



Submersible Operators Group

Environmental Guidelines The Blue Handbook

*Advisory guidance only
Adopt and adapt to your system*

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Foreword

The ocean depths and freshwater bodies are not just our workplace, they are our shared responsibility

As operators, we move through fragile ecosystems that cannot speak for themselves. What we do beneath the surface matters above it too.

We are all privileged to exist, explore, and operate within some of the most extraordinary and vulnerable environments on Earth. With that privilege comes responsibility, a responsibility to lead with integrity, to innovate with foresight, and to operate with care.

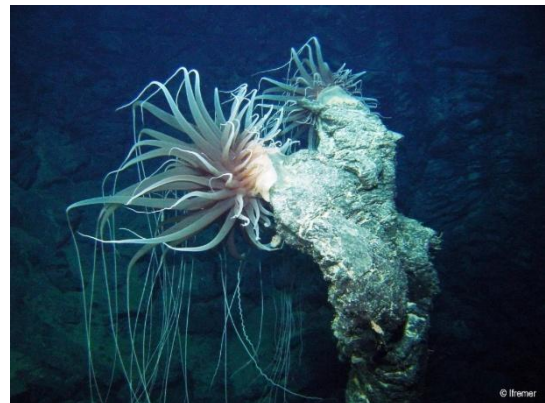
This document is a collective call to action. It is a leadership challenge. A mindset shift. A compass for those who believe operational excellence and environmental stewardship are inseparable.

Crafted with insight and intent, it challenges us to think beyond compliance and embrace our role as stewards of the environment. It is rooted in the belief that sustainability and mission success are not competing objectives, but complementary imperatives.

Within these pages, you will find practical steps, thoughtful frameworks, and a culture of continual improvement. It is designed to support all operators in the Submersible Operators Group (SOG), regardless of geography or mission, to raise the bar for what responsible and sustainable operations should look like.

This reflects who we are and who we aspire to be. Let us go forward with purpose. Let us protect what lies beneath the surface of the ocean.

**Together, we go deeper with care
Together, we protect what lies beneath**



Introduction

Purpose

These Guidelines cover marine and freshwater operations, recognising the different sensitivities of each. It contains recommended best environmental practices and the SOG ethos into one place - clear principles, straightforward techniques, and examples you can lift directly into your existing meetings and checklists. You will find guidance that works from concept to recovery. The emphasis is on simple, repeatable routines: brief the right risks, set clear abort triggers, manage fuel and waste with discipline, protect wildlife and habitats, and keep an accessible Environmental Case that shows what you did and why.

The aim for these Guidelines is to become a living baseline for the community. The intended outcome is simple: no trace, no harm, strong science, and missions we are proud to stand behind.

Scope

These guidelines have been developed by a small team in the SOG, for the SOG community and partners. They provide a strategic framework to inspire, align, and guide environmentally responsible submersible operations, provide operational efficiency, ease permit access, and build stakeholder trust.

They are a handrail, not a regulation, inviting operators to lead with purpose and foresight while recognising that local and international laws and permits always apply, and apply to mission design and procurement, operational planning and execution, recovery and logistics, scientific, research, tourism, commercial and governmental missions, and the supply chain and contractors that support them.

How to Use This Document

This document contains advice, which is practical, leadership-driven, and adaptable. It is intentionally high-level and adaptable to local law, mission type, and organisational maturity. Adopt and adapt this guidance as a living part of your culture.

The guidance in this document is split into three defined sections:

- Principles and Culture
- Systems and Processes
- Operational Guidance

This document is intended as a guideline to support a wide range of users involved in submersible organisations. Different users will come to the document with different needs.

Owners and Operators: can use it to align environmental practices with organisational strategies, and demonstrate leadership, support permitting, and build trust with clients, regulators, and communities. Use Section 1 to embed environmental performance in culture, Section 2 for an overview of Systems and Processes that can support environmental thinking and Section 3 for platform-specific good practice.

Expedition and Project Planners: can use it to design structured ways to plan expeditions, secure permits and integrate environmental thinking into planning, executing and debriefing expeditions. Section 2 contains reference material to build systems and processes, whilst section 3 helps translate environmental considerations into operational briefs.

Submersible Team Leaders: can use it to set expectations for team, shape mission briefs and embed environmental thinking in daily operations. You will find materials that help you plan missions, prepare teams for sensitive environments, and integrate controls, abort triggers, and environmental prompts into everyday

operations. Section 1 supports leadership messaging; section 2 provides structures for building environmental operations and section 3 offers specific operational guidelines.

Submersible pilots: may be looking for concrete operational guidance. Treat Section 3 as your core reference and use Section 1 for guiding principles.

Scientists: may use this document to design low-impact sampling strategies and embed environmental controls into the workflow. Scientific sampling guidance in Section 3 provides protocols that can be used in dive plans, SOPs, and permit applications.

Navigate the Document

Below is a suggested way to navigate for any user. Over time, treat this document as a living baseline. It is there to be adapted and brought in the systems and routines already in use.



Acronyms and Abbreviations

The following acronyms and abbreviations can be found throughout the document.

Acronym	Meaning
AUV	Autonomous Underwater Vehicle
BAT	Best Available Techniques (or Technology)
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means
CADMID	Concept, Assessment, Demonstration, Manufacture, In-Service, Disposal
CoC	Code of Conduct
CoP	Code of Practice
DP	Dynamic Positioning
DPA	Designated Person Ashore
DVL	Doppler Velocity Log
eDNA	Environmental DNA
EC	Environmental Committee
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ERG	Environmental Review Group
EWG	Environmental Working Group
GPS	Global Positioning System
HAB	Harmful Algal Bloom
HSE	Health, Safety and Environment
HVAC	Heating, Ventilation and Air Conditioning
ID	Identification
ISO	International Standards Organisation
KPI	Key Performance Indicator
LBL	Long Baseline (acoustic positioning)
LFE	Learning from Experience
MPA	Marine Protected Area
NTU	Nephelometric Turbidity Unit
PDCA	Plan–Do–Check–Act
PMS	Planned Maintenance System
PPE	Personal Protective Equipment
QA	Quality Assurance
RACI	Responsible, Accountable, Consulted, Informed
ROV	Remotely Operated Vehicle
RPM	Revolutions per Minute
SDS	Safety Data Sheet
SME	Subject Matter Expert
SOG	Submersible Operators Group
SOP	Standard Operating Procedure
SoC	State of Charge (battery)
UAS	Uncrewed Aircraft System (drone)

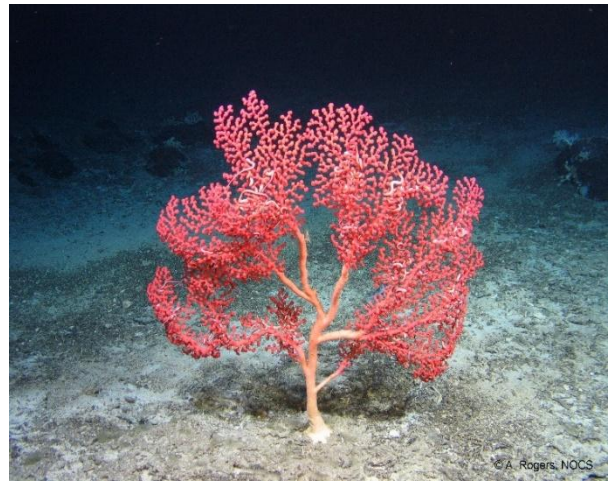
1. Principles and Culture

Who this section is for: everyone

What this section does: outlines our “Why” and the principles, behaviours, and competencies that teams need to plan, operate and improve with environmental responsibility in mind

Intended outcomes: Environmental thinking embedded in everyday decisions, visible leadership, shared ownership of outcomes

Where to go next: Use Section 2 to turn these principles into systems and processes that support consistent delivery



1.1. Our Shared Environmental Commitment

Environmental responsibility is part of who we are. It shows up in everyday choices, from how we design and procure, to how we launch, operate underwater, recover, and maintain. We reduce impact, raise efficiency, and build trust by setting clear expectations, making the right action easy, and celebrating good practice. We plan with the environment in mind, speak up when we see risks or improvements, and share what we learn so everyone gets better together.

Together we can:

- Embed environmental responsibility into organisational culture and decision-making.
- Minimise harm and maximise positive contributions to ecosystems and communities.
- Demonstrate transparency, integrity, and leadership in environmental performance.
- Collaborate openly to share learning and elevate performance across the community.

1.2. Why It Matters - The Intrinsic Case

We operate in places that most people will never see but that everyone depends on. Healthy oceans and fresh waters regulate climate, generate oxygen, support food systems and livelihoods, and inspire science and culture. Protecting them protects our mission, the communities we serve and the planet.

Our intent is to operate with:

- Purpose and pride - ‘No-trace’ missions are a mark of mastery: precise planning, clean execution, thoughtful recovery.
- Mission success - Quieter, cleaner operations deliver better data, calmer wildlife, and safer work.
- Trust - Visible stewardship keeps doors open and makes permitting simpler.
- Innovation - Low-impact constraints unlock lighter, quieter, cleaner designs that cost less to run.
- Leadership - We set the tone for the sector by doing the right thing - especially when no one is watching.

1.3. Guiding Principles

1.3.1. Embed Environmental Thinking

Consider the environment from day one. Ask the right questions at concept and design, and carry them through procurement, mission planning, sub-sea operations, maintenance, and decommissioning. Use existing gates

(design reviews, go/no-go) to check environmental risks, controls, and trade-offs, capture decisions so they are visible and reusable. Keep prompts short and inside the processes you already run.

- Integrate environmental aspects into concept, design, procurement, planning, operations, maintenance, and decommissioning.
- Build environmental risk/opportunity reviews into project gateways and operational readiness reviews.
- Include environmental aspects in risk assessments and mission briefs, record decisions, and trade-offs.

1.3.2. Design for the Planet

Choose designs and materials that tread lightly. Favour modular, reusable components over single-use parts, specify low-toxicity, recyclable materials with a clear route for recovery at end of life. Reduce energy draw and waste through efficient power management, lightweighting, and durable build standards. Ask suppliers for environmental data up front so cleaner choices are baked into the bill of materials.

- Avoid single-use components where robust alternatives exist, prioritise modular, reusable designs.
- Select low-impact materials (recyclable, non-toxic, ethically sourced) and prefer closed-loop lifecycle solutions.
- Reduce emissions and waste via efficient power management, lightweighting, and component longevity.
- Use procurement influence to request environmental performance data and options from suppliers.
- If possible, consider supporting environmental innovation and open-source environmental design that will help the industry move forward in the sustainability path.

1.3.3. Measure What Matters

Track a small, stable set of indicators so progress is visible, and decisions are evidence-based. Focus on things that link directly to impact and efficiency, fuel/energy per mission hour, underwater noise/light footprint, waste generated and returned, recovery rate for any items released, and recorded wildlife-disturbance events. Review these per mission and quarterly and use insights to tune plans, procurement, and procedures.

- Energy/fuel use, greenhouse gas, and pollutant emissions.
- Underwater noise/vibration, light footprint, habitat/flora/fauna disturbance.
- Waste generation, segregation, and disposal (including hazardous wastes).
- Resource use (water, consumables, chemicals) and losses to sea with recovery rates.

1.3.4. Minimise Harm, Maximise Benefit

Prevent impacts before they happen and design missions that leave no trace.

BPEO (Best Practicable Environmental Option), BAT (Best Available Techniques) and BPM (Best Practicable Means) are complementary decision tools used to choose sensible, effective, responsible, and proportional controls. They prompt teams to ask: What option delivers the least environmental harm for the mission we are planning, using techniques and resources that are reasonably available to us?

Think of BPEO–BAT–BPM as the environmental version of As Low As Reasonably Practicable (ALARP) in safety.

Where ALARP drives you to cut the risk down as much as you sensibly can - pushing it lower until any extra reduction would be unreasonable for the time, effort, or cost involved, BPEO–BAT–BPM steers you to reduce environmental harm in three linked moves:

- BPEO picks the least-harm, proportionate option overall;
- BAT selects the best currently available techniques to achieve it
- BPM proves you can deliver those controls reliably in the real world

Together, they turn good intent into balanced, evidence-based choices that are ambitious and practicable, exactly the mindset that makes ALARP work for safety, applied to the planet.

BPEO means the overall option that minimises environmental harm for a given objective when you balance impact, cost, safety, technical feasibility, and timing.

BAT are the current state-of-the-art methods and technologies proven to deliver strong environmental performance and reasonably accessible to the operator.

