



FORTY-EIGHTH CONSULTATIVE
MEETING OF CONTRACTING PARTIES TO
THE LONDON CONVENTION
&
TWENTY-FIRST MEETING OF CONTRACTING
PARTIES TO THE LONDON PROTOCOL
5 – 9 October 2026
Agenda item 5

LC 48/5/1
23 June 2026
Original: ENGLISH
Pre-session public release: ☒

MARINE GEOENGINEERING INCLUDING OCEAN FERTILIZATION

Draft revised Ocean Alkalinity Enhancement Assessment Framework

Note by the Secretariat

SUMMARY

Executive summary: The annex to this document provides the draft revised Ocean Alkalinity Enhancement Assessment Framework approved by the Scientific Groups in 2026, for consideration and adoption by the governing bodies.

Action to be taken: Paragraph 3

Related documents: LC 48/5; LC/SG 49/16 and LC/SG 49/3/1

Introduction

1 At LC/SG 49 in 2026, the Scientific Groups finalized and approved the revised Ocean Alkalinity Enhancement Assessment Framework (LC/SG 49/3/1, annex 1). In doing so, the Scientific Groups further requested the Secretariat to conduct an editorial review aligning the text with the revised Ocean Fertilization Assessment Framework (OFAF) (LC 48/5) and to forward the framework to the governing bodies for consideration and adoption (LC/SG 49/16, paragraph 3.29).

2 The draft revised Ocean Alkalinity Enhancement Assessment Framework is set out in the annex. The text contains a number of legal and policy issues requiring consideration by the governing bodies, which are included in square brackets.

Action requested of the governing bodies

3 The governing bodies are invited to review the draft revised Ocean Alkalinity Enhancement Assessment Framework set out in the annex, and address any outstanding legal and policy issues, with a view to adoption.

ANNEX

DRAFT OCEAN ALKALINITY ENHANCEMENT ASSESSMENT FRAMEWORK

1 INTRODUCTION

1.1 This "Ocean Alkalinity Enhancement Assessment Framework" (the Framework) has been developed as a tool for Contracting Parties to conduct a case-by-case assessment of scientific research proposals for ocean alkalinity enhancement activities¹ to determine whether the proposed activity constitutes legitimate scientific research that is not contrary to the aims of the London Convention (LC) as provided in article II² and the London Protocol (LP) as provided in article 2.³ Each section of the Assessment Framework should be used in accordance with the precautionary approach. This Framework is also intended to serve as the Specific Assessment Framework referred to in article 6bis (2) that Parties can use to comply with LP annex 5.⁴

1.2 Ocean alkalinity enhancement is any activity undertaken by humans to increase the alkalinity of seawater to enhance the uptake of atmospheric CO₂ by the ocean (i.e. change the air to sea CO₂ partial pressure gradient) or to counteract ocean acidification [draft working definition as of December 2025].

1.3 Principally, the definition includes, but is not restricted to, the following sub-categories of ocean alkalinity enhancement:

- .1 adding alkaline matter directly to the ocean;
- .2 electrochemical approaches resulting in alkalinity release to the ocean; and
- .3 adding alkaline matter to seawater in chemical reactors on land or on ships or other platforms and subsequent release of a more-or-less equilibrated solution to the ocean.

¹ The Framework is to be interpreted and applied in conformity with the relevant rules of international law, including as reflected in the United Nations Convention on the Law of the Sea, 1982 (UNCLOS). Nothing in this Framework prejudices the rights, jurisdiction and duties of States under international law, including as reflected in UNCLOS.

² Contracting Parties shall, as provided for in the following articles, take effective measures individually, according to their scientific, technical and economic capabilities, and collectively, to prevent marine pollution caused by dumping and shall harmonize their policies in this regard. ([LC 1972](#))

³ Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and, where practicable, eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonize their policies in this regard. ([LP 1996](#))

⁴ Resolution [LP 4\(8\)](#)

How to use the Framework

1.4 In general, the Contracting Parties should ensure that the Framework is used in an iterative and integrated manner, recognizing that the different steps do not need to be implemented in a strictly linear manner. It may, for example, be appropriate to undertake, reconsider or repeat certain steps at different stages in the assessment process, recognizing in particular that project details may be revised or new information may become available during the assessment. For example, mitigation measures may be identified and incorporated into the project proposal by the proponent during the assessment process, or in the project design. In addition, new information may be received through consultation processes that would inform the details of the proposed project or the environmental assessment.

