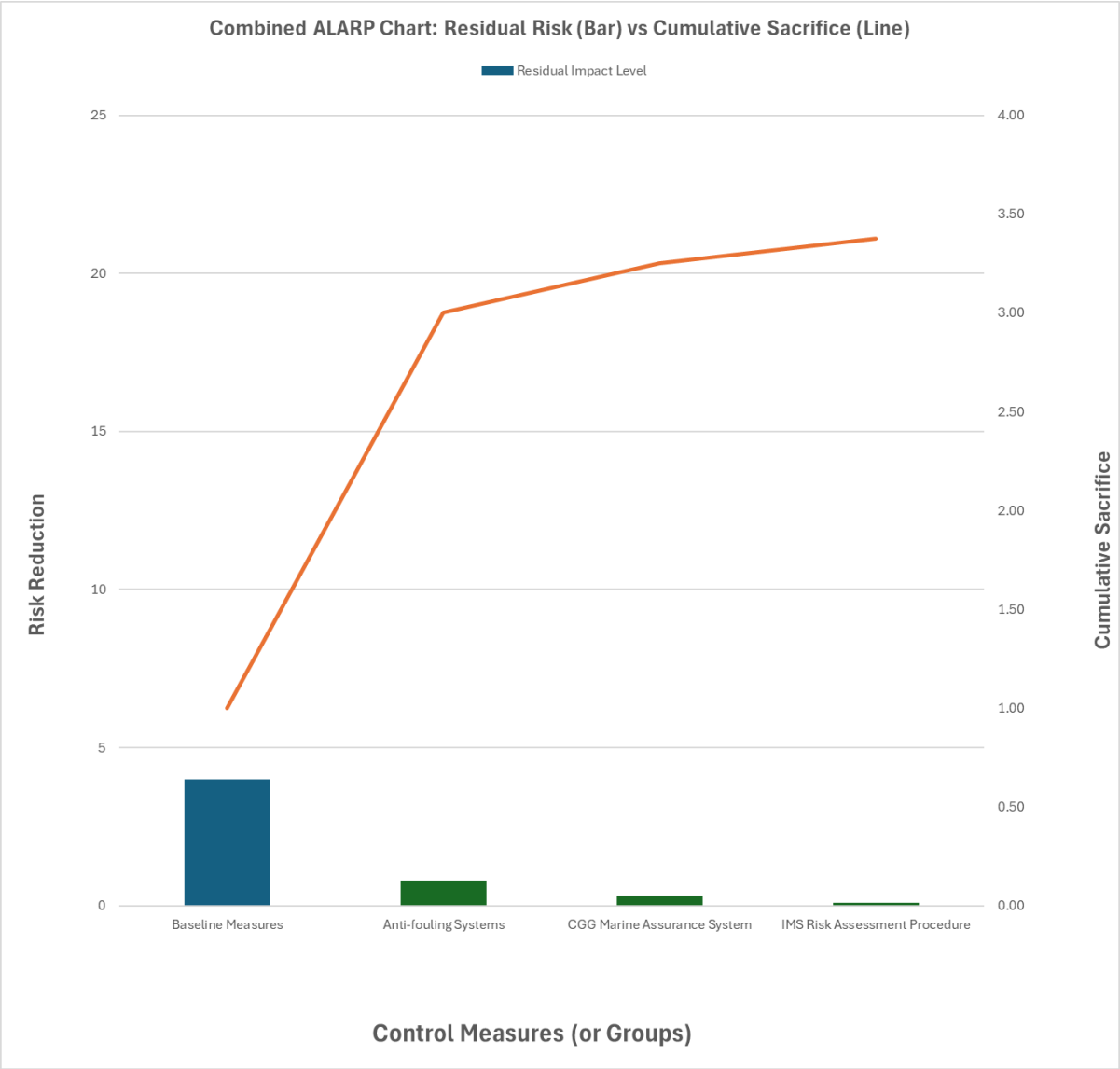


Figure F2-16 - Combined ALARP chart showing residual risk reduction (bars) and cumulative sacrifice (line) for the Invasive Marine Species risk pathway.

7.4 Accidental Release of Fuel

7.4.1 Baseline

Table F2-23 specifies the activity limitations, legislative requirements, and components of the implementation strategy that have been considered in the establishment of a baseline risk level and baseline quantum of sacrifice.

Table F2-23 - Baseline Measures – Accidental Release of Fuel

Baseline Measure	Inclusion Rationale	Intrinsic Effectiveness
Fuel inventory capped at 250 m³	Fuel tank inventories limited to 250 m³ to reduce maximum credible spill volume.	Limiting the fuel tank inventory directly constrains the worst-case volume of spill in the event of a loss of containment, reducing potential impact footprint and aiding spill response effectiveness.
No bunkering within 50 km of marine parks	Bunkering restrictions reduce the risk of fuel exposure to sensitive marine environments in the unlikely event of a spill.	Limiting bunkering locations spatially near marine parks protects biodiversity values and minimises the consequence of a potential release.
Compliance with marine legislation	Compliance with Navigation Act, MARPOL, COLREGS and Marine Orders ensured by CGG Marine Assurance System.	Legislative compliance is critical in ensuring industry-accepted safe vessel operation standards are adhered to, thereby minimising the risk of vessel incidents that could lead to fuel spills.
Use of dry-break couplings during refuelling	Use of dry-break couplings during refuelling to limit maximum credible release. Whilst this is an item of equipment it is also a legislative requirement for at-sea bunkering.	Dry-break couplings minimise the volume of release in the event of a refuelling hose failure, offering both preventative and containment benefits.
Spill response equipment and crew training	Vessel spill response equipment and training in place for immediate containment and response.	Readily available response equipment and trained personnel provide the ability to quickly contain a spill, minimising its spread and potential impact.
Emergency Plans	The Shipboard Oil Pollution Emergency Plan (SOPEP) and Oil Pollution Emergency Plan (OPEP) are legislative requirements detailing the role of vessel masters, CGG and AMSA in the event of an oil spill.	The SOPEP and OPEP ensure a coordinated and compliant emergency response in line with national expectations, ensuring roles, communication, and resourcing are clear during an incident.
Operational and Scientific Monitoring Plan (OSMP)	Operational and Scientific Monitoring Plan (OSMP) developed to identify effects of a fuel release. It is a legislative requirement.	Monitoring allows for timely detection of environmental effects and informs escalation or remediation actions, supporting environmental protection outcomes.