BPM is the day-to-day application of those controls, what you can reliably implement on this asset, in these conditions, with your people and resources.

Used together, you can select options via BPEO, choose the technology and methods via BAT, then embed them operationally via BPM.

- BPEO focuses on overall impact - selecting the option that achieves the best environmental outcome while remaining realistic in context.
- BAT focuses on technology and methods - using the best proven techniques available to the sector or operation.
- BPM focuses on practical application - ensuring controls are proportionate, workable, and maintained day-to-day.

Used together, these concepts help justify environmental decisions: not chasing perfection at any cost but choosing the most effective and responsible solution that can actually be delivered in the field. Recording these choices in the Environmental Case strengthens permitting, transparency, and operational credibility.

Codes of Conduct (CoC) or Codes of Practice (CoP) for scientific operations provide guidelines that minimise environmental impact while still enabling the subsea sampling and data collection needed to advance knowledge.

Use BPEO/BAT/BPM in conjunction with guidance from codes of conduct to implement and evidence controls that are effective and proportionate. Aim for clean operations (no spills, no residue, no wildlife disturbance), set recovery targets for any items released by necessity, and look for ways to minimise disturbance and add value while you are there - support biodiversity monitoring, log debris for recovery, or share environmental data with partners.

- Apply BPEO/BAT/BPM/CoC, document rationale for chosen controls.
- Seek mission-linked positive contributions (biodiversity monitoring, debris recovery).
- Set recovery targets for any items released by necessity and verify with post-mission checks.

1.3.5. Operate with Integrity and Transparency

Meet or exceed local laws and protected-area rules, record what you do, and share what you learn. Report incidents and near-misses promptly, close actions transparently, and keep traceability clear from permit conditions to procedures and logs. Engage openly with communities, regulators, scientists, and NGOs. Hold suppliers and contractors to the same standards you hold yourselves.

- Meet or exceed applicable laws and site protections, respect marine protected areas, and cultural sites.
- Share Learning from Experience (LFE): near-misses, preventative actions, and good practice.
- Report incidents/near-misses and engage respectfully with communities, regulators, and NGOs.
- Flow down environmental expectations to contractors and suppliers.

1.3.6. Be Prepared for the Unexpected

Assume surprises and be ready for them. Build clear environmental emergency plans into every mission: who leads, who calls, what to deploy, and when to stop operations. Run short, realistic drills for spills, leaks, wildlife disturbance, equipment loss, and sensitive-habitat contact. Keep spill equipment, containment, and recovery

equipment where they are needed, with simple role cards attached. Set clear abort triggers (e.g., sheen observed, wildlife agitation, uncontrolled plume) and practice calm, factual communications with authorities and stakeholders. After any event, debrief fast, fix gaps, and update procedures so the next response is sharper. It can be managed by identifying these aspects up-front and applying simple, reliable controls.

- Scenario-based drills for spills, leaks, wildlife disturbance, and ecosystem damage.
- Pollution control equipment on board and at support bases, clear response protocols.
- Crisis leadership training focused on calm, ethical decision-making.

1.4. Leadership and Culture

1.4.1. People as the Engine of Environmental Excellence

Leadership and Culture are the people components that makes environmental intent real: visible leaders set the tone (“no trace, no harm, learn fast”), culture defines how teams behave under pressure (psychological safety to speak up, curiosity to improve, fair accountability), and competence ensures everyone has the role-specific skills to act (targeted training, drills, and verified proficiency). It aligns expectations across staff and contractors, empowers anyone to pause operations on environmental grounds, and turns lessons into updates to procedures and briefs. When these three elements reinforce each other, good choices happen by default, assurance is easy to demonstrate, and environmental excellence becomes the everyday norm.

This can be achieved through:

- Visible leadership: Leaders set a unified goal, set the bar and lead by example, pre-launch walk-throughs, involvement in briefings, and post-mission debriefs.
- Competence: role-specific training and refreshers, simulator/table-top drills, on-the-job sign-offs.
- Culture: adopt psychological safety, support speak-up norms, just-culture approach to mistakes, curiosity to learn and improve.
- Positive dialogue: engage communities, regulators, scientists, NGOs, share short seasonal performance notes.

1.4.2. Designated Person Ashore

Irrespective of whether the International Safety Management (ISM) Code applies, every operator - large or small – could benefit from one clearly named person who keeps a straight line between day-to-day operations and senior decision-makers on pollution prevention, and environmental performance (and safety). This is the Designated Person Ashore (DPA) idea in spirit: simple, visible accountability that makes issues move.

The DPA in a leadership position within any organisation is a key contributor and influencer of organisational culture and is the named link between operations and the accountable executive for pollution prevention, and environmental performance (and safety). They ensure key controls are in place and effective, ensure sufficient competent personnel are in place, conduct audits, receive and escalate concerns, can maintain the Environmental Case, verify permit compliance, and may call a precautionary stop-work when justified.

SOG advises each operator to nominate a DPA appropriate to their size and risk. This is advisory and not a regulatory requirement and does not presume ISM compliance, instead it is a practical way to keep environmental stewardship (and safety) visible, resourced, and connected to leadership.

1.5. Training and Competence

Equip every role with the knowledge, skills, and confidence to prevent harm, spot weak signals early, and act. Keep it practical, role-specific, and embedded in daily work.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
What good looks like	<ul style="list-style-type: none"> • A concise training matrix by role (pilot, surface officer, bridge officer, deckhand, small-craft driver, engineer, planner, scientist, contractor, land crew) covering environmental risks, controls, and abort/hold triggers. • Induction and refreshers tied to mission risk (e.g., polar season, sensitive habitats, freshwater operations). • Regular drills that test real decision points, not just theory. • Documented competence sign-off and easy-to-show records. • Support testing pilot procedures aimed at improving environmental protection.
Core competencies	<ul style="list-style-type: none"> • Environmental awareness: local sensitivities (species, habitats, seasons), protected-area rules, standoff distances, and site-specific guidance. • Wildlife interaction: standard approach behaviours, quiet conduct, open egress, abort cues. • Seabed protection: thruster/DP quiet profiles, altitude discipline, plume triggers, anchoring alternatives. • Sampling discipline: non-intrusive methods first, soft-capture tools, reversible tagging, minimal expendables, recovery of deployables. • Pollution prevention: fuel/oil handling, separator use (no bypass), waste segregation/backhaul, microplastics discipline, controlled washdowns. • Biosecurity: Clean–Check–Dry routines, hull/internal system management, decon stations, pathway awareness. • Emergency response: role cards, first actions, comms discipline, spill/wildlife/recovery scenarios. • Permitting and records: what conditions mean on the day, how to use the Environmental Case (controls, logs, evidence).
Training methods	<ul style="list-style-type: none"> • Toolbox talks (10–15 min) before sensitive missions: top three risks, controls, triggers. • Table-top drills and walkthroughs at all points of use. • Simulations for pilots/surface officers/vessel crew/small craft crew: standoff judging, low-plume manoeuvres, abort calls. • Micro-learning clips or one-pagers for new/updated procedures, QR codes on role cards. • After-action debriefs: one improvement captured and fed back into SOPs/checklists.
Assessment and assurance	<ul style="list-style-type: none"> • Initial sign-off per role (knowledge + practical), then periodic re-validation (e.g., annual or before high-risk seasons). • Observed practice scores for key behaviours (e.g., wildlife standoff, spill setup, biosecurity steps). • Records: attendance, results, photos of drills/setups, and competence sign-offs.
Contractors and suppliers	<ul style="list-style-type: none"> • Contractual flow-down of environmental expectations, ask for proof of competence for relevant roles. • Quick on-boarding pack (site sensitivities, permit conditions, controls, emergency cards).
Refresh cadence	<ul style="list-style-type: none"> • Induction on starting role and refresh annually, mission-specific brief each operation, role refreshers quarterly (high-risk roles) or bi-annually, emergency drills monthly in season. • Make training visible, brief, and continuous—so the right environmental choices are automatic when conditions change.



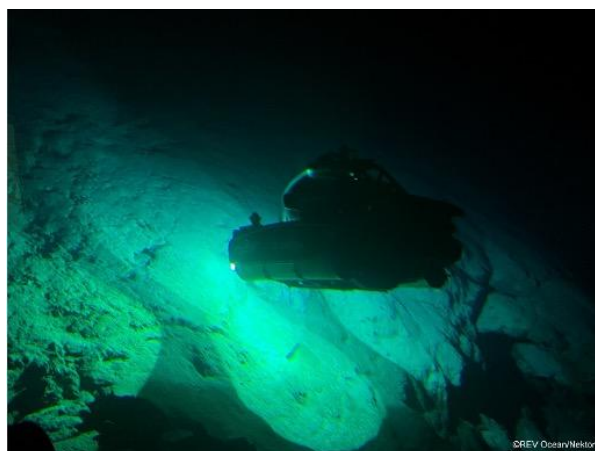
2. Systems and Processes

Who this section is for: everyone, but specifically owners and leads

What this section does: outlines systems, structures and processes that ensure environmental principles are embedded in how projects are planned, executed, and reviewed

Intended outcomes: make environmental thinking consistent, traceable, and repeatable across missions and seasons

Where to go next: Use Section 3 to apply these systems in day-to-day operations and platform-specific delivery



2.1. Systems

This subsection focuses on the core systems that underpin environmentally responsible operations. It describes the Environmental Management system, Environmental Case and continuous-improvement mechanisms that jointly create a framework for environmental performance.

2.1.1. Environmental Management System (EMS) Foundations

An Environmental Management System (EMS) is a framework that turns environmental intent into routine practice, evidence, and improvement. It defines scope and policy, names accountable roles, records your significant aspects and impacts, sets a small set of objectives and targets, embeds operational controls into the procedures, briefs, and checklists people actually use, and supports them with competence, training, and emergency preparedness.

Through Plan-Do-Check-Act, it can track KPIs, incidents, compliance against permits, runs short risk-based audits, and rolls insights into management reviews and updates to the work. Scaled to the size and risk of the operation, a good EMS makes good behaviour the default and assurance straightforward for clients and regulators.

An EMS turns good intentions into routine behaviours, clear evidence, and steady improvement. Keep it lightweight but complete and scaled to your risk profile.

Example content:

- Defined scope and leadership (signed policy, named accountable person, roles by mission).
- Aspects and Impacts register with significance and gap actions.
- Objectives/targets tied to significant aspects, with owners and resources.
- Operational control embedded in procedures, briefs, checklists, contractor flow-down.
- Competence, training, and awareness by role, refreshers before sensitive missions.
- Emergency preparedness and response with equipment, drills and lessons captured.
- Monitoring/measurement/records (KPIs, logs, inspections, maintenance).
- Internal audits/assurance (short, risk-based spot checks).
- Management review on a fixed cadence with decisions captured.
- Documents and change control with easy access to current versions.
- Permits/legal compliance: register and condition-to-evidence map.

2.1.2. Environmental Case

The Environmental Case (Living Record) is the single, version-controlled file that travels with a system, project, or mission and shows - clearly and concisely - how environmental risk is being managed in practice. It brings together the essentials in one place: scope and policy, roles and responsibilities, a summary of significant aspects and impacts with the chosen controls (and BPEO/BAT/BPM rationale), permits and their mapped conditions, links to current procedures and checklists, readiness evidence (training, inspections), mission KPIs, and a short log of incidents, near-misses, and learning with actions closed.

Updated at each stage gate and after every deployment, it gives crews what they need to operate consistently and gives clients and regulators immediate assurance that controls exist, are used, and are improving over time. The single, up-to-date file that tells the story of how you are managing environmental risk for a system, project, or mission.

Example content:

- Overview and Context (purpose, scope, locations, sensitivities, stakeholders).
- Policy and Roles (signed policy, accountable person, mission environmental lead, role cards).
- Aspects and Impacts summary with chosen controls and BPEO/BAT/BPM rationale.
- Permits and Legal Conditions mapped to procedures, checklists, logs, and records.
- Operational controls and procedures (links to current versions).
- Monitoring and KPIs (few metrics with trend charts/tables).
- Readiness evidence (training, sign-offs, inspections).
- Incidents, near-misses and learning (log with actions and where fixes were embedded).
- Change log and version control.

2.1.3. Continuous Improvement: Plan – Do – Check – Act

Continuous Improvement (Plan–Do–Check–Act, PDCA) is a simple, repeatable loop that keeps environmental performance moving forward. Plan by setting clear objectives, identifying significant risks and opportunities, and selecting proportionate controls. Do by embedding those controls into real work - procedures, briefs, training, and point-of-use checklists. Check by measuring KPIs, auditing key controls, and capturing incidents, near-misses, and positive observations. Act by fixing root causes, updating procedures, and training, and allocating resources where they matter most.