1.5 Furthermore, while the Contracting Parties should, in general, also ensure that all steps in the assessment receive full consideration before a final decision is made whether to allow or deny a proposed project, it should be noted that, when it is determined part-way through the assessment of a proposal that unacceptable impacts are considered likely, the assessment process may be terminated without completing all steps in the Framework in order to avoid unnecessary work (i.e. the proposal is withdrawn or not allowed to proceed).

1.6 It is intended that every experiment, regardless of size or scale, should be assessed in accordance with the Framework. However, paragraph 1.12 acknowledges that the level of detail and depth of assessment will vary according to the nature of each experiment.

1.7 If more than one Contracting Party is involved in an experiment,⁵ the Parties should consult one another to determine the most appropriate lead for the application of the Framework. In the case where an experiment is intended to take place within the jurisdiction of a Contracting Party, that Contracting Party should take the lead. Otherwise, the flag State of the vessel(s) being used for the alkalinity enhancement activity would usually take the lead. [Otherwise, the state claiming jurisdiction or control over the experiment through another legal basis would usually take the lead.]

1.8 Monitoring should be considered iteratively within various stages in the assessment framework.

1.9 The Framework contains the following sections:

- .1 project information needs – project details that should be provided by the project proponent and assessed for completeness by the entity conducting the assessment;
- .2 initial assessment – considerations for the appropriate authority of the Contracting Party based upon the information provided by the project proponent, including identification of consultation needs;
- .3 environmental assessment – details needed for the project proponent, Contracting Party's appropriate authority, or other responsible entity to conduct an environmental assessment using the project information;

⁵ Parties could be "involved" depending on the flag of the vessel/s used [or where the ship is registered], where the matter is loaded, where the experiment occurs, [where the headquarters/head office of the organizer of the activity is based], the funding source/s, the scientific expertise involved, [including the nationality of the lead researcher].

- .4 decision-making – criteria and considerations for the appropriate authority of a Contracting Party to make decisions about a proposed project and develop risk management strategies;
- .5 review of results of projects – guidelines for the sharing of information/reports and review of monitoring results of an authorized project; and
- .6 glossary – glossary of terms used within the Framework.

1.10 The various steps and assessments within the Framework may be carried out by or under the authority of a Contracting Party, which may draw on independent research organizations or other responsible entities that the appropriate authority of a Contracting Party identifies as having the necessary expertise to conduct the assessment. However, the decision-making process can only be done by the Contracting Party or its authorized permitting authority.

1.11 Contracting Parties, their appropriate authorities, or other responsible entities, shall verify that key assumptions and statements of the Assessment Framework are supported by sufficient information on which to base a decision, including all the issues covered in the Framework.

1.12 The assessments completed under the Framework should accurately communicate the complexity of the project. The level of detail and depth of assessment required for each issue should be appropriate to the nature of the proposal, including what, where, how and when it is proposed. Smaller, more focused studies may be less complex, and may have fewer components and interactions as well as smaller regions of impact. However, given the spatial and temporal variability of the marine environment, the potential for deleterious impacts depends not only on the spatial scale or amounts of matter added, but also on the other parameters raised in the Project information needs section (e.g. its location, sensitivity of the area, timing, frequency and composition of introduced matter), and the more factors there are, the higher the complexity and risk will tend to be.

1.13 [Contracting Parties are encouraged to apply the Framework to activities/experiments proposed for areas beyond national jurisdiction. Where an assessment is completed in accordance with the Assessment Framework for an experiment/ activity in areas beyond national jurisdiction, the Contracting Party should ensure that the assessment report is shared through the BBNJ Clearing House Mechanism (as per BBNJ art. 29(5) BBNJ).]