The outcome of the impact assessment for accidental release of fuel was that the likelihood was ranked as Rare (1) and the consequence ranked as Moderate (3). Therefore, the residual risk after the application of baseline measures is Medium (3).

The quantum of sacrifice for complying with the baseline has been calculated and includes the following:

- Engineering, design, and operational constraints to limit fuel tank capacity to 250 m³, ensuring that potential spill volume remains within manageable limits.

- Development, acceptance, and ongoing implementation of a NOPSEMA-compliant Oil Pollution Emergency Plan (OPEP), including scenario planning, response escalation, and stakeholder coordination protocols.
- Procurement and installation of dry-break coupling systems across relevant fuel transfer lines, minimising potential release volumes during hose or valve failure.
- Purchase, placement, and maintenance of vessel spill response kits, including absorbents, booms, and portable containment, along with regular crew training in their deployment.
- Integration of fuel containment and transfer risk controls within the CGG Marine Assurance System, encompassing routine inspections, audit procedures, and contractor compliance obligations.
- Design and deployment of an Operational and Scientific Monitoring Plan (OSMP) tailored to hydrocarbon release scenarios, supported by contingency arrangements for escalation to AMOSC and/or scientific advisors.

The baseline for this risk pathway is intentionally set at a high level because any accidental release of fuel is considered unacceptable. In this context, investment in preventive controls delivers the highest environmental return and is a necessary foundation for achieving ALARP. These baseline measures represent a comprehensive package of activity limitations, legally mandated requirements, and established good practice measures. As a result, the additional controls assessed in this ALARP process build upon an already low residual risk. This means their relative incremental sacrifices appear small in comparison. However, this does not mean they are low-cost or trivial to implement. The cumulative quantum of baseline sacrifice is normalised to 1.0. All further control measures will be evaluated relative to this.

7.4.2 Assessment

Table F2-24 shows the step-by-step process followed for the ALARP assessment of Accidental Release of Fuel. The reasons to support assigning percentage values for the intrinsic effectiveness (or environmental benefit) and the incremental sacrifice are provided in Table F2-24.

Table F2-24 - Step-by-step ALARP Assessment – Accidental Release of Fuel

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
1	Baseline Measures	See baseline table and discussion.	-	-	-	4	1.0	1.0	See discussion above.	See discussion above.
2	Support Vessel	Additional vessel support prevention of collision	4	95%	3.80	0.20	0.4	1.4	The support vessel provides navigational safety by front-running the seismic vessel, clearing potential hazards and actively communicating with oncoming traffic. It also holds the capability to tow the seismic vessel in case of mechanical failure, significantly reducing the likelihood of a scenario that could lead to an accidental release of fuel. This high intrinsic effectiveness score (95%) reflects its proactive role in avoiding both collision and loss-of-position incidents.	The sacrifice reflects the high operational cost of chartering, crewing, fuelling, and maintaining a dedicated support vessel for the duration of the survey. Although it provides multiple safety functions, the investment is substantial, particularly as the risk has already been reduced through previous procedural controls. However, the full cost of the support vessel wouldn't be the correct allocation as it functions to reduce other impacts and risk. A score 0.4 has been assigned to this sacrifice.
3	CGG Marine Assurance System	Contractor vessel vetting system for safety, pollution, and refuelling standards	0.20	50%	0.10	0.10	0.2	1.6	The CGG Marine Assurance System introduces a structured vessel vetting process focused on pollution prevention and refuelling safety. The environmental benefit is modest, given overlap with baseline legal obligations, but it strengthens consistency and quality assurance across contractors. It is highly effective because it must always be applied by CGG and includes pre-survey audits and inspections but due to the overlap with legislative measures only receives a score of 50%.	The associated sacrifice includes moderate administrative and financial burdens such as audit coordination, vessel pre-qualification, and potential scheduling delays if vessels fail assurance. This is not a one-off or periodic investment relative to operational scale, justifying a small sacrifice rating of 0.2.

Step	Short Title	Detail of Control Measures	Res Previous	IE (%)	MR	Res After	Incremental Sacrifice	Cumulative Sacrifice	Intrinsic Effectiveness	Sacrifice Quantum
4	Vessel Bunkering Procedure	Procedure for supervision and hose integrity checks during fuel transfers.	0.10	90%	0.09	0.01	0.3	1.9	The Vessel Bunkering Procedure introduces formal checks for hose integrity, spill trays, and supervision during all refuelling activities. It significantly reduces the likelihood of small operational spills, which represent the most credible release scenario for this pathway. Its high effectiveness score (90%) reflects its clear and targeted function, ease of implementation, and strong compatibility with baseline controls.	The sacrifice primarily arises from additional crew time during refuelling, adherence to procedure, and minor scheduling adjustments. These are modest increases in operational burden and are easily absorbed by vessel crews. Given its high effectiveness and practical implementation, a moderate incremental sacrifice of 0.3 is justified.
5	Petroleum SIMOPS Plan	Requires coordination across all petroleum activities in the region.	0.01	20%	0.002	0.008	0.3	2.2	The Petroleum SIMOPS Plan sets out procedures for managing simultaneous operations between vessels, with specific attention to coordination during refuelling. While its effectiveness (20%) is lower than previous measures due to its indirect role, it helps reduce confusion and human error in multi-vessel operations, particularly during bunkering. It integrates well with the baseline measures and supports procedural clarity during higher-risk transfer activities.	The sacrifice is associated with upfront planning effort, crew training, and inter-vessel communication protocols. While not resource-intensive, it requires alignment between different operational teams and regular updates, especially during dynamic offshore campaigns. The procedural overhead and ongoing coordination needs justify a moderate sacrifice rating of 0.3. For this risk alone the measure would be grossly disproportionate. However, it is adopted for management of other impacts and risks so will be useful for management of this risk too.