Run on a regular cadence (per mission and seasonally), PDCA turns lessons into common practice and makes year-on-year improvement visible and defensible to teams, clients, and regulators.

- Plan - set objectives, identify risks, and define controls.
- Do - implement actions, controls, and training.
- Check - monitor performance, audit, and review incidents.
- Act - act on findings, learn, and elevate practice.

2.2. Processes

This subsection sets out the practical processes that guide how environmental considerations are built into day-to-day work. It covers tools that teams can apply in planning, decision-making, and execution.

2.2.1. Lifecycle Thinking (CADMID)

Impacts and opportunities differ at each phase, acting early prevents lock-in of higher impacts. Lifecycle thinking is a way of planning and running operations that considers environmental, safety, cost, and performance impacts across the entire life of a system - from Concept and Assessment, through Demonstration and Manufacture, into In-Service use, and finally Disposal (the CADMID model).

Instead of optimising a single task or phase, it asks: what choices now will prevent harm, avoid lock-in to higher impacts, reduce whole-life cost, and make recovery and end-of-life responsible?

Practically, it means comparing options on energy, waste, noise, seabed effects, and biosecurity at design, validating controls in trials, specifying durable, low-toxicity materials and clear end-of-life pathways, operating to “no-trace” levels with simple KPIs, and closing the loop with upgrades and responsible decommissioning.

Build environmental care into every phase, so good choices stick, and costly fixes aren’t needed later.

- Concept - Define the project with ‘least-impact’ as a design constraint from day one.
- Assessment - Compare options on energy, waste, noise, seabed effects, and biosecurity, record trade-offs, pick the best practicable option.
- Demonstration - Trial controls in realistic conditions, measure actual noise, plume, waste, and recovery performance, refine before rollout.
- Manufacture - Specify recyclable, low-toxicity materials, and responsible suppliers, plan maintenance, spares, and end-of-life recovery while you build.
- In-Service - Operate to ‘no-trace,’ track KPIs, conduct quick learning reviews, apply mid-life upgrades that cut impact, keep the Environmental Case current.
- Disposal - Decontaminate, recover, recycle, and document final disposition, avoid abandonment.

2.2.2. Operational Focus Areas

Identify and manage your key environmental aspects across operational and support activities.

For example:

- Oil/hydraulic leaks, fuel spills, grey/bilge discharges.
- Waste generation, microplastics, paint/coating leachates.
- Seabed disturbance (thrusters, anchors, landings) and sediment plumes.
- Noise and light pollution, proximity to sensitive species/habitats.
- Loss of ballast/equipment, sampling releases, residues post-maintenance/washdown.
- Biosecurity risks: invasive species via hulls, intakes, equipment, footwear.
- Air ops (helicopters/UAS): noise, wildlife disturbance, fuel handling.
- Small craft (Zodiacs/RIBs): wildlife approach behaviour, wake effects, emissions.

2.2.3. Environmental Impact Assessment (EIA) Identify, Evaluate, and Manage Your Key Aspects

Turn “know your impacts” into a clear, repeatable process that covers both operational and support activities. Use an EIA (scaled to the size and risk of the mission) to move from aspects to effects to controls to evidence.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Screen and scope	<ul style="list-style-type: none"> • Screening: Decide whether a formal EIA is needed (triggers: protected areas, sampling, discharges, underwater noise, aerial ops, freshwater intakes, cumulative activity). • Scoping: Define what to assess: locations, seasons, habitats/species of concern, cultural/heritage features, community interfaces, and credible accident scenarios (spill, turbidity plume, equipment loss). • Alternatives: List viable alternatives (route, timing, method, platform) for later comparison using BPEO/BAT/BPM.

Aspect	Guidance
Establish the baseline	<ul style="list-style-type: none"> • Compile existing data (charts, MPAs, seasonal closures, prior surveys), then fill gaps with targeted baseline surveys (e.g., habitat maps, wildlife use, turbidity/noise background, community receptors, freshwater intakes). • Record constraints maps: sensitive benthic features, haul-outs/colonies, spawning grounds, cables/pipelines, cultural sites, no-go zones.
Aspect–pathway–receptor	<ul style="list-style-type: none"> • Build an aspects and impacts register for all mission and support activities: <ul style="list-style-type: none"> ○ Aspects (examples): thruster use near seabed, small-craft approaches, refuelling/maintenance, lighting at night, aerial overflight, sampling/deployables, biosecurity pathways, waste handling, discharges (grey/bilge where lawful), underwater acoustics, sediment disturbance. ○ Pathways: water, sediment, noise, light, physical contact, introduction of organisms/chemicals. ○ Receptors: habitats/biota (corals, sponges, birds, mammals, fish), water users (utilities, fisheries, recreation), cultural/heritage sites, communities.
Assess significance	<ul style="list-style-type: none"> • For each aspect, estimate magnitude (extent, duration, frequency, reversibility) and sensitivity (legal protection, conservation status, ecosystem function). • Classify significance (e.g., negligible / minor / moderate / major) with clear criteria and assumptions/uncertainties stated. • Consider cumulative effects with other operators or repeated missions.
Apply the mitigation hierarchy	<ul style="list-style-type: none"> • Avoid: reroute/retime to miss sensitive seasons/sites, exclude no-go polygons, avoid overflight. • Reduce: standoff distances, low-thrust corridors, quiet profiles, shielded lighting, DP gains, non-intrusive sampling first. • Restore/Remediate: rapid spill cleanup, debris/tool recovery, habitat-safe reinstatement if contact occurred. • Offset/Compensate (only where lawful/appropriate): science support, monitoring contributions - last resort. • Justify selections with BPEO/BAT/BPM and link each control to a procedure/checklist and mission role.
Define monitoring and triggers	<ul style="list-style-type: none"> • Monitoring plan: what you will measure (e.g., turbidity NTU, energy per mission hour, underwater noise levels, standoff confirmations, wildlife behaviour logs, waste returned). • Operational triggers: stop/abort thresholds (e.g., plume length/NTU exceedance, wildlife agitation, visible sheen, entanglement risk). • Data handling: who records, how often, where stored, QA of logs, photos, and telemetry.
Management and emergency plans	<ul style="list-style-type: none"> • Integrate controls into an Environmental Management Plan (EMP) for the mission: roles, drills, spill/wildlife/ recovery cards, equipment locations, comms. • Align with permit conditions (distances, reporting windows) and site-specific guidance.
Document the case	<ul style="list-style-type: none"> • Produce a concise EIA report (scaled to risk): <ul style="list-style-type: none"> ○ Project description, baseline, aspect–impact assessment, mitigation hierarchy with BPEO/BAT/BPM rationale, monitoring, emergency preparedness, cumulative assessment.
Summarise	<ul style="list-style-type: none"> • Aspects and Impacts summary table, Permit Condition Map (condition, control, evidence), KPI set, abort triggers, and maps (sensitive features, no-go zones, standoff buffers).
Consult and coordinate	<ul style="list-style-type: none"> • Engage stakeholders early (regulators, communities, science partners, other operators) to validate baseline, constraints, and controls, deconflict timings to minimise cumulative impacts. • Involve stakeholders in planning and executing operations and sharing LFE after operations. • Record feedback and how it changed the plan.

Aspect	Guidance
Implement, verify, improve	<ul style="list-style-type: none"> • Implement: brief crews and contractors, embed controls in SOPs, checklists, and go/no-go. • Verify: spot checks, audits, and KPI dashboards, photo evidence of key controls (spill equipment, biosecurity stations, DP settings). • Improve: debrief each mission, update the register, EMP, track corrective actions to closure.

Identify and manage your key environmental aspects across operational and support activities by running a lean, evidence-backed EIA. It clarifies risks, justifies controls, embeds monitoring, and gives regulators and crews a single, practical story of how you protect the environment while getting the mission done.

2.2.4. Project-Oriented Environmental Management

Project-Oriented Environmental Management is the practice of embedding environmental responsibility directly into the rhythm of a project - its planning, briefs, operations, and debriefs - rather than treating it as a separate programme or paperwork exercise.

It translates high-level sustainability goals into simple, repeatable habits owned by the team delivering the mission. This means environmental prompts are built into existing gates and checklists, one person is clearly accountable for the environmental picture, key risks and controls are reviewed at kick-off and before launch, and short learning loops after each mission drive continuous improvement. By riding on the project's natural workflow, it keeps environmental performance practical, visible, and operational - turning intent into real-world behaviour.

Project-oriented environmental management takes big sustainability goals and embeds them into the day-to-day rhythm of a project so that good practice happens as part of doing the work - not as an extra layer.

2.2.5. Environmental Committee

Environmental management works best when decisions are made with early, informed input from the people affected by them. An Environmental Committee (EC) gives decision-takers a standing forum to engage stakeholders, test trade-offs, and draw on subject-matter experts (SMEs) before, during and after operations. It converts high-level intent into practical, auditable choices for each project, system, or season.

What the Environmental Committee does (scope and outcomes):

- Plan and assure: Review environmental risks/opportunities, select BPEO/BAT/BPM controls, and verify they're embedded in procedures and briefs.
- Enable permitting: Align evidence for applications, map permit conditions to controls, monitor compliance and reporting.
- Oversee the Environmental Case: Approve structure, ensure it is updated at each gate/mission, and that evidence is complete.
- Monitor performance: Track KPIs, incidents, near-misses, and positive observations, drive PDCA actions and close-outs.
- Coordinate stakeholders: Engage communities, regulators, science partners, and contractors, deconflict activities to avoid cumulative impact.
- Manage change: Approve environmental changes to design/operations (RACI and change log maintained).

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Composition	Include representation from all areas with environmental responsibility. Keep the core group small and pull SMEs as needed.

Aspect	Guidance
	<p>Example members</p> <ul style="list-style-type: none"> • Chair / Environmental Lead • Operations Lead / Mission Director • Chief Pilot (Submersibles) / ROV–AUV Manager • Engineering and Maintenance Lead • Permitting/Compliance Officer • Science Lead • HSE Lead
Cadence and rhythm	<ul style="list-style-type: none"> • Kick-off (Concept/Assessment): establish objectives, constraints, stakeholders, and permit path. • Gate reviews (CADMID): short EC checkpoints at Design, Demonstration, Manufacture, pre-In-Service, and before Disposal. • Operational cadence: 30–45 minutes bi-weekly during active seasons, ad-hoc meetings for incidents/permit RFI. • Post-mission debrief within 72 hours for significant events or sensitive sites.
Inputs to the EC	<ul style="list-style-type: none"> • Aspects and Impacts register (current revision) • Mission packs (site maps, sensitive features, sampling plans) • KPI dashboard and incident log (with close-outs) • Training/drill records, photos of equipment and control setups ○ Change requests with BPEO/BAT/BPM rationale
Outputs from the EC	<ul style="list-style-type: none"> • Approved controls and abort/stop triggers, written into SOPs/briefs • Updated Environmental Case sections (policy, AandI summary, controls, permits, KPIs) • Decisions on permit applications/responses and evidence collection • Action list with owners/dates, updates to templates and role cards
Success indicators (what “good” looks like)	<ul style="list-style-type: none"> • Permit submissions accepted first time or with minimal RFIs • “No-Trace” rate above target, unrecovered items at zero or investigated/recovered quickly • Actions closed on time, changes reflected in the next mission brief/SOP version • Crews can show compliance quickly (Environmental Case ready, photos/logs present) • Stakeholders report constructive engagement, fewer surprises, fewer escalations

An Environmental Committee makes environmental performance routine and defensible. It brings the right people to the table early, turns expertise into clear controls, and ensures the record of care, the Environmental Case stays accurate, current, and persuasive.

2.2.6. Permitting

Permits are your licence to operate and your credibility test. Done well, permitting protects sensitive environments and communities by ensuring activities are planned, proportionate and monitored. It protects operators by clarifying conditions up front (what is allowed, where, when, and how), reducing the risk of delays, fines, or shutdowns. Strong permitting also builds trust with authorities and stakeholders, shortens future approvals through a proven compliance record, and enables access to special, sensitive sites to improve knowledge, protection, and cultural values (e.g. polar regions, MPAs, freshwater intakes, cultural areas).

The following table provides short, practical, and common-sense guidance on the permitting process for you to adopt if you wish.