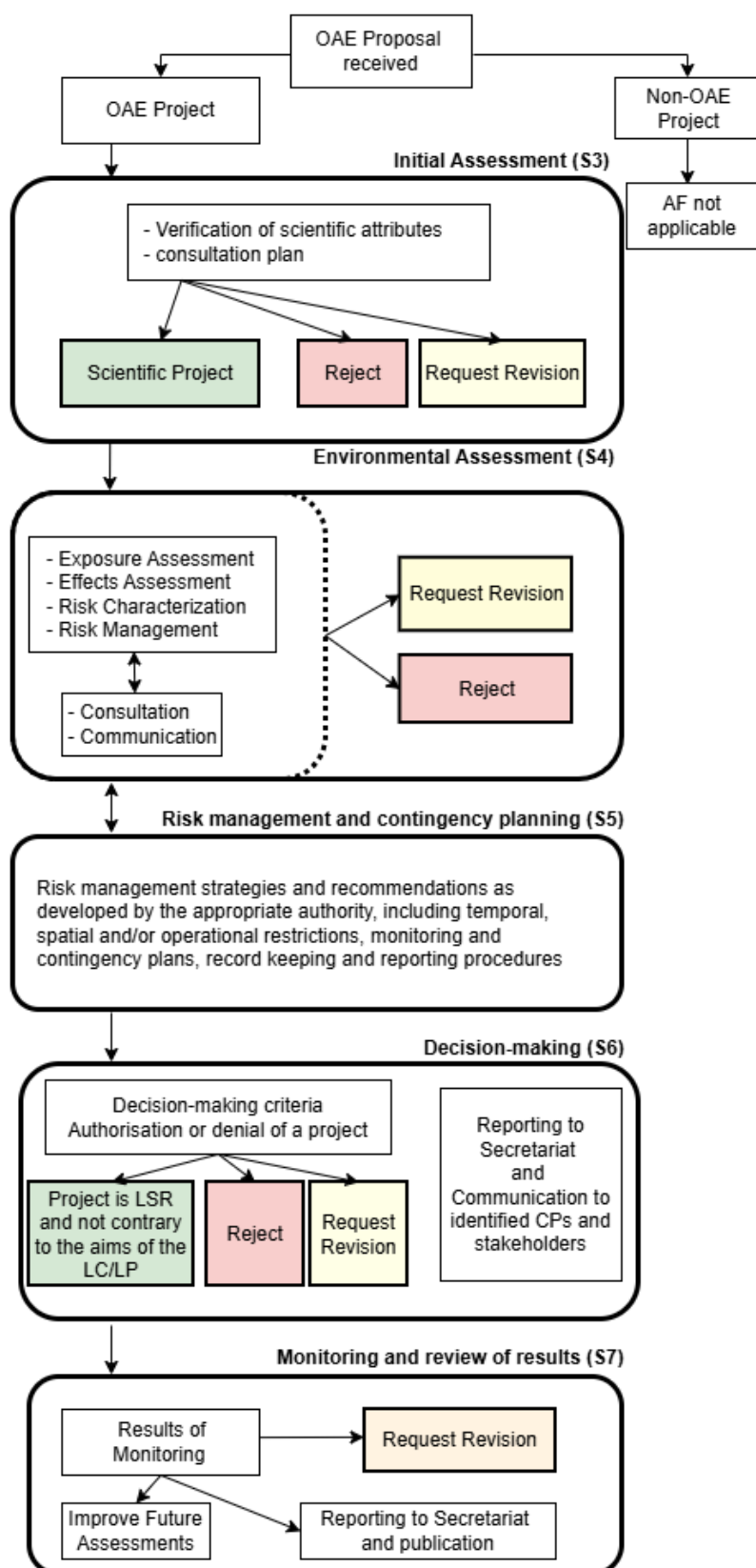


Figure 1: Ocean Alkalinity Enhancement Assessment Framework (OAE). This figure provides a simplified descriptive illustration of the elements of the assessment framework. It is not intended as a linear process given that it is intended for use in an iterative manner.

2 PROJECT INFORMATION NEEDS

2.1 A variety of information about the proposed project and its potential impacts will be needed to conduct the assessments within the Framework. A detailed list of the types of appropriate and relevant project information to support assessment of a proposal is provided in appendix 1 and the review of these data and information by the appropriate authority of the Contracting Party for ensuring completeness of the information submission. When assembling a project proposal, project proponents should consider whether there are feasible alternatives for the project that would prevent or reduce to a minimum potential adverse impacts, while achieving the research goals.