7.4.3 Consideration of Alternative, Additional, or Improved Control Measures

One additional control measure was considered:

Double-Walled or Internal Fuel Tanks

Double-walled or internal fuel tanks offer an additional barrier against fuel loss in the event of a hull breach or collision. These are increasingly found on modern vessels and can materially reduce the likelihood of a release due to external damage. However, retrofitting vessels with such tanks is not reasonably practicable due to prohibitive costs and technical complexity. Therefore, this measure has only been partially adopted by giving preference to vessels with double-bottomed or double-walled tank configurations during vessel selection as part of the CGG Marine Assurance System. The associated sacrifice was estimated at 4.4, reflecting the significant financial and scheduling implications of requiring double-walled tanks. This approach achieves a partial benefit by incorporating the measure at the procurement stage without imposing retroactive modification obligations.

7.4.4 Results

Figure F2-17 illustrates the results of the progressive ALARP assessment for the risk pathway accidental release of fuel, plotting residual risk reduction against cumulative sacrifice. The baseline measures deliver most of the risk reduction, with the addition of the support vessel, CGG Marine Assurance System, and the vessel bunkering procedure offering further reductions. The Petroleum SIMOPS Plan contributes only marginal additional reduction, with increasingly disproportionate costs. The trendline confirms the presence of diminishing returns, with the inflection point reached prior to adoption of the final measures. Due to small additional benefit, the SIMOPS Plan falls just below the ALARP threshold and is retained due to their broader impact and risk management utility. The analysis shows that most of the effective risk reduction is achieved early, reinforcing the efficiency of the baseline controls.

Figure F2-18 shows a combined ALARP chart for the accidental release of fuel risk pathway validates the results of the progressive assessment by displaying both residual risk reduction (bar) and cumulative sacrifice (line) for each control measure. The baseline measures deliver the largest reduction in risk, while successive measures such as the support vessel, CGG Marine Assurance System, and vessel bunkering procedures contribute incremental improvements. The Petroleum SIMOPS Plan, while offering minimal additional reduction, incurs a substantial cumulative sacrifice. The vertical reference line indicates where costs become grossly disproportionate, confirming that this final measure lies at the margin of acceptability and should be scrutinised carefully. The chart supports the earlier finding that diminishing returns are reached quickly and reinforces the value of early-stage control measures.

Based on this evaluation, and considering the high cumulative effectiveness of baseline and adopted control measures, the pathway is assessed to be reduced to ALARP.