Aspect	Guidance
Scope and screen	Define the activity (who/what/where/when/how) and identify the legal frameworks (national, regional, site-specific). Screen for triggers: protected areas, seasonal windows, discharges, sampling, overflight, biosecurity, cultural heritage.

Aspect	Guidance
Engage early	<p>Contact the competent authority (Environment/Maritime/Parks) as soon as feasible, ideally more than 6 months before the intended window. Ask:</p> <ul style="list-style-type: none"> • “When are your submission cut-offs and review meetings?” • “What is the typical timeline after a completeness check?” <p>Build your internal schedule backwards from their calendar</p>
Pre-submission consultation	<p>Share a one-page outline (purpose, locations, system/vessel, key mitigations). Ask if the format, data, or controls align with current expectations. Adjust before formal submission.</p>
Prepare the application package	<ul style="list-style-type: none"> • Cover application form (official template). Request early—even in concept phase—to understand data needs. • Project description: purpose, scope, timelines, vessel/system details. If using a vessel of opportunity, specify performance/DP class requirements now and update on confirmation. • Environmental Management Plan (EMP): noise, light, waste, wildlife, emergency response—mapped across the project timeline. • Stakeholder engagement record: who you consulted and outcomes (adds credibility to chosen mitigations). • Maps and coordinates: planned dive sites, transit routes; accurate to support authority cross-checks. • Certificates and insurance: classification, liability, pollution coverage. • Crew qualifications: pilot certification, medicals, safety training. • Legal review: confirm flag- and coastal-state compliance. • Sensitive-features cross-check: species/habitat databases, cultural heritage registers.
Submit and respond	<p>File a clean, self-contained package (publication-ready):</p> <ul style="list-style-type: none"> • Cover letter summarising purpose/sites/dates/contacts. • Table of contents and annex list (maps, vessel certs, insurance, EMP). • Short executive summary for non-technical reviewers. • Use clear filenames. • Provide both editable (Word/Excel) and locked (PDF) versions. • Respond quickly to RFIs with targeted evidence (photos, SOP extracts, layouts, training records).
Approval and conditions	<p>Read conditions carefully (distances, thresholds, reporting windows). Enter them into a Permit Condition Map that links each condition to:</p> <ul style="list-style-type: none"> • A procedure/checklist, • A role/owner, and • An evidence log (what will prove compliance).
Operate and evidence	<p>Brief conditions to crews. Bake triggers into go/no-go criteria and role cards. Collect evidence during operations (KPI logs, standoff confirmations, turbidity/noise records, biosecurity photos). Notify as required.</p>
Report and close	<p>Submit post-mission reports on time (including incidents, near-misses, and lessons learned). File everything and update procedures if conditions revealed gaps.</p>
How to make permitting easier (and faster)	<ul style="list-style-type: none"> • Start early and work backwards: book review slots around the authority’s timetable, not yours. • Use a local liaison or marine agent: they translate expectations, hand-deliver documents, and align cultural/community requirements—often speeding processing. • Submit a clean, self-contained pack: missing pieces restart clocks. • Use familiar language and recognised references: cite relevant codes (e.g., IMO Underwater Radiated Noise guidance, IAATO/AECO/IUCN best practice, national EIA regs—with section refs). Mirror the regulator’s wording for mitigations where appropriate.

Aspect	Guidance
	<ul style="list-style-type: none"> Map BPEO/BAT/BPM rationale: show that chosen controls are effective and proportionate; keep this in the Environmental Case. Align operations with permits: standoff distances, thresholds, and reporting timeframes should appear in mission briefs, checklists, and go/no-go criteria. Maintain visible competence: keep training records, drill logs, photos of staged spill kits/biosecurity stations/marked standoff zones/DP or anchoring settings.
Evidence reviewers expect to see	<ul style="list-style-type: none"> Documented EMS; current Environmental Case; Aspects and Impacts register; KPI dashboard; incident/near-miss log with closed actions. Condition compliance evidence: standoff rangefinder notes, turbidity logs vs thresholds, discharge registers, noise/light controls. Photos: spill equipment, biosecurity stations, DP settings, designated anchoring zones. Training/competence records for relevant roles (pilots, small-craft drivers, tether manager, spill/wildlife leads). Emergency preparedness: role cards, drill records, equipment locations. Biosecurity logs: Clean–Check–Dry, hull/internal water management.
Build a reusable “permitting pack”	<p>Create a single digital binder (cloud folder) that always contains:</p> <ul style="list-style-type: none"> Certificates and insurance Noise/light data Standard EMP Crew credentials Contact list and template letters

Then, for each new permit, add only the site-specific annexes. This saves days of collation and ensures consistency.

Bottom line: treat permitting as operational enablement, not paperwork. When controls are proportionate, embedded in how you work, and evidenced in the Environmental Case, approvals move faster, oversight is easier, and access to sensitive sites remains sustainable.

2.2.7. Metrics, Targets and Reporting

Measure what matters, at a steady cadence, and act on it.

A tight Key Performance Indicator (KPI) set (e.g. fuel/energy intensity per mission hour, No-Trace rate, recovery rate for any released items, wildlife-disturbance events (target zero), waste returned by type, and permit-condition compliance) makes performance visible and comparable across seasons and teams. Set clear annual targets and mission-level triggers, collect data in debriefs, and show rolling trend charts so issues are seen early.

When a metric goes red/amber, agree one concrete change (procedure, equipment, training, planning), assign an owner and date, and verify the fix appears in the next brief/checklist.

Publish short internal updates (dashboard + one lesson) and share concise summaries with clients/regulators where appropriate. Done consistently, this turns numbers into decisions, builds credibility, and proves continuous improvement.

- Choose a short, stable KPI set.
- Set annual targets and mission-level triggers, publish a one-page dashboard with rolling trends.
- Capture data at debrief, review at ERG/ops meetings and at management review.
- For red/amber metrics, agree one change with owner/date, verify it appears in the next brief/checklist.
- Share concise summaries with clients/regulators when appropriate, celebrate good catches and improvements.

2.2.8. Knowledge Exchange and Shared Observations

At the heart of the SOG is a no-blame culture where operators feel safe to share what worked, what didn't, and what they would change next time. When crews trade real experiences, near-misses, clever fixes and honest mistakes, everyone's controls get sharper and safer.

Knowledge exchange

The openness of sharing knowledge doesn't just raise our own bar, it keeps us ahead of regulators by demonstrating that we are spotting issues early, learning quickly and improving by design.

Keep knowledge flowing

- Short, shareable debriefs: After sensitive missions, create and share a one-page summary (context, what happened, environmental cues, action, fix) that others can lift into their briefs.
- No-blame storytelling: Celebrate observations and near-misses, not just perfect outcomes.
- Common language: Use the same terminology so insights are shared cleanly between teams.
- Annual SOG Conference: 20-minute, operator-led sessions at each SOG conference to walk through an example and the environmental controls used.

Toward a Shared SOG Database for Environmental Observations

Some members dive the same sites repeatedly. That continuity is a unique scientific asset: over time, simple observations can reveal trends e.g., eye damage on chimaera fish, seafloor litter density, wildlife agitation cues, turbidity plumes by season.

SOG would like to develop an operator-friendly observation database to turn these notes into evidence that supports better practices and informs science and policy.

What you can do now (before the database exists)

- Start light: Add an "Environmental Observation" section to your mission debrief (species/behaviour changes, plume notes, litter sightings, retrieval outcomes).
- Tag evidence: Keep a folder for geo-tagged photos/video and short clips of notable events (e.g., wildlife abort cues, plume exceedances).
- Use a common template: Log date, site, depth, gear state (thruster RPM/DP mode), observation type, and action taken. Keep it to one page.
- Offer to submit: Volunteer as an early contributor when SOG opens the platform - your routine dives in familiar sites are especially valuable.

Why this matters:

- Faster learning: Patterns become visible across teams and seasons, so guidance evolves with reality.
- Sharper controls: Data-driven tweaks (e.g., raising minimum altitude at a specific seabed type) reduce impact without slowing missions.
- Credible assurance: Aggregated evidence shows regulators and clients that the community is proactive, transparent, and improving continuously.
- Real science: Repeated, comparable observations can underpin studies that shape smarter outcomes and technology.

Keep sharing. Your field experience, wins, wobbles and work-arounds are the engine of SOG's progress. As we work towards the shared observations database, those everyday notes will become collective insight, helping all of us protect the places we work and the missions we care about.



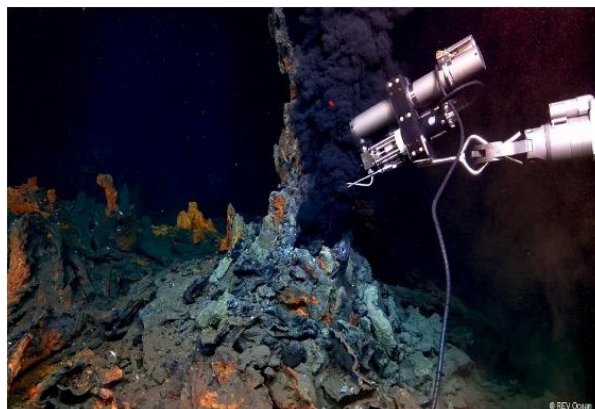
3. Operational Guidance

Who this section is for: everyone, but specifically team leaders, pilots, crew, scientists, and engineers

What this section does: provides practical, experience-based guidance for clean, low-impact operations. It is here for your benefit to adopt, adapt, or set aside as your system, mission and context require

Intended outcomes: platform-specific good practice to be used as starting point

Where to go next: feed lessons learned back into section 2



Important: Nothing in this section is mandatory or regulatory, every platform is different, every site is unique, and judgement matters. Treat these practices as a starting point from an environmental management perspective: lift what helps, tailor what you need, and document your choices in your Environmental Case so they are clear, defensible, and useful.

3.1. Scientific Sampling - Minimal-Impact Protocols

Scientific sampling delivers high value - but it must not leave a scar. This section standardises how to plan, execute and recover sampling so data quality is high while disturbance, residue and loss of equipment are driven as close to zero as practicable.

3.1.1. Existing Codes of Conduct

Approved international best practices for scientific marine sampling already exist. These guidelines ensure that environmental disturbance is minimised, significant harm is avoided, and ethical considerations are addressed, while still enabling the effective collection of the data needed for successful research and innovation. Below is a non-exhaustive table providing details and links to some of the major existing guidelines relevant to scientific activities in the ocean. These guidelines and conventions are not specific to submersible operations but can guide operators and scientists when planning submersible activities, be these scientific, for industry support, focused on filming or dedicated to touristic dives.

Issuing body	Name	Topic	Link
GENERAL GUIDELINES			
UNCLOS UN Convention on the Law of the Sea	General Principles for Marine Scientific Research (Art. 240)	Foundational legal principles for how marine scientific research must be conducted. Includes topics such as peaceful purposes; appropriate methods; avoiding unjustifiable interference; and complying with environmental protection rule.	UN, 1982
UNESCO-IOC United Nations Educational, Scientific and Cultural Organization – Intergovernmental Oceanographic Commission	Guidelines for Environmentally Responsible Research in the Ocean	Practical guidance for planning and executing low-impact ocean research; Complements UN Ocean Decade ethos.	UNESCO-IOC, 2021

Issuing body	Name	Topic	Link
UNESCO-IOC/UNOD/IODE/GOOS United Nations Ocean Decade; International Oceanographic Data and Information Exchange; Global Ocean Observing System	Ocean Best Practices System	Curated repository of community-vetted methods and best-practice protocols across ocean science, including low-impact sampling	UNESCO-IOC/IODE/GOOS, 2021
HABITAT, TOPIC OR REGION SPECIFIC			
InterRidge	Statement of Commitment to Responsible Research Practices at Deep-Sea Hydrothermal Vents	Seminal code for minimizing disturbance of scientific activities at hydrothermal vent sites.	IR, 2007 ; Devey et al., 2007
OSPAR Oslo–Paris Convention for the Protection of the Marine Environment of the North-East Atlantic	Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area	Regionally adopted code built on InterRidge principles to limit research impacts in deep sea/high seas of the NE Atlantic	OSPAR, 2008
SCAR Scientific Committee on Antarctic Research	Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments	Strict protocols to prevent contamination and protect unique microbial ecosystems during drilling/sampling	SCAR, 2011
SPECIFIC TO UNDERWATER NOISE & BENTHIC CONTACT			
CMS-Bonn Convention Convention on the Conservation of Migratory Species of Wild Animals	Environmental Impact Assessments for Marine Noise-Generating Activities (endorsed via CMS Res. 12.14)	Environmental Impact Assessment modules for seismic, sonar, construction, and shipping; Best Available Techniques (BAP) and Best Environmental Practices (BEP) with emphasis on reduction of biological impacts	CMS, 2017
FAO Food and Agriculture Organization of the United Nations	International Guidelines for the Management of Deep-Sea Fisheries in the High Seas:	These is a non-binding but influential framework to avoid significant adverse impacts on Vulnerable Marine Ecosystems (VME) – regularly used to shape research trawling/ exploratory protocols. It focuses on bottom fisheries, but considerations on VMEs are applicable across activities.	FAO, 2008
CCAMLR Commission for the Conservation of Antarctic Marine Living Resources	Conservation Measures	Require prior assessment and controls for bottom fishing and allow only carefully conditioned scientific research in VME areas.	CCAMLR, 2019

3.1.2. Guidelines specific for sub operations

The emphasis of the guidelines provided below for sub operations is on non-intrusive first, tiny footprints when contact is essential, strict plume/force control, and rigorous retrieval of anything introduced to the environment. The following table provides short, practical, and common-sense guidance for you to adopt if you wish. In addition, a number of Codes of Conduct for scientific sampling already exist.