2.2 Appendix 1 contains a list of available data and information related to a proposed ocean alkalinity enhancement research project that would be needed to complete the assessments within the Framework. This information would be provided primarily by a project proponent but may also be supplemented with other sources of information including by a Contracting Party or its appropriate authority to ensure that sufficient information is available and complete for the purposes of the Initial Assessment and Environmental Assessment.

Review of project information

2.3 The appropriate authority of the Contracting Party or other responsible entity should evaluate the information provided by the project proponent (e.g. information under the "List of relevant project information" included in appendix 1) to ensure that sufficient and valid information is available before proceeding with the assessments of the Framework. While some information requirements may appear to be identical or similar, attention should be paid to the purpose of each section for guidance on how to use the information to complete that section of the risk assessment.

2.4 Upon an initial review of the available project information, it should be evident that the available project information contains sufficient detail to enable the appropriate authority of the Contracting Party or responsible entity to:

- .1 consider proposed site(s) location(s) for the proposed project, [in order to reject inappropriate proposals and pursue the assessment];
- .2 [if needed, notice warnings and concerns regarding risks and impacts of the proposed project, in order to enable the project proponent to adapt their proposal accordingly;
- .3 consider initial options to prevent, avoid, minimize, or mitigate risks to the environment, human health, or other ocean uses. (note that additional mitigation recommendations will also be informed by the environmental assessment and decision-making processes); and
- .4 complete the initial assessment.]

2.5 If, upon review, the appropriate authority determines that there are insufficient data and information to complete the assessments in the Framework, then additional project information should be requested from the project proponent or collected from other sources of information, such as available environmental data or scientific/technical publications, as appropriate. If sufficient project information is not provided by the project proponent and is not otherwise available, then the appropriate authority should pause the assessment process until such a time that sufficient data and information to assess the proposal becomes available or reject the proposal if sufficient information is not provided.

2.6 Once the appropriate authority of the Contracting Party or other responsible entity determines that sufficient data and information are available, the appropriate authority should communicate site selection preferences and initial mitigation recommendations resulting from the review of the project information to the project proponent; the project proponent can then identify appropriate revisions or updates to the project information for further consideration during the ensuing assessments of the Framework.

3 INITIAL ASSESSMENT

3.1 The appropriate authority of the Contracting Party or other responsible entity should use the Project information needs section to conduct the initial assessment of a proposed project and to create a plan for consultations with potentially affected stakeholders.⁶

Initial assessment criteria

3.2 The appropriate authority should conduct an initial assessment to determine if a proposed activity has proper scientific attributes. Contracting Parties may inform the Secretariat after receiving a proposal and should inform the Secretariat in writing upon completion of the initial assessment.

3.3 Only proposed activities meeting the following criteria should proceed through subsequent stages of this assessment:

- .1 the proposed activity should be designed to answer questions that will add to the body of scientific knowledge (see "List of relevant project information" section):
 - .1 proposals should state their rationale, research goals, scientific hypotheses and methods, scale, timings and locations with clear justification for why the expected outcomes cannot reasonably be achieved by other methods or alternative means which may have fewer or less adverse impacts;
 - .2 where relevant, the proposed activity should have been previously tested in a laboratory or mesocosm;
- .2 economic interests should not influence the design, conduct and/or outcomes of the proposed activity:
 - .1 there should not be any financial and/or economic gain arising directly from the experiment or its outcomes. Such a restriction, however, should not preclude payment for services rendered in support of the experiment or future financial impacts of patented technology. Information regarding the principal project team and their related professional affiliations should be provided, as well as identification of the proposed funding sources;

⁶ The term "stakeholders" typically refers to states and global, regional, subregional and sectoral bodies, as well as civil society, the scientific community, Indigenous Peoples and local communities.

- .3 the proposed activity should be subject to scientific peer review at appropriate stages in the assessment process:
 - .1 the outcome of the scientific peer review should be taken into consideration by the responsible Contracting Party or appropriate authorities of the Contracting Party. The peer review methodology should be identified prior to initiation of peer review and the outcomes of the peer review of successful proposals should be made publicly available together with the details of the project. Where appropriate, it would be beneficial to engage expert scientists from other countries in peer review; and
- .4 the project proponents should commit to sharing the results of the research:
 - .1 the proponents of the proposed activity should commit to publish the results of projects (upon completion and after data review and analysis) in peer reviewed scientific publications and include a plan in the proposal to make the data and outcomes publicly available in a specified time frame.