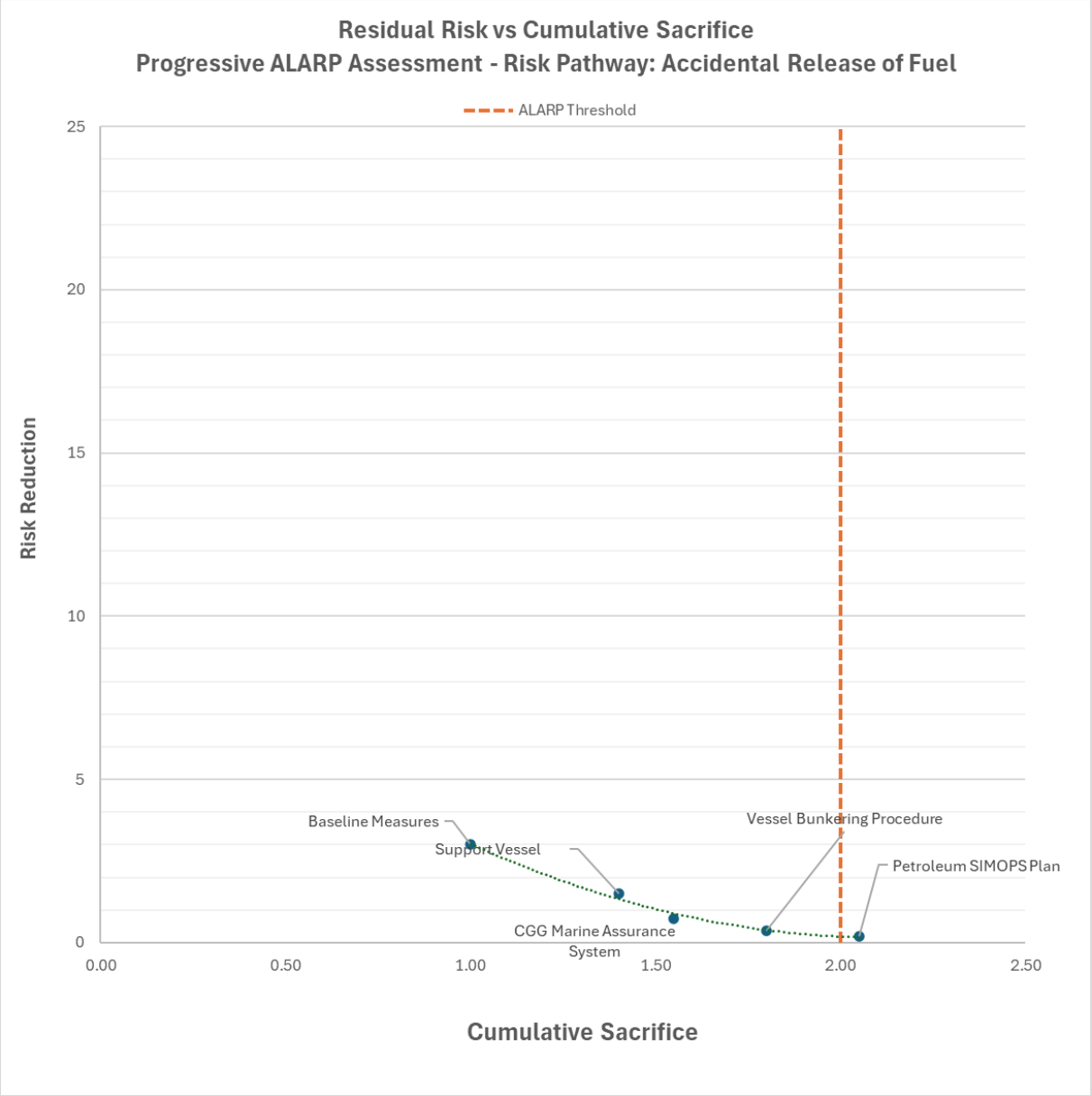


Figure F2-17 - Residual Risk vs Cumulative Sacrifice for the Accidental Release of Fuel risk pathway, demonstrating that most of the risk reduction is achieved through baseline and early-stage controls, with later measures yielding marginal gains approaching the ALARP threshold.

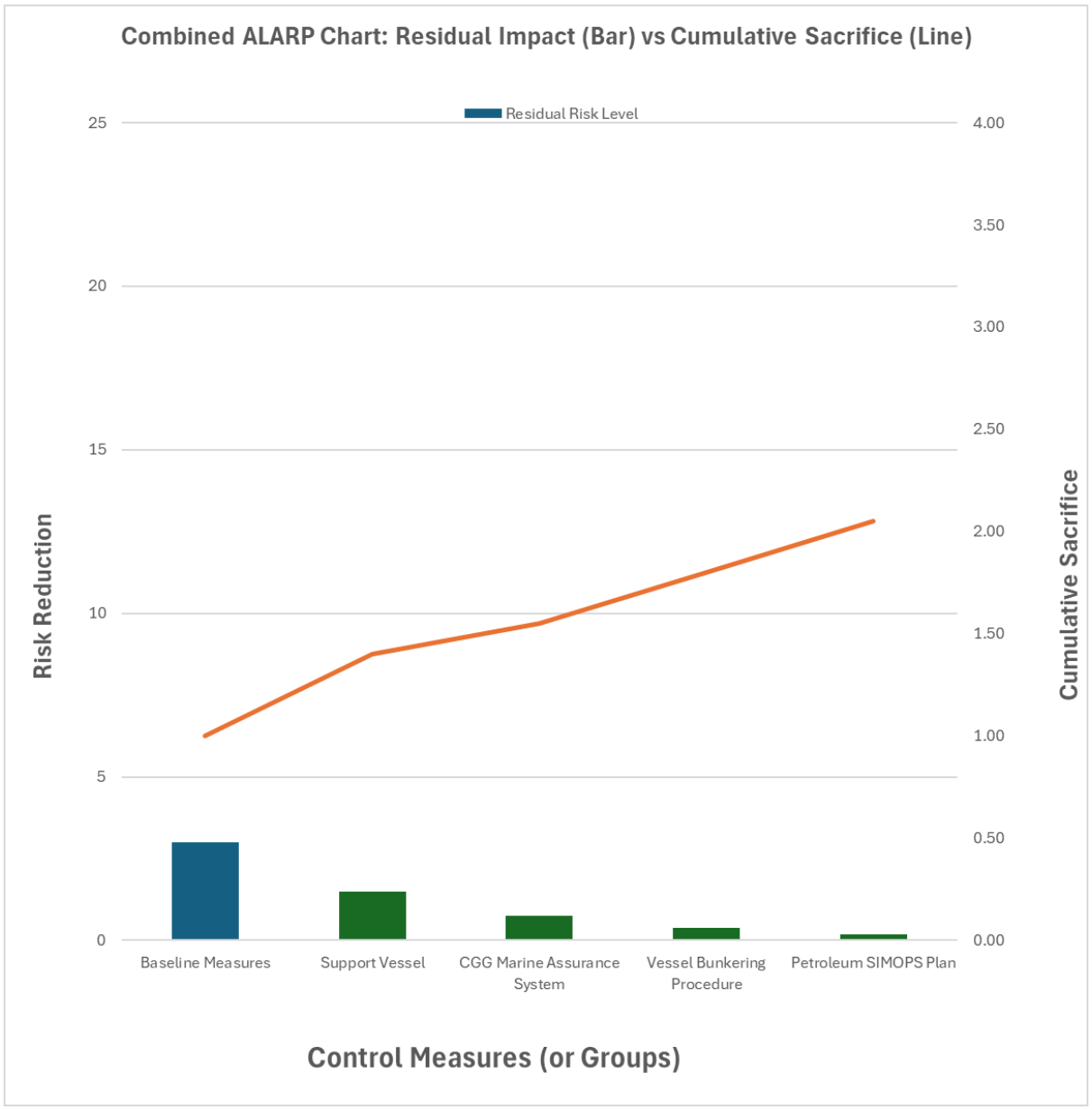


Figure F2-18 - Combined ALARP chart showing residual risk reduction (bar) and cumulative sacrifice (line) for the Accidental Release of Fuel risk pathway, highlighting diminishing returns and validating the ALARP threshold for identifying grossly disproportionate measures.