Aspect	Guidance
Planning and Design	<ul style="list-style-type: none"> • Check existing guidelines and permit specifics • State the sampling objective and the minimum information needed. If imagery/eDNA/water samples can answer the question, do those first and document the rationale for any physical collection. • Design a minimal footprint sampling plan. Limit the number/size of grabs/cores/biological samples, cluster replicates inside a small polygon to avoid spreading impact, pre-define no-go habitats or habitats requiring special care or adherence to a code of conduct (biogenic reefs, coral/sponge gardens, vents, archaeological sites) or seasons (spawning). • Map sensitivity and routes. Overlay targets on bathymetry, substrate/biotope maps, known communities, wrecks/cables, and cultural sites, define minimum altitude/lateral standoff and “low-thrust corridors.” • Choose the gentlest viable method. Prioritise suction samplers with inline capture, push-cores with stop-rings, soft-tip manipulators, and low-mass tools, avoid dredges or scraping devices unless specifically permitted. • Pre-plan retrieval. Assign an ID and recovery method to every deployable (traps, markers, core liners, transponders, clump weights). Record primary and contingency recovery approaches.
Pre-dive Readiness	<ul style="list-style-type: none"> • Tools and force limits set. Calibrate manipulators with software force limits, fit soft jaws, verify torque settings on corers/samplers. • Containment ready. Sample canisters pre-labelled, anti-backflow meshes fitted on suction lines, secondary containment for any fluids. • Sensors and thresholds. Set turbidity/optical backscatter and altimeter alarms, confirm DVL/USBL/LBL offsets for precise positioning. • Umbilical plan. Brief lay-back, mid-water catenary, and touchdown points away from fragile features. • Recovery aids onboard. Markers, acoustic pingers (with timer), small lift bags, grapnels/magnets, and a “lost-item” playbook. • Leave-No-Trace equipment. Micro-debris capture mesh, cable ties/tethers for tools, evidence camera, and a post-dive inspection sheet.
In-dive conduct (how to sample with minimal harm)	<ul style="list-style-type: none"> • Approach and positioning. Enter the site up-current where possible, hold stable altitude using DVL/altimeter, use wide, gentle arcs - no burst thrust near the bottom. • Plume control. Enable low-plume thruster modes, if turbidity rises beyond thresholds or persists for more than 30 seconds, increase altitude, reduce thrust, or back out along the approach path.
Sampling Hierarchy	<ul style="list-style-type: none"> • Non-intrusive: imaging (video/stills, structured light), acoustics, spectroscopy, • Low-intrusive: eDNA, water, micro-swabs, • Targeted physical: small-cores, fragment samples of colonial species, minimum number of specimens needed. • Footprint discipline. Keep the sampling polygon tight, avoid contact with living structures minimise harm when using tools to “clear” biota from rock. • Manipulator technique. Use soft captures, approach from the side, not top-down into biota, stabilise with trim, not thrust, pause if any deflection or tearing is observed. • Lighting and acoustics. Use minimum effective light with diffusers/angles away from fauna, soft-start active acoustics and avoid overlapping high-power modes near mammals. • Marking/tagging. Prefer reversible, minimal-residue tags/markers where essential to science, pre-approve adhesives/fixings, set a recovery window for temporary marks.

Aspect	Guidance
Sampling tools and materials	<ul style="list-style-type: none"> • Corers: Push-cores with stop-rings and retaining caps, avoid heavy vibro-corers in fragile habitats unless specifically authorised. • Suction samplers: Low-flow heads with inline meshes, valves that prevent blow-out, labelled chambers. • Manipulators: Soft jaws, force/velocity limits, torque limiting on tools. • Chemicals: Avoid tracers/dyes and hazardous fixatives in situ, if unavoidable under permit, use smallest practicable volumes and capture residuals. • Avoid losing cable ties or other items used to tie equipment to the sub during descent.
Deployables and retrieval (leave the seabed as found)	<ul style="list-style-type: none"> • Tag everything. Unique ID on each core liner, marker, trap, or transponder, log time, depth, and coordinates. • Retrieval plan per item. Primary (direct pickup) and contingency (grapnel/magnet/lift bag) methods briefed, timers on pingers, floating recovery lines only where safe and non-entangling. • No abandonments. Treat unintentionally unrecovered items as incidents, escalate to recovery operations where practicable and safe. • Final sweep. Before departing the box, do a slow pass to check for dropped caps, cable ties, swabs, or fragments, recover anything not native.
Abort / stop triggers	<ul style="list-style-type: none"> • Rapid turbidity spike or persistent plume beyond set limit. • Contact or near-contact with living reef, coral, sponge, or cultural artefact. • Umbilical snag/drag risk or tightening loop. • Visible sheen, leak alarm, or abnormal chemistry/odour. • Unexpected fauna reaction (mass emergence/fleeing) near the tool.
Post-dive recovery and records	<ul style="list-style-type: none"> • Vehicle inspection. Check skids/tools for residue, fragments, or attached fauna, bag, and log debris. • Reconcile deployables. Confirm all items by ID, if missing, initiate the recovery plan and record the outcome. • Sample custody. Secure chain-of-custody, verify labels and metadata (time, depth, coordinates, habitat). • File track plots, standoff/turbidity logs, sampling polygon map, interactions/abort notes, photos of any recovered debris, and a "No-Trace" declaration (or incident form with actions). • Learning. Note hotspots (e.g., fine silt at Site C), refine standoff/approach, and update SOPs/checklists before the next sortie.
Minimum (apply on every sampling dive)	<ul style="list-style-type: none"> • Non-intrusive first, smallest practicable physical sample if required. • Low-plume thrust and altitude discipline at all times near seabed. • Force-limited manipulators and soft interfaces. • Unique IDs and recovery plans for every deployable, end-of-dive site sweep. • Unrecovered items = incident, recovery attempted where safe/practicable.
Evidence to keep	<ul style="list-style-type: none"> • Dive/Sampling plan with BPEO/BAT/BPM rationale, sensitivity map, no-go polygons. • Pre-dive checklist, force-limit, and sensor threshold settings. • Turbidity/standoff logs, polygon map, sample/ID list, deployable recovery report. • Photos of tools post-dive, recovered debris, and any contacted areas (if applicable).
Common pitfalls	<ul style="list-style-type: none"> • Plumes from trim inputs: Train pilots to use trim/ballast over thrust. • Tool slippage: Calibrate force/torque each mission, practice on inert targets topside. • Unmarked micro-debris: Tether small items, conduct mandatory final sweep, carry micro-debris mesh. • Forgotten markers/traps: Use a live checklist tied to unique IDs, reconcile before leaving site.
Advanced options	<ul style="list-style-type: none"> • Adaptive sampling. Live turbidity/optical feedback to modulate approach/force in real time. • Structured-light/photogrammetry. Baseline and post-sample imagery to verify no net damage.

Aspect	Guidance
	<ul style="list-style-type: none"> eDNA first policy. Require negative/positive controls and strict contamination barriers to replace some physical samples. Acoustic release minimisation. Use low-power command sequences and timers, test releases topside.

Handled this way, scientific sampling remains rigorous and reproducible without lasting disturbance, leaving the seabed unharmed so far as practicable and ensuring that what we bring to the site, we take home again.

3.2. Operations in Polar, Protected and Sensitive Areas

Operations in polar, protected or ecologically sensitive areas – e.g. Vulnerable Marine Ecosystems (VMEs), Ecologically or Biologically Significant Areas (ESBAs), marine protected areas (MPAs) – demand heightened care, deliberate planning, and disciplined execution. These environments often have low resilience, slow recovery rates, and higher regulatory and public scrutiny.

Applying a conservative approach - greater standoff distances, strict biosecurity, cautious manoeuvring, and reduced noise and light - is essential to avoid disturbance or irreversible harm. Teams must understand site-specific protections, map sensitive features such as breeding sites or fragile seabed communities and integrate clear go/no-go criteria into mission planning.

By tailoring controls to local conditions, coordinating with other operators, and documenting evidence, operators maintain access, protect critical ecosystems, and demonstrate the leadership expected in the world's most vulnerable waters.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Plan before entry	<ul style="list-style-type: none"> Confirm the legal and ecological context before you cross the boundary. Identify protected designations (MPAs, SPAs/SSSIs, seasonal closures) and pull any site-specific rules (approach distances, no-go areas, reporting windows). Build a sensitive-features map (breeding/haul-out sites, fragile seabed communities, cultural/archaeological locations, drinking-water intakes) and set conservative go/no-go criteria tied to weather, visibility, ice, wildlife density, and plume risk. Include abort thresholds in the ops plan.
Access and overflight	<ul style="list-style-type: none"> Choose launch/landing points that avoid wildlife paths and fragile ground/vegetation, mark exclusion buffers on the deck plan. For aircraft/UAS, plan downwind approaches, avoid overflight of wildlife, maintain ample lateral/vertical separation, minimise hover/repeat passes, and brief explicit wave-off cues. Deconflict timing with surface craft to reduce combined disturbance.
Biosecurity	<ul style="list-style-type: none"> Implement strict Clean–Check–Dry at each site boundary. Clean equipment, boots, umbilicals, and skids in controlled areas with capture/filtration (never rinse to natural waters), inspect traps and recesses, and fully dry when feasible, otherwise use approved heat/disinfectants. Manage hull biofouling and internal water systems (ballast/intakes) per local rules. Quarantine suspect items and keep a photo-backed biosecurity log.
Anchoring and manoeuvring	<ul style="list-style-type: none"> Prefer dynamic positioning where safe, if anchoring is essential, use pre-surveyed zones on firm substrate and minimise drag. Define low-thrust corridors and altitude limits over sensitive habitats, avoid burst thrust near the bottom. Monitor for sediment plumes (visual/NTU) and correct immediately - reduce thrust, increase altitude, or relocate.

Aspect	Guidance
Noise and light	<ul style="list-style-type: none"> • Fly/drive quiet profiles: slow, steady approaches, no tight turns, or repeated passes. • At night, shield and dim lights, favour task lighting over floods, and aim beams away from shorelines and rookeries. Schedule operations to avoid peak wildlife activity where practicable.
Sampling and deployables	<ul style="list-style-type: none"> • Use non-intrusive methods first (imaging, eDNA, water sampling). When physical sampling is essential, keep footprints tiny (micro-cores, soft manipulators), avoid living structures, and minimise expendables. • Assign unique IDs to every deployable with a pre-planned recovery method, timing, and success criteria, treat unrecovered items as incidents with follow-up.
Fuel, waste and discharges	<ul style="list-style-type: none"> • Handle fuels and oils with secondary containment, never decant over water. • Operate a zero-discharge posture wherever restricted by permit - no grey/bilge where prohibited - and log any lawful discharges. • Segregate and backhaul all wastes, manage microplastics (lint filters, retire frayed lines, contain foam/paint prep), and prohibit over-the-side maintenance that risks release.
Team competence and drills	<ul style="list-style-type: none"> • Deliver a site-specific environmental brief covering sensitivities, standoff distances, biosecurity steps, plume/noise/light controls, and abort triggers. • Assign clear roles (wildlife lead, spill lead, comms) and run short, realistic drills (spill containment, wildlife abort, turbidity exceedance, UAS wave-off) before entry.
Coordination and permits	<ul style="list-style-type: none"> • Coordinate ETAs and viewing windows with other operators to avoid crowding and cumulative impact. • Keep permits onboard and map each condition to a control, checklist, and evidence source so crews can show compliance on request. • Notify authorities promptly about incidents, near-misses, strandings, or unusual observations.
Records and evidence	<ul style="list-style-type: none"> • Capture GPS tracks, standoff confirmations (rangefinder notes), plume/turbidity logs, wildlife behaviour notes, and photo evidence of biosecurity and control setups. • File all materials so assurance is immediate and learning feeds back into the next plan.