Consultation considerations

3.4 The appropriate authority of a Contracting Party should establish a consultation process with all potentially affected stakeholders, nationally or internationally, after receipt by the appropriate authority of a complete proposal (e.g. containing the information under the "List of relevant project information" section). Contracting Parties should also encourage the project proponents to initiate their own consultations with potentially affected stakeholders so that the project proponent can understand, consider, and address issues in the development of its project proposal.

3.5 Contracting Parties should establish a consultation process with all potentially affected stakeholders that begins as early in the assessment process as practicable and continues throughout the assessment process, so that the consultation processes can conclude before the appropriate authority makes a final decision to allow/authorize or reject a project.

3.6 A robust consultation plan would include the following aspects:

- .1 identifying and notifying potentially affected stakeholders, including:
 - .1 potentially affected countries: for example, any [coastal] State for which the Region of Potential Impact of a proposed project may have any effect in any area of the sea in which they are entitled to exercise jurisdiction in accordance with international law or in any area of the sea beyond the jurisdiction of any State;
 - .2 relevant regional organization(s): for example, where the placement activity has the potential to have any effects on an area subject to a regional intergovernmental agreement or arrangement, consultation should be implemented with a view to ensuring consistency with applicable regional objectives and requirements;

- .3 independent international experts or an independent international advisory group of experts, as described in LP annex 4, especially in situations where paragraph 10 of LP annex 5 applies. The advice from independent experts could address scientific, technical, social, [cultural] or economic aspects of the proposal. It shall, as appropriate, include a peer review of the information and data provided by the proponent with regard to its scientific and technical quality;
- .4 Indigenous Peoples and local communities with relevant traditional knowledge, where applicable;
- .5 civil society and the public, where relevant;
- .2 sharing of information with potentially affected stakeholders on the proposed project and its potential impacts with a view towards encouraging scientific cooperation; and
- .3 providing a process for ongoing consultation with potentially affected stakeholders, including consideration of information, advice, and recommendations received through consultation. [The Contracting Party should take into account substantive comments received during the consultation process, as appropriate, including revisions to the project description.]

4 ENVIRONMENTAL ASSESSMENT

4.1 Following the precautionary approach, the appropriate authority should conduct an environmental assessment using the data and information about the proposed activity (Project information needs section) and other relevant sources of scientific information. A rigorous environmental assessment consists of an exposure assessment (paragraphs 4.4 to 4.6) to determine specific assessment endpoints; an effects assessment to develop a conceptual site model and impact hypotheses (paragraphs 4.7 to 4.15); and a risk characterization (paragraphs 4.16 to 4.17) to develop an overall description of the risks of the proposed project.

4.2 The environmental assessment may be developed iteratively if the project details are revised or new information becomes available. For example, mitigation measures may be identified and incorporated into the project proposal by the proponent during the assessment process, or in the project design. In addition, new information may be received through consultation processes that would inform the details of the proposed project or the environmental assessment.

4.3 Outcomes of the environmental assessment, including the list of assessment endpoints and impact hypotheses developed for these assessment endpoints, should be reviewed, specifically to:

- .1 consider whether unacceptable impact(s) to assessment endpoint(s) have been identified that may require substantial revision or rejection of the project; and
- .2 identify specific assessment endpoints or environmental conditions that should be monitored as part of the monitoring programme.

Exposure assessment

4.4 The exposure assessment would:

- .1 include an assessment of the movement and fate of added matter within the marine and connected environments; and
- .2 identify potential hazards associated with the project so that potential marine receptors can be identified and their exposure calculated.

4.5 The exposure assessment should result in the formulation of specific assessment endpoints for the proposed project and should include a description of the methodology used to estimate the exposure processes and pathways. The uncertainties associated with such an assessment also need to be identified, including any implications of limited knowledge of risk assessment baseline conditions, and consideration of the sensitivity of the exposure to underpinning assumptions, uncertainties and data gaps.

4.6 Relevant considerations for the exposure assessment include:

- .1 the anticipated fate of added/redistributed matter including, where appropriate, uptake and settling and the movement and fate of all added/redistributed matter (tracers, etc.) with respect to physical processes (e.g. currents, wind patterns