8 Conclusion

CGG have used a semi-quantitative approach that shows how much environmental benefit is achieved for every unit of sacrifice we invest - reduction per unit of sacrifice. In simple terms this is like the term '*return on investment*', but for environmental performance. It allows us to compare across all the different environmental impact and risk pathways and present a strong demonstration that each is managed to ALARP.

Figure F2-19 presents the environmental impact/risk reduction per unit of sacrifice across all assessed cause effect pathways. The value is calculated by dividing the total reduction in residual impact or risk by the cumulative sacrifice (expressed as a relative unit) associated with the implementation of adopted control measures. This metric highlights the relative return on investment for each pathway in terms of environmental benefit per unit of cost, time, or operational complexity.

Higher values indicate pathways where significant environmental improvements were achieved with a commensurately higher degree of sacrifice. For example, Planned Discharges and Atmospheric Emissions show low returns (i.e. a lower reduction per unit of sacrifice) because the baseline measures achieved almost complete mitigation with minimal additional sacrifice. Conversely, Underwater Sound and Physical Presence exhibit higher returns due to the large reduction per unit of sacrifice required to reduce impacts that are inherently difficult to manage, reflecting both the complexity and the uncertainty involved.

This analysis complements the ALARP assessments completed for each pathway by illustrating the comparative efficiency of mitigation efforts, helping to validate that resources were allocated in a proportionate and defensible way.

The calculation of impact/risk reduction per unit of sacrifice (i.e. total reduction divided by cumulative sacrifice) provides a normalised measure of efficiency across different impact and risk pathways. It tells you how much environmental benefit is being gained for every unit of effort, cost, or time invested.

This is especially valuable because:

1. It allows for comparison across pathways: Each impact or risk pathway is different in scale, consequence, and complexity. By normalising the return on sacrifice, this calculation shows where investments in control measures are most efficient — and where they may offer diminishing returns.

2. It validates proportionality: ALARP assessments must demonstrate that impacts and risks are reduced in proportion to their significance. This metric helps show that greater effort has been applied where potential harm is greatest, aligning with the core principle of focusing resources where they matter most.

3. It supports decision-making: When determining whether further control measures are warranted, this value helps to identify when additional effort would result in marginal benefit — a key consideration in recognising the point of gross disproportion.

4. It's defensible: If challenged, this ratio helps explain and justify why some measures were adopted and others were not. It shows that decisions were not arbitrary but grounded in a consistent, semi-quantitative framework.

5. It is visually communicative: When plotted in a figure, it provides a compelling illustration of where value was achieved — and helps non-technical audiences understand the logic used in environmental protection.