3.3. Wildlife Interaction

This guidance standardises how the crew approach, observe, and depart from wildlife, so encounters are respectful, brief and have a low impact.

The core principles are simple: let animals set the distance, approach parallel from the rear quarter at no-wake speed, keep radios/voices low, never chase, herd, encircle, or block egress routes, and abort immediately if agitation, mass movement, repeated dives, or protective displays are seen. If animals approach you, go neutral/idle and drift until they are clear.

Aerial systems avoid overflight and maintain generous lateral/vertical separation, small craft minimise wake, tight turns, and reverse thrust near animals.

No feeding, touching or sound playback. Crews nominate a wildlife spotter, carry rangefinders, coordinate with other vessels to prevent boxing-in, and record distances, behaviours, and any aborts.

Done consistently, these behaviours protect fauna, reduce operational risk, and preserve licence to operate.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish. If well documented (i.e. include day, time, LAT/LON, depth, and observation), they also provide unique scientific data.

Aspect	Guidance
Approach	<ul style="list-style-type: none"> Let animals set the distance. Approach parallel from the rear quarter at no-wake speed. Avoid sudden speed or equipment changes.
If approached	<ul style="list-style-type: none"> Shift to neutral/idle and allow a passive drift. Re-engage propulsion only when animals are well clear. Never box animals in, keep open egress routes to sea/ice/shore.
Standoff	<ul style="list-style-type: none"> Adopt generous separations and keep encounters short. Run no-wake speeds near colonies/rafts, never box animals between craft and shore/ice, and coordinate with other vessels so clear egress lanes remain open. Define simple, unambiguous abort triggers - agitation, mass movement, repeated dives/flushes, protective displays - and practice backing off smoothly without sudden equipment changes.
Abort triggers (back off immediately)	<ul style="list-style-type: none"> Agitation or protective displays. Mass movement or stampede toward water. Repeated dives/flushes or prolonged avoidance. Unexpected close surfacing near the craft. Presence of calves/pups with adult behaviour change.
Thrusters	<ul style="list-style-type: none"> Use soft thruster control where possible. Avoid hard and fast inputs to minimise cavitation and instant noise.
Lights	<ul style="list-style-type: none"> Minimise light usage in vertical transit to minimise impact on the migration of wildlife. Dim lights, if possible, in the vicinity of wildlife
Comms and conduct	<ul style="list-style-type: none"> Keep radios and voices low near wildlife. Passengers seated and quiet, no feeding, touching, or playback of sounds. Hands inside the craft, do not block wildlife paths or entry/exit lanes.
Aerial systems (helicopters/UAS)	<ul style="list-style-type: none"> No overflight of wildlife, plan downwind approaches. Maintain generous lateral/vertical separation, minimise hover and repeated passes. No refuelling ashore in sensitive areas.
Record and learn	<ul style="list-style-type: none"> Log behaviours, distances, durations, and any aborts. Update local wildlife notes and file evidence.

3.4. Platform-Specific Good Practice

3.4.1. Support Vessels and Small Craft (Zodiacs/RIBs)

Small-craft operations are where people get closest to wildlife and where most minor releases or disturbances can occur, so discipline matters.

- Standardise a tight routine: thorough pre-launch briefings (PFDs, quiet conduct near wildlife, embark/disembark method, “no trash/no overboard”), route plans with no-wake zones and sensitive areas marked, and engine checks to ensure “clean-running” (no sheen, secure lines, spill equipment aboard). On the water, approach parallel from the rear quarter at no-wake speed, keep open egress routes between animals and shore/ice, minimise wake and reverse thrust in shallow or fragile habitats, and tether loose items with immediate recovery plans for anything dropped. Refuel only at designated, bunded stations, no decanting underway.
- Use clear abort cues: visible sheen, uncontrolled sediment plume, unexpected close surfacing, or agitation - then go neutral/idle, widen standoff, and reassess.
- On recovery: wipe down contact points, capture micro-debris, log observations, and restock equipment.

Run this playbook at every sortie to protect wildlife, prevent releases, and keep crews and guests safe.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Before launch	<ul style="list-style-type: none"> • PFDs on, confirm seating and weight trim. • Brief quiet conduct near wildlife, no-rubbish / no-overboard rule. • Spill equipment aboard and reachable, route marked with no-wake and sensitive areas. • Engines clean-running (no sheen), fuel lines secure.
On the water	<ul style="list-style-type: none"> • Manage wash in shallow/fragile habitats, avoid tight turns/reverse near wildlife. • Tether cameras/tools/lids, have an immediate retrieval plan for anything dropped.
Fuel and fluids	<ul style="list-style-type: none"> • No decanting underway. Refuel only at bunded stations (ship/shore). • Watch for sheen at start-up and after high load, shut down, fix, log, clean immediately.
Abort / stop	<ul style="list-style-type: none"> • Triggers: wildlife agitation, visible sheen, uncontrolled sediment plume. • Response: neutral/idle, widen standoff, reassess, and report.
Post op	<ul style="list-style-type: none"> • Wipe down contact points, capture micro-debris (line frays, foam, tape, zip ties). • Log observations/actions, restock spill/biosecurity equipment.

3.4.2. Dynamic Positioning (DP)

There should always be an intent to minimise the use of DP where reasonably practicable to minimise the exposure of noise pollution to marine species. However, this might not always be possible due to the requirements of the operation. When DP is used for extended periods during dive operations, careful setup and disciplined control can minimise noise, vibration, and seabed disturbance while maintaining safety and mission quality.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Plan and configure	<ul style="list-style-type: none"> • Site screen: Map sensitive receptors (wildlife colonies/haul-outs, cultural sites, vents/corals/sponges, seagrass/kelp, cables/pipelines). Define no-go/low-thrust zones and minimum altitude/standoff over fragile substrates. • Mode selection: Choose the lowest-impact DP mode that still meets safety (e.g., head-to-seas or weather-vaning where feasible). Pre-set conservative gains/position limits for work near the bottom. • Power strategy: Plan thruster minimisation (fewer units online, RPM caps, eco-profiles) and confirm redundancy so you can keep RPMs low without compromising station-keeping. • Brief triggers: Include DP limits, standoff rules, turbidity thresholds, and abort/hold cues in the mission brief.
Set up for low impact	<ul style="list-style-type: none"> • Thruster alignment: Use orientations that reduce hull–structure interactions and cavitation, avoid jetting toward the seabed or shoreline. • RPM and pitch limits: Apply RPM caps and “quiet profiles” to cut acoustic output and plume risk, prefer small continuous corrections over frequent bursts. • Sensor hygiene: Validate wind, gyro, GNSS, USBL/LBL offsets and latency to avoid over-correction. • Lighting and comms: Shield/dim task lights, keep radios low near wildlife.
During operations	<ul style="list-style-type: none"> • Real-time monitoring: Watch turbidity/optical backscatter, ROV/AUV camera cues, wildlife behaviour, and fuel/power trends. • Station-keeping finesse: Prefer weather-vaning and set-point biasing to reduce thruster work, use heading-only control when safe to minimise power.

Aspect	Guidance
	<ul style="list-style-type: none"> Traffic coordination: Deconflict with small craft and UAS so combined disturbance stays low.
Noise and vibration control	<ul style="list-style-type: none"> Quiet hours and routing: Avoid prolonged station-keeping near breeding/haul-out sites, route approach legs to downwind/down-current of sensitive fauna. Maintenance matters: Keep propellers/ducts clean and balanced, worn edges increase cavitation and noise. Acoustics discipline: Limit use of high-power sonars, soft-start acoustics, and record on/off times.
Plume and habitat protection	<ul style="list-style-type: none"> Plume triggers: If visible plume length or NTU exceeds limits, reduce RPM, increase altitude, shift set-point, or temporarily suspend operations. Seabed contact: If anchor-less DP is unsafe, use pre-surveyed anchoring zones on firm substrate with minimal chain sweep.
Abort / stop cues (anyone can call STOP)	<ul style="list-style-type: none"> Turbidity beyond agreed threshold or persistent plume, Wildlife agitation/mass movement, Unexpected reduction in standoff/altitude, Loss/instability of key sensors causing excessive thruster activity.
Records and evidence	<ul style="list-style-type: none"> Log DP configuration (modes, gains, RPM caps), turbidity readings/plume observations, wildlife notes, and acoustic on/off times. Save tracks, set-point changes, and fuel/energy intensity to the Environmental Case, note any holds/aborts and the corrective action taken.
KPIs (suggested)	<ul style="list-style-type: none"> Energy/fuel per DP hour, average thruster RPM vs. sea state, turbidity exceedances (count/duration), wildlife disturbance events (target zero).

3.4.3. ROVs and AUVs

Comprehensive environmental guidance for ROVs and AUVs associated with submersible operations are beyond the scope of this document. However, as a high-level guide, plan, pilot and recover vehicles with as low as reasonably practicable impact inflicted on the environment.

In the water, use low-plume thrust profiles, hold stable altitude with DVL/altimeter, favour wide, gentle turns, and back out along the approach path if turbidity rises, keep umbilicals off the bottom with controlled lay-back and mid-water catenary, and never “saw” the seabed.

Prefer non-intrusive methods first (imaging, eDNA, water samples), if manipulating, use soft captures and force limits, avoid living structures, and log every interaction.

Minimise acoustic load with soft-starts and only the transmissions you need, use diffused lighting to reduce attraction/avoidance.

Treat any sheen, leak alarm, or abnormal chemistry as an immediate stop, likewise unexpected fauna reactions, or entanglement risk.

Post-dive, inspect for residue or fragments, bag debris, reconcile deployables, and file tracks, standoff compliance, turbidity/fauna notes, and lessons learned before the next sortie.

Ensure known species within area of operation are documented and their potential behaviours when met

Analyse known species for potential effects your presence might have upon them such as light and noise.

Mitigate potential effects with a plan for timing the usage of thrusters or lights, standoff distances and procedures for wildlife approaching the vehicle i.e. hold station, no sudden manoeuvres, no chase.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Pre-dive planning	<ul style="list-style-type: none"> • Load habitat/bathymetry maps, define minimum standoff (vertical/lateral) and no-go polygons over fragile substrates/structures. • Set low-thrust corridors, alternate routes, and safe loiter boxes. • Register every deployable with a unique ID and a primary/contingency recovery plan (method, window, responsible owner). • Plan dives within permit parameters
Thrusters and manoeuvring	<ul style="list-style-type: none"> • Use low-plume modes and maintain disciplined altitude via DVL/altimeter. • Fly wide, gentle arcs, back out along ingress path if visibility/turbidity degrades. • In an environment where a current exists, avoid manoeuvres upstream of objects that could cause impact if loss of control occurs. • Apply conservative DP gains/limits near sensitive substrates, prefer trim adjustments over burst thrust. • Avoid touch down on the seabed without prior permitting and planning considerations.
Umbilicals and cables	<ul style="list-style-type: none"> • Control lay-back, maintain a mid-water catenary, keep heavy/negative segments off the bottom. • Pre-select touchdown zones on firm substrate, no “sawing” or dragging. • Assign a dedicated tether manager and a nav/observer to call snags, loops, or drag risk.
Navigation and perception	<ul style="list-style-type: none"> • Use DVL, USBL/LBL, multibeam, and forward-looking sonar, validate sensor offsets pre-dive. • Set turbidity/optical backscatter thresholds that trigger altitude increase/hold. • Run minimum effective lighting, angled/diffused away from fauna to reduce attraction/avoidance.
Sampling and interaction	<ul style="list-style-type: none"> • Non-intrusive first (imaging, eDNA, water samples), escalate only if required by plan/permit. • Use soft capture, force/velocity limits, and avoid living structures, keep sampling polygons tight. • Ensure Auto controls for ROVs are not going to interfere with a lift and cause unwanted control inputs. • Prefer reversible tagging/markers, log every interaction (time/depth/location/tool/force).
Acoustics and comms	<ul style="list-style-type: none"> • Keep acoustic transmissions to the minimum needed, soft-start active sonars. • Avoid overlapping high-power modes near marine mammals, log timestamps/power levels for assurance. • When trackable assets are recovered and ensure transceivers are turned off.
Energy, leaks, and materials	<ul style="list-style-type: none"> • Pre-dive integrity checks (seals, hoses, penetrators, syntactic), place absorbent pads in tool trays. • Specify low-leach coatings and secure sacrificial elements to prevent shedding. • Ensure battery containment/thermal monitoring, avoid field swaps in sensitive areas. • Monitor insulation faults to prevent loss of control.
Deployables and expendables	<ul style="list-style-type: none"> • Each item has a retrieval plan with the named owner and timing window, test releases topside. • Log all releases (GPS/time/depth/ID). Treat unrecovered items as incidents with root cause and recovery attempt.
Abort / stop cues (immediate actions)	<ul style="list-style-type: none"> • Turbidity beyond limit or persistent plume, • Fauna reaction/near-contact or unexpected mass movement, • Umbilical entanglement risk (snag/loop tightening), • Sheen/leak/abnormal chemistry alarms. • Response: stop thrust / increase altitude / retreat on ingress track / notify.