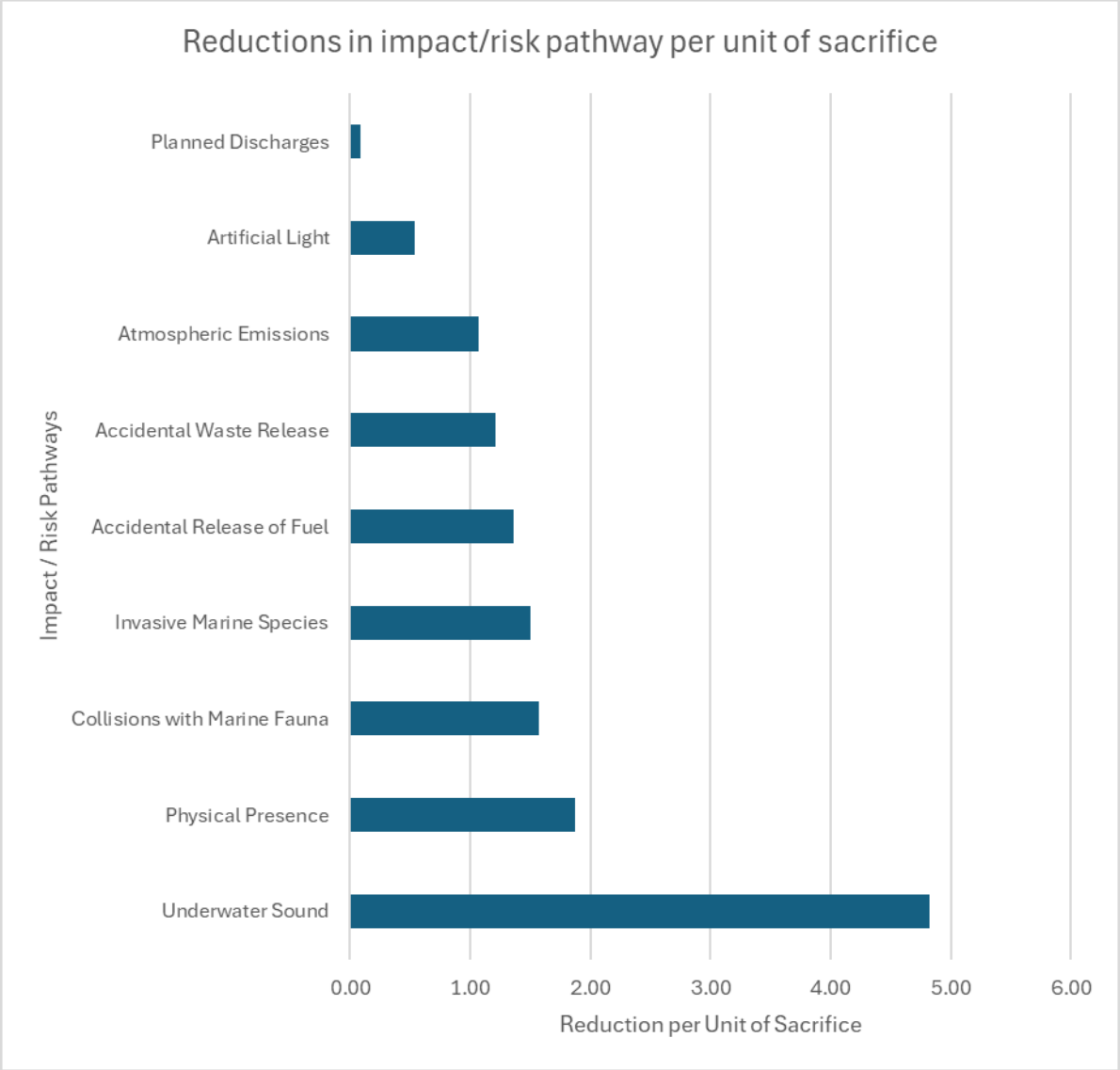


Figure F2-19 - Environmental Impact/Risk Reduction per Unit of Sacrifice for Each Assessed Pathway.

The ALARP assessments presented in this report demonstrate that control measures have been applied with appropriate proportionality across all impact and risk pathways. The analysis shows that pathways associated with the greatest potential for environmental harm — such as underwater sound and physical presence — received the most significant investment and yielded the highest levels of risk and impact reduction per unit of sacrifice. Conversely, for pathways where residual impacts / risks were already very low after baseline measures, further reduction would have required disproportionate sacrifice for limited benefit and was therefore not pursued.

This outcome reflects a systematic, thorough, disciplined and evidence-based application of the ALARP principle, ensuring that each control measure adopted contributes meaningfully to impact and risk reduction and that cumulative effort has been directed where it matters most. The framework applied throughout this assessment supports a conclusion that impacts and risks have been reduced to a level that is as low as reasonably practicable.

9 Document Control

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	29 June 2023	MS	Template created.
0.1	1 October 2023	MS	Updated with control measures from impact and risk assessments.
0.2	6 October 2023	SJ	Reviewed for consistency with the impact and risk assessments.
1	29 December 2023	MS	Updated following consultations and polished for submission to NOPSEMA.
2	15 May 2024	RH/AC/MS	Updated after public comment to include adoption of a dedicated spotter vessel and MFOs for marine fauna detection.
3	7 November 2024	MS	Updated following NOPSEMA assessment.
4	16 April 2025	MS	Updated following NOPSEMA assessment to include all the background data and methodology that underpinned previous work. Reset baselines to accommodate differences across each impact/risk rather than one anchor point baseline to allow comparison.
5	9 December 2025	MS	Updated following NOPSEMA assessment.

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Annex 1- Public Comment

The completed EP was published for public comment on the NOPSEMA website on 25 Jan 2024 for a 30-day period, closing 26 February 2024. Table F2-25 shows how this feedback has been incorporated into the environmental assessments.

Table F2-25 - Public comment input into the preparation of the EP.

Matter	Matter ID	Changes made arising from public comment
Matter: Consideration of alternative survey technology	O01	CGG acknowledges claims regarding the consideration of alternative survey technologies and EP Appendix F2 (ALARP Assessment) has been updated to include additional information on this assessment.

Annex 2- Objections and Claims Raised from Consultation

During the consultation process relevant persons were invited to raise objections and claims about the adverse effects of the activity. An assessment of merit of each objection or claim has been made by CGG which can be found in the consultation report using the Feedback ID number shown in Table F2-26. If an objection or claim had merit and was relevant to this assessment it has been included in the table below.

Table F2-26 - Objections and Claims raised from consultation.

Feedback ID	Objection or Claim Summary	Titleholder Response	Event ID
4137	Mention of installing sound curtains underwater to reduce destructive sound.	Bubble curtains are not suitable for a moving activity, nor are other measures such as acoustic blankets. This has been included in the ALARP assessment.	2830
4297	The stakeholder requested to know the total cost of the MSS so they could ascertain if ALARP had been reached, as a cost-benefit analysis. The information provided by the titleholder to date was deemed insufficient to know if ALARP had been achieved.	Outlined the concept of 'costs' is more than the narrow interpretation of a monetary value, it includes money, time and trouble. Outlined that the 'cost' of a control measure could be weighed against total costs of the survey for context but that this point of reference fails to consider the environmental benefit of adopting the control. Agreed that the current presentation of ALARP could be improved and that CGG would prepare a dedicated report explaining how we have reached decisions about what measures needed to be adopted (Event ID 4062).	4062
4339	What new technologies are CGG considering for reducing impacts?	Provided the reasons that these technologies are currently not proposed, however acknowledge that they aren't explicitly excluded and if they become viable as the design of the activity is refined, they'll be considered (Event ID 4280).	3705
4359	Request for seismic blasting to be limited to 12 hours out of any 24-hour period and not carried out at night	The titleholder acknowledged this concern, however undertaking the seismic survey only in daylight hours would have a disproportionate cost without a significant environmental benefit. The survey would take twice as long, potentially resulting in cumulative effects to sensitive species.	2821
4178	Seismic should not be used; use alternative methods to seismic blasting to map the seabed.	No measures were adopted because of this claim. Utilising acoustic sources for marine seismic surveying provides a framework grounded in extensive research and practical experience. Their environmental impacts, both short-term and long-term, have been studied, facilitating the development of effective mitigation strategies. On the other hand, marine vibriosis, while holding promise as a newer technology, is not only more expensive but also shrouded in technical and environmental uncertainties. Its long-term effects, particularly concerning particle motion and its potential impact on marine ecosystems and sensitive aquatic species, remain inadequately explored. Exploring these environmental impacts is unlikely until the technology is commercially competitive. Until we have a comprehensive grasp of these implications, it is prudent to rely on technology with known and manageable impacts rather than embracing potentially riskier avenues	3145