Aspect	Guidance
Recovery and post-dive	<ul style="list-style-type: none"> Inspect vehicle for fragments/residue and seal integrity, bag and log any debris. Reconcile deployables against IDs, initiate recovery plan for any missing items. File data (tracks, standoff/turbidity logs, interaction records), update SOPs/checklists before the next sortie.

3.5. Equipment Maintenance

Well-maintained equipment is cleaner, quieter, safer, and more efficient. Good maintenance prevents leaks before they happen, reduces underwater noise and vibration, cuts energy use, and extends service life—avoiding waste and unplanned interventions in sensitive places. Make maintenance a visible pillar of environmental performance, not just a reliability function.

What “good” looks like

- Preventive by design: Maintenance tasks are planned into the lifecycle (CADMID), with access, spares, and take-back options considered at build/procurement.
- Risk-based and right-sized: High-consequence items (fuel systems, hydraulics, batteries, separators, thrusters) get tighter intervals and condition monitoring.
- Embedded in operations: Pre-mission checks, hot-seat inspections at turnarounds, and post-mission decon/inspection are routine and logged.
- Evidence-rich: Work orders, torque logs, photos, oil samples, and calibration certificates are filed and referenced in the Environmental Case.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Planned Maintenance System (PMS)	<ul style="list-style-type: none"> Hierarchies and intervals: list all assets, set time/cycle/condition-based intervals, flag high-consequence tasks. Kitting and spares: pre-pack kits for critical jobs (seals, clamps, o-rings), keep lead-time spares for mission-critical systems. Change control: after any modification, update procedures, spares lists, sensor offsets, and PMS intervals.
Competence and culture	<ul style="list-style-type: none"> Role-specific training: leak-proof joints, hose lifing, torque methods, cleanliness/biosecurity, calibration basics. Tool control and debris discipline: tethers, inventories, post-task counts. Speak-up cues: any sheen, unusual vibration/noise, smell of fuel/oil, temperature rise, or unexpected power draw - STOP and engage with an engineer.
Condition-based tools	<ul style="list-style-type: none"> Vibration/thermal imaging for rotating machinery, oil analysis for gearboxes/hydraulics, current draw trends for thrusters and winches.
Pre/Post-mission routines	<ul style="list-style-type: none"> Pre-mission checklist: leaks, RPM caps, separator status, spill kit present, PPE, tool control, calibration due dates. Turnaround: wipe-downs, quick leak/fastener checks, tidy cabling/umbilicals, recharge/refill logs. Post-mission inspection: look for residue on skids/tools, check seals, bag, and tag debris, record any deviations.
Fluids and containment (fuel, oils, hydraulics, coolants)	<ul style="list-style-type: none"> Integrity checks every mission: hoses, clamps, seals, filters, breathers, drip trays, replace age-limited hoses proactively. Pressure and leak tests: after maintenance and before sensitive missions, keep absorbents at points of use. Separators and sumps: never bypass, test alarms, auto-stops, and interlocks, record any lawful discharges with time/position/volume.

Aspect	Guidance
Thrusters, propulsors and DP units	<ul style="list-style-type: none"> Oil condition monitoring: periodic sampling (viscosity, particulates, water) to catch wear and leaks early. Clean, balanced, sharp: remove fouling, repair nicks, balance props/impellers to reduce cavitation (noise) and power draw. Bearing and seal health: vibration/temperature trend checks, planned replacement before failure. DP tuning: validate sensors (wind, gyro, GNSS, USBL/LBL), set conservative gains/RPM caps for low-noise station-keeping.
Submersibles / ROVs / AUVs	<ul style="list-style-type: none"> Pressure boundaries: inspect penetrators, o-rings, syntactic foam, viewports, vacuum/pressure tests pre-mission. Umbilicals and connectors: check for abrasion, kinks, water ingress, clean, dry, and cap, track bend-radius compliance. Manipulator/tools: calibrate force/velocity limits, replace worn pads, verify soft-capture systems. Lighting and acoustics: ensure minimum-effective output, replace flicker/noisy drivers, soft-start sonars and log on/off times.
Small craft (Zodiacs/RIBs) and support vessels	<ul style="list-style-type: none"> Engines and fuel lines: inspect primer bulbs, clamps, quick-connects, and venting, confirm no sheen at start-up/high load. Bilge and scuppers: clear and test, keep bungs and absorbents in place per plan. Steering and hulls: maintain tight steering to avoid over-throttle corrections, repair hull/sponson damage promptly.
Batteries and electrical	<ul style="list-style-type: none"> State-of-charge control: follow charge profiles, keep records, rotate packs to avoid deep-cycle stress. Containment and thermal: inspect enclosures, test BMS, temperature sensors, and fire-safe storage/charging setups. Cables and insulation: check gaskets, glands, strain relief, replace cracked insulation to prevent leaks/shorts.
Sensors and calibration	<ul style="list-style-type: none"> Routine calibration: DVL, USBL/LBL, multibeam, FLS, turbidity, flow, and pressure transducers, keep certificates handy. Offset validation: confirm alignment/latency to avoid over-correction (noise) and off-track manoeuvring. Ensure transceivers and transponders are clear of debris and growth. Ensure power and gain settings of comms and tracking equipment is optimal during the dives.
Coatings, structure, and corrosion control	<ul style="list-style-type: none"> Low-leach systems: maintain antifouling/coatings per spec, vacuum-sanding, and tarps to capture debris. Anodes and fasteners: replace before end-life, ensure no shedding, verify torque and anti-seize use.
Biosecurity and cleanliness	<ul style="list-style-type: none"> Clean–Check–Dry: build decon into post-mission routines, capture washings and debris, dry out gear. Microplastics discipline: retire frayed lines, capture lint/foam, avoid shedding consumables.
Records, evidence, and assurance	<ul style="list-style-type: none"> Work orders and photos for critical tasks (before/after). Calibration and test certificates linked to asset IDs. Oil sample results, vibration trends, RPMS/energy per hour for key equipment. Deviation and fix logs (what happened, root cause, corrective action, verification).
KPIs (suggested)	<ul style="list-style-type: none"> Leak incidents per 100 mission hours (target downward trend, aim for zero). Energy per mission hour / per DP hour (improve YoY). Underwater noise proxy (average thruster RPM at set sea state). Preventive vs. Corrective maintenance ratio. Overdue critical PMs (target zero).

Disciplined maintenance is one of the highest-leverage environmental controls you own. It stops spills, quiets the water, saves energy, and keeps missions on schedule - delivering clean, reliable operations you can prove.

3.6. Pollution Prevention and Resource Efficiency

Keep water clean and cut waste at the source by treating leaks, discharges, noise, light, and energy use as controllable, routine variables - not surprises. Standardise integrity checks on fuels, oils, and hoses, use secondary containment for all transfers, treat any sheen as an incident, and never decant over water.

Run strict “zero-overboard” housekeeping: colour-coded segregation, sealed backhaul of all wastes, microplastic controls (lint filters, retire frayed lines, contain foam/paint prep), and lawful, logged use of separators - no bypass.

Reduce operational footprint with quieting profiles and shielded, minimal lighting, choose low-leach coatings and biodegradable cleaners, and procure modular, repairable equipment with clear end-of-life routes. Plan energy the way you plan navigation: eco-speeds, efficient routes and loiter profiles, managed hotel loads, and shore/battery power where feasible - then track fuel/energy per mission hour to drive improvement.

Stage spill equipment at points of use with role cards, practice short scenarios, and photo-document spot checks and corrective actions so prevention stays visible, verifiable, and continuously improving.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Fuel / oils / maintenance	<ul style="list-style-type: none"> • Run pre-mission integrity checks on hoses, clamps, seals, filters, and vents, torque-verify known leak points. • Use secondary containment for all transfers (bunds, drip trays, absorbent socks), never decant over water. • Treat any sheen as an incident: stop source, contain, clean, bag waste, log with photos, investigate cause. • Aim your PMS (planned maintenance system) at leak hotspots: pressure tests, gasket lifing, hose age limits, vibration checks.
Waste	<ul style="list-style-type: none"> • Enforce strict segregation (general / recyclable / hazardous / sharps / oily rags) with clear labels on every platform. • Zero overboard: seal, manifest, and backhaul all wastes to approved reception facilities. • Control microplastics: fit dryer lint filters, retire frayed lines, capture foam/paint prep debris, and bag cable-tie offcuts.
Water systems / discharges	<ul style="list-style-type: none"> • Keep separators in service - no bypass. If lawful discharges occur, log time/position/volume. • Only conduct controlled washdowns using approved agents, use capture mats or filtration, prevent runoff to surface waters. • Manage grey water per local rules, prefer shoreside reception where required.
Noise / light	<ul style="list-style-type: none"> • Use quiet profiles (lower RPM, smoother tracks), avoid repeated passes near sensitive areas. • Make slow approaches to reduce cavitation and wake. • Shield/dim lights at night, prefer task lighting over floodlighting and aim beams away from shorelines/rookeries.
Coatings / cleaning / consumables	<ul style="list-style-type: none"> • Specify low-leach, durable coatings, collect and contain prep debris (vac-sanding, tarps). • Choose biodegradable, low-toxicity cleaners and standardise dilution to avoid overuse. • Where safe, use reusable absorbents and refillable containers, label, and store correctly.

Aspect	Guidance
Procurement / design	<ul style="list-style-type: none"> Request supplier environmental data (materials, emissions, take-back options) and prefer transparent vendors. Buy modular, repairable equipment with spares and end-of-life routes documented. Select high-efficiency motors/lighting and implement energy-aware control logic (auto idle, sleep modes).
Energy	<ul style="list-style-type: none"> Optimise routes and profiles to reduce transit/loiter time, adopt eco-speeds on support craft. Manage hotel loads (HVAC setpoints, lighting, non-essential systems), use battery/shore power when available. Track energy intensity (fuel/energy per mission hour) and review trends for quick wins.
Spill readiness	<ul style="list-style-type: none"> Stage spill equipment at points of use (fuel stations, deck, workshops, small craft) with role cards attached. Run short drills (10–15 min): drip/leak control, containment, waste handling, comms. Keep chemicals and oils in secure, bunded storage with current SDS and inventory control.
Assurance	<ul style="list-style-type: none"> Maintain simple logs: fuel/energy, any discharges, waste volumes by type, spills/leaks, and corrective actions. Perform spot checks on high-risk areas (manifolds, separators, washdown zones) and file photo evidence. Store all records so compliance and improvements are easy to show.

3.7. Biosecurity and Invasive Species Control

Prevent “hitchhikers” at the source by treating every movement of hulls, water, equipment, and people as a potential vector - and closing those pathways with simple, repeatable routines.

Map your vectors (hulls/props/intakes, ballast and internal water systems, umbilicals and ropes, sampling equipment, boots/clothing, pallets/packaging).

Enforce Clean–Check–Dry at every site boundary using designated wash stations with capture/filtration - never rinse to natural waters.

Drain and dry bilges, intakes, and ballast before transiting between waterbodies, decontaminate high-risk equipment with approved heat or disinfectant when drying isn’t feasible, flake and wipe umbilicals to avoid dragging fragments between sites, and bag all scrapings and residues as contaminated waste. Issue easy-clean footwear, provide brushes and drying racks at gangways, and sequence itineraries low-risk to high-risk to minimise carryover.

Keep a photo-backed biosecurity log (what was cleaned, how, by whom, where the waste went), brief crews on priority species and fast-track response (stop transfer, photograph, log, notify, contain) if suspected.