Feedback ID	Objection or Claim Summary	Titleholder Response	Event ID
		with unforeseen or highly uncertain environmental impacts.	
4375	Claims that threats from the survey to SRW and their migration routes and HCTS means that impacts from the Regia survey are not ALARP.	Event ID 6529 - ALARP (As Low As Reasonably Practicable) is a criterion used to determine whether control measures should be implemented by balancing the environmental benefit with the sacrifice required for their adoption. NOPSEMA guidance and the Regia MSS EP provide details on how to demonstrate that environmental impacts and risks are reduced to ALARP. The stakeholder claims that "such threats do not pass the ALARP test," but its statements about SRWs and the eastern SRW population, some of which are directly copied from the SRW National Recovery Plan, fail to address control measures, their benefits or costs, or critique the ALARP demonstration presented in the Regia MSS EP. As a result, this claim is unclear in its application of the ALARP concept. CGG is open to further educating the stakeholder on the ALARP concept, assuming they are trying to provide information that might lead CGG to reconsider the control measures implemented or rejected, which have already demonstrated that environmental impacts and risks of the proposed Regia MSS have been reduced to ALARP.	6410
4488	Claims that CGG has not incorporated effective control measures to reduce impacts and risks to ALARP or to ensure those impacts will be acceptable. It maintains that several control measures in the Environment Plan (EP) are inconsistent or conflicting, making them difficult or impossible to implement. GMTOAC further contends that CGG has weakened its mitigation framework compared with the November 2024 EP by replacing required sound-source shutdowns with an undefined “low power zone” when Karntubul (Southern Right Whales) are present. Also, that CGG has not ensured its activity will avoid unacceptable impacts on Koorn Moorn, which feed in Nyamat Mirring waters extending 200 m around Deen Maar Island. It claims CGG has not used the best available science in its noise modelling and has relied on comparative analyses rather than updated models, making results difficult to interpret. Additionally, GMTOAC argues	CGG maintains that the Environment Plan (EP) incorporates effective control measures and satisfies the legal requirements for demonstrating that impacts and risks have been reduced to As Low As Reasonably Practicable (ALARP) and to an acceptable level. It asserts compliance with Regulation 34 and emphasises that its environmental performance outcomes and controls are grounded in the best available science and tailored to the identified ecological and cultural sensitivities. Culturally significant species and features, including Karntubul and Koorn Moorn, are included in impact and cumulative risk assessments using a methodology intended to reflect both scientific evidence and cultural. CGG argues that GMTOAC’s objections substitute personal disagreement for the regulatory test, noting that the legislation does not require stakeholder agreement or grant veto powers over EP design decisions. While GMTOAC criticises the revised ALARP assessment methodology (April 2025 EP), CGG reiterates that its approach satisfies the regulatory criteria. In response to claims that mitigation measures have “weakened”, particularly the shift from sound-source shutdowns to a “low power zone”, CGG characterises these changes as part of a normal, adaptive, and consultation-driven refinement process. It describes the evolution of the activity as a progressive reduction in operational footprint, increasingly targeted controls, and strengthened performance-based measures, noting that core protections such as timing restrictions to avoid Karntubul birthing seasons remain in place.	EVT352

Feedback ID	Objection or Claim Summary	Titleholder Response	Event ID
	that the revised ALARP assessment methodology introduced in the April 2025 EP, intended to address flaws in the November 2024 version, is inadequate, less systematic, and less defensible than the earlier approach.	CGG states that cultural and ecological sensitivities associated with Karntubul, Wuuloc, and Koorn Moorn have been integrated into the assessment, with Appendix F3 acknowledging their cultural significance and informing mitigation commitments. CGG reiterates that its control measures are based on contemporary scientific evidence and incorporate cultural and ecological sensitivities throughout the EP.	
4489	Claims that CGG cannot determine what constitutes an "acceptable" level of impact or risk to Gunditjmara cultural values in Nyamat Mirring. States the April 2025 Environment Plan contains flawed cumulative impact assessments due to this lack of consultation. GMTOAC identifies several shortcomings: CGG's interpretation of potential impacts to Gunditjmara and other First Nations cultural heritage is too narrow; CGG wrongly assumes that acceptable ecological impacts equate to acceptable cultural impacts; and CGG's cumulative impact assessment for Karntubul (Southern Right Whale), previously criticised by NOPSEMA in its February OMR, remains unchanged.	CGG rejects GMTOAC's claim that inadequate consultation prevents CGG from determining "acceptable" levels of cultural impact, asserting that it fully met its consultation obligations. CGG argues that the legal test is whether the Environment Plan demonstrates impacts and risks are reduced to ALARP and to an acceptable level. It maintains that GMTOAC's critiques conflate subjective opinion with the regulatory standard under Regulation 34 and emphasises that the law does not grant stakeholders a veto over design decisions. In response to the assertion that its interpretation of cultural heritage is too narrow, CGG maintains that GMTOAC has already articulated its cultural values clearly and extensively through published materials and received during consultation. These values, encompassing ceremony, obligations, kinship systems, spiritual relationships, and ecological connections are thoroughly integrated across the EP. The EP references the Nyamat Mirring Plan 2023–2033, incorporates cultural values and sensitivities into Appendix F3, and identifies culturally significant species and places as sensitive receptors with tailored management measures, for example, timing restrictions to avoid birthing seasons. CGG states that it has incorporated analysis of cumulative effects on Sea Country, including those arising from the survey in combination with other activities. It confirms that Karntubul is included in cumulative risk assessments with corresponding mitigation commitments.	EVT352
4507	GMTOAC objects to the ALARP methodology used in CGG's April 2025 Environment Plan (EP). In that EP, CGG adopts a "semi-quantitative" approach that begins with a baseline of assumed controls, including legal requirements and activity limitations, and then applies additional measures to which CGG assigns its own "effectiveness scores." GMTOAC argues this framework is even less systematic, transparent, or reproducible than the ALARP method rejected by NOPSEMA in 2024, as it allows CGG to define both the starting level of predicted impacts and the magnitude of their reduction.	GMTOAC's critique of the Regia MSS ALARP assessment is based on misunderstandings of the regulatory framework, the ALARP principle, and the methodology set out in Appendix F2. CGG clarifies that the ALARP baseline includes all legally required control measures and activity limitations, which cannot be altered or removed. Assertions that the baseline is arbitrarily constructed or manipulable are therefore incorrect. CGG also notes that GMTOAC's arguments are internally inconsistent, for example, claiming the baseline is both too rigid and too flexible. CGG rejects GMTOAC's claims that only measures reducing source noise can reduce noise impact, explaining that acoustic impact management relies on avoiding exposure through detection tools, shutdown zones, and real-time monitoring. Similarly, CGG clarifies that support personnel and the Whale Expert Panel are not "double counted" but serve as additional assurance mechanisms beyond baseline staffing.	EVT352