Fresh water needs stricter controls - many species survive damp - so prioritise full dry-out or heat treatment between basins.

Done consistently, biosecurity becomes a visible habit that protects ecosystems, preserves permits, and keeps operations welcome.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Plan pathways	<ul style="list-style-type: none"> Map all potential vectors: hulls/props/intakes, ballast and internal water systems, ropes/umbilicals, sampling equipment, footwear/clothing, and packaging/pallets. Build these into mission plans (where/when cleaning happens, who signs off, how waste is contained and removed).
Clean–Check–Dry (baseline)	<ul style="list-style-type: none"> Establish designated cleaning stations with capture/filtration - never rinse to natural waters. Clean: remove mud, biofilm, plant matter from equipment, skids, ropes, boots, use approved detergents or hot water. Check: inspect hard-to-clean areas (foam, Velcro, zips, strainers, brush heads, cable terminations). Dry: full dry-out before moving sites, when drying isn't practical, use approved heat/disinfectant methods and record them.
Vehicles and equipment	<ul style="list-style-type: none"> Rinse submersibles/ROVs/AUVs with captured water, collect and bag debris/scrapings as contaminated waste. Manage umbilicals to avoid dragging across seabed/lakebed, flake, and wipe on recovery. Use site-dedicated equipment (nets, waders, sample tools) where feasible, otherwise decon between sites and label "clean."
Hulls and internal water systems	<ul style="list-style-type: none"> Maintain compliant antifouling, plan controlled in-water cleanings with capture where allowed, otherwise haul-out. Manage ballast/intake/tank operations per local rules (exchange/treatment), log times/locations. Treat strainer residues, scrapings, and washings as waste - bag, label, and dispose ashore.
Footwear and clothing	<ul style="list-style-type: none"> Issue easy-clean boots and outerwear, provide brushes, wash stations, and drying racks at gangways. Enforce "no mud / no seeds" policy on embark/disembark and between sites, decon before boarding and at site exit.
Sequencing	<ul style="list-style-type: none"> Visit low-risk sites first, higher-risk last to minimise carryover. Log decon completion (who/what/when/how, with photos) before moving to the next site.
Detection and response Records and training	<ul style="list-style-type: none"> If a priority species is suspected: stop transfer (stop equipment), photograph, log GPS/time, notify the authority, and contain as directed. Quarantine suspect items and mark "STOP – BIOSECURITY" until cleared.
	<ul style="list-style-type: none"> Maintain a photo-backed biosecurity log covering stations used, methods (heat/disinfectant), waste handling, and sign-offs. Deliver role-based training (deck, pilots, scientists, guests) and place clear signage at cleaning stations with step-by-step cues.
Freshwater specifics	<ul style="list-style-type: none"> Apply heightened controls between basins/watersheds - many species survive damp equipment. Prioritise full dry-out or heat/disinfection before entering a new lake/river. Bag plant fragments and residues, never rinse to natural waters, dispose via approved facilities.

3.8. Freshwater Operations

Lakes, reservoirs, rivers, and canals behave differently from the open ocean: they're often closed or semi-closed systems that change quickly, amplify noise and light, and are highly sensitive to sediment, nutrients, and invasive species.

Operate with tighter controls - Clean–Check–Dry between every distinct waterbody, drain and dry bilges, intakes, and ballast before transits, decontaminate umbilicals, skids, nets, waders, and boots using approved heat/disinfectants when drying isn't feasible, and bag all plant fragments and residues as contaminated waste.

Plan routes with extra altitude and low-thrust profiles over fine sediments and macrophyte beds, in rivers, approach upstream and avoid station-keeping that scours the bed. Respect fisheries closures, spawning and nesting standoffs, and maintain generous separation from drinking-water intakes, dams, and fish passes. No refuelling on the water, use bunded shore or mother-ship stations only.

Set turbidity/plume triggers and pause to let waters clear if exceeded. Log biosecurity steps, turbidity, wastes, and any sheen or plume, and share observations on invasives or harmful algal blooms with local authorities.

These stricter habits protect water supplies, fisheries, and recreation - and keep freshwater access and permitting on your side.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Planning and permits	<ul style="list-style-type: none"> • Check local designations: abstraction zones, drinking-water intakes, bathing waters, fisheries closures, navigation bylaws. • Sequence sites (lowest risk first, highest risk last) and build decon windows into the plan. • Map shallow flats, macrophyte beds, spawning grounds, intake pipelines, and screens, mark no-go areas and conservative standoffs on mission charts. • Ensure buoyancy considerations of all equipment are understood and mitigated for use in freshwater to avoid loss of control.
Biosecurity	<ul style="list-style-type: none"> • Enforce Clean–Check–Dry between waterbodies, use designated stations with capture/filtration. • Drain/dry bilges, intakes, and ballast before trailering or transiting to a new lake/river. • Decontaminate umbilicals, ropes, waders, and boots (approved heat/disinfectant if drying impractical), photo-log steps, quarantine suspect items and notify per local protocol.
Thrusters, wake, and turbidity	<ul style="list-style-type: none"> • Use low-thrust modes in littoral zones and hold extra altitude over fine sediments/weed beds. • In rivers, approach upstream with gentle corrections, avoid station-keeping that scours the bed. • Set turbidity triggers (NTU or visual plume length), if exceeded: pause, increase altitude, reduce thrust, or relocate.
Nutrients and water quality	<ul style="list-style-type: none"> • Avoid disturbing nutrient-rich sediments during stratified periods (warm seasons) to prevent algal blooms. • Avoid scums/outfalls and recent stormwater inputs, plan alternate routes. • No uncontrolled washdowns or decanting - use contained wash areas with capture/filtration only.
Wildlife and fisheries	<ul style="list-style-type: none"> • Respect spawning closures and marked standoff zones for fish redds, amphibian breeding, and nesting waterfowl. • Keep noise/light to a minimum - small basins amplify both, prefer task lighting and slow approaches near colonies/roosts.
Intakes, dams, and infrastructure	<ul style="list-style-type: none"> • Maintain generous standoff from drinking-water intakes, hydropower inlets, and fish passes. • Avoid creating entrainment currents that pull debris toward screens. • Never tether across navigation channels or fish ladders, coordinate with operators where required.
Small craft	<ul style="list-style-type: none"> • No refuelling on the water, use bunded shore/mother-ship stations only.

Aspect	Guidance
	<ul style="list-style-type: none"> • Capture plant fragments on props/jet intakes, clear on shore and bag as waste. • Carry per boat: compact spill equipment, rangefinder, short tethers, waste bag with lid.
Data and reporting	<ul style="list-style-type: none"> • Log turbidity, wildlife observations, biosecurity steps, waste returns, and any plumes or sheen. • Share observations of invasive species or harmful algal blooms (HABs) with catchment authorities or science partners as applicable.

3.9. Environmental Emergency Preparedness and Response

Environmental incidents are decided in minutes, not meetings: the first five actions determine whether a drip stays a drip - or becomes a headline, habitat impact, or permit breach.

Preparedness turns chaos into choreography. By pre-planning the most likely scenarios (fuel/oil spills, chemical leaks, wildlife disturbance/strike, equipment loss/entanglement, turbidity plumes in sensitive habitats, battery/thermal events), assigning clear roles with laminated action cards, staging the right equipment exactly where they're needed, and rehearsing short, realistic drills, teams can detect fast, stop the source, protect sensitive receptors, recover safely, and communicate cleanly with authorities.

Universal abort/stop triggers (e.g., visible sheen, uncontrolled leak, wildlife agitation, persistent turbidity, umbilical snag risk) empower anyone to pause work.

Plain language, early notification, and disciplined logging protect credibility and speed mutual aid.

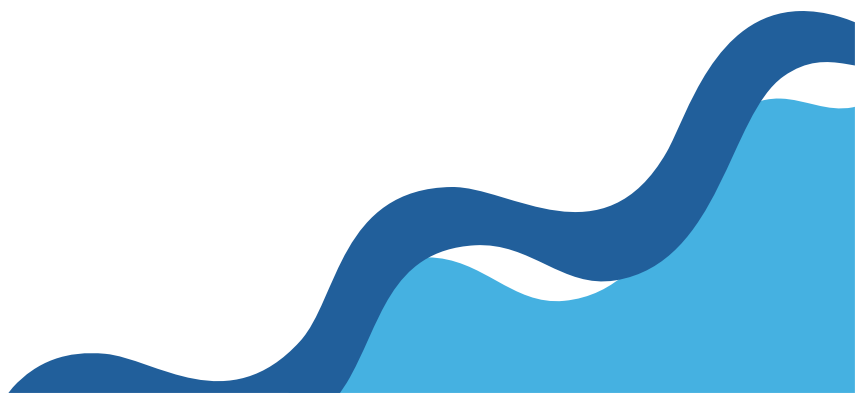
A 24-hour debrief with root-cause fixes, restocked equipment, and updated procedures closes the loop.

In short: preparation protects ecosystems, people, reputation, and licence to operate - when seconds count.

The following table provides short, practical, and common-sense guidance for you to adopt if you wish.

Aspect	Guidance
Response cards	<ul style="list-style-type: none"> • Prepare one-page action cards for: fuel/oil spills, chemical leaks, grey/bilge discharge, wildlife disturbance/strike, equipment loss/entanglement, sensitive-habitat turbidity plume, and battery/thermal events. • Each card shows: detect, make safe, contain, notify, recover, report, with site contacts and permit-specific timeframes.
Roles	<ul style="list-style-type: none"> • Assign: Response Lead (on-scene), Comms Lead (authorities/stakeholders), Spill Lead, Wildlife Lead, Safety Officer, Recovery Lead (lost items), Log keeper. • Consider: Designated Person Ashore for coordination of Outside Help in the event an emergency is unable to be handled locally. • Place laminated cards at points of use (bridge, deck, ROV van, small-craft rack) with radio call signs and alternates.
Equipment (right equipment, right place)	<ul style="list-style-type: none"> • Stage: spill packs (pads, socks, drain bungs, PPE, disposal bags), wildlife packs (binoculars, camera, rangefinder, incident forms), recovery aids (grapnels, magnets, lift bags, marker buoys), emergency comms (dedicated channel, spare radios), and a printed contact ladder (MPA office, port, regulator, science partners). • Position equipment at fueling points, workshops, boat racks, and ROV/AUV bays, seal, and date-check contents.
Abort/stop triggers	<ul style="list-style-type: none"> • Immediate STOP on visible sheen, uncontrolled leak, wildlife agitation/mass movement, turbidity beyond limit, umbilical snag/entanglement risk, battery thermal cue.

Aspect	Guidance
	<ul style="list-style-type: none"> • Response basics: neutral/idle, make area safe, notify the Response Lead, and deploy the relevant scenario card.
Drills	<ul style="list-style-type: none"> • Run 10–15-minute tabletop or live drills for the top scenarios, rotate crews and locations. • Time the response, identify one concrete improvement, update the card/equipment, and record attendance.
Communications	<ul style="list-style-type: none"> • Use a single radio channel, keep plain language calls, avoid cross-talk. • Make early, factual notifications to authorities (who/where/what/when/volume/actions/assistance). • Appoint one spokesperson for external comms, log every contact (name, time, content) in the incident record.
Contain / clean / recover	<ul style="list-style-type: none"> • Stop the source, protect receptors (booms/bungs, exclusion), recover (pads/pumps/lift), waste handling (label, secure storage, manifest). • For wildlife: stand-off switch to observation/documentation, call designated experts - no improvised handling. • Unrecovered items (tools, markers, weights) are logged as incidents with a recovery plan and follow-up.
After (close the loop fast)	<ul style="list-style-type: none"> • Debrief within 24 hours: cause, what worked, what to change, assign owners and dates. • Update SOPs, role cards, and equipment lists, restock and photograph equipment post-use. • Record the event (timeline, evidence, notifications) and align reports with permit requirements, verify action closure at the next EC/ops meeting.



Conclusion

Go Deeper with Care and Purpose

This document is more than guidance; it is a connection between our craft and the waters that enable it.

Use it as your handrail. Build the small habits - clean launches, quiet approaches, sharp abort cues, tidy recoveries - that add up to “no-trace” missions and easier permits, season after season.

Share what you learn, raise the bar for your peers, and let your leadership be visible in the details no one else sees.

If we design thoughtfully, execute precisely, and learn relentlessly, we protect the places we depend on - and prove that operational excellence and environmental stewardship are the same journey.

Ocean Biodiversity is the Superpower of the Planet

Contribute to its protection and conservation for future generations