Feedback ID	Objection or Claim Summary	Titleholder Response	Event ID
	GMTOAC notes that CGG's selected "baseline" already incorporates key operational controls, shutdown procedures, exclusion zones, and seasonal timing restrictions, that CGG itself has full discretion to modify or strengthen. By embedding these controls in the baseline rather than treating them as adjustable mitigation measures, CGG effectively limits the scope for further impact reduction and risks underestimating the true level of harm. Despite this favourable baseline, CGG still predicts "High" impacts on marine mammals from underwater sound. The reduction of these impacts to "acceptable" levels is achieved by applying effectiveness scores to additional measures such as increased personnel, enhanced detection equipment, or expanded monitoring. GMTOAC argues this is flawed because these measures do not physically reduce noise exposure; they only increase the likelihood of detecting whales. In several cases, CGG appears to "double count" controls, treating them as part of the baseline while also awarding them separate effectiveness scores, which artificially reduces the predicted level of harm. GMTOAC highlights particularly problematic examples, such as CGG assigning an 80% effectiveness rating to "support personnel" and then reducing predicted harm by 80%, even though those personnel merely enable measures already included in the baseline. Similarly, CGG gives towed passive acoustic monitoring (PAM) a 50% effectiveness score and cuts predicted impacts in half, even though PAM cannot detect silent whales and has no ability to reduce noise levels themselves. Overall, GMTOAC concludes that the ALARP methodology	CGG notes that PAM is appropriately assessed and contributes to reducing exposure risk, with effectiveness ratings justified in the EP. Overall, CGG concludes that GMTOAC's critique lacks evidentiary support and overlooks the structured, transparent, and regulator-aligned approach presented in Appendix F2.	

Feedback ID	Objection or Claim Summary	Titleholder Response	Event ID
	used by CGG lacks scientific defensibility and systematically underestimates risk. GMTOAC expresses deep concern that this approach may not genuinely reduce impacts to Nyamat Mirring, its ecosystems, culturally significant species, or cultural values to acceptable or legally required levels.		

Annex 3- Ensuring Integrity in ALARP Assessments

Guidance for Assessors

Assessors are responsible for ensuring that ALARP assessments are conducted with transparency, conservatism, and discipline. While the methodology provides structure, it still relies on subjective judgments, particularly when assigning intrinsic effectiveness and estimating sacrifice. These areas are vulnerable to manipulation, whether intentional or inadvertent. To ensure the assessment remains robust and credible, assessors should:

- **Avoid Overestimating Intrinsic Effectiveness:** Resist the temptation to assign high effectiveness scores without strong justification. When there is uncertainty in the measure's performance (e.g. due to operational limitations, environmental variability, or limited evidence), a conservative estimate should be used. This ensures that the assessment does not prematurely conclude that further control measures are unnecessary.
- **Strengthen and Clarify Sacrifice Justifications:** Sacrifice should be expressed in clear, comparable terms—ideally in monetary value, but also in time and operational effort where appropriate. Avoid vague or speculative estimates. Ensure it is clear whether the sacrifice is incremental to the baseline and whether all relevant costs (e.g. training, maintenance, or implementation complexity) have been considered.
- **Document the Rationale Clearly:** Intrinsic effectiveness and sacrifice are not standalone numbers. They must be supported by detailed justification that references functionality, availability, reliability, independence, and compatibility (for effectiveness), or cost components and practical implications (for sacrifice). If a value cannot be substantiated, reassess its inclusion.

Guidance for Reviewers

Reviewers play a critical role in ensuring the ALARP assessment is applied with rigour and that conclusions are genuinely justified. When reviewing an assessment, be alert to signs of poor discipline or potential manipulation. These include:

- **Repeatedly High Effectiveness Scores:** Be cautious where multiple measures are assigned very high intrinsic effectiveness (e.g. 80–90%) without clear justification. This pattern may indicate that the assessment has been structured to reduce residual impact/risk too quickly, limiting the evaluation of other reasonable measures.
- **Vaguely Justified or Inflated Sacrifice:** Sacrifice estimates should be well explained and broken down into their component parts. Watch for measures rejected with minimal or speculative reasoning, or costs that seem out of proportion to the control measure and baseline sacrifice described.
- **Rapid Plateauing of Impact/Risk:** If the residual risk or impact drops sharply within the first few measures and the trendline flattens early, this may suggest an overly optimistic treatment of effectiveness or sacrifice. Review whether the residual values and polynomial trendlines genuinely reflect diminishing returns.

By applying these checks, reviewers can verify that the ALARP conclusion is based on a balanced and evidence-based assessment and not the result of subjective inputs skewed to justify doing less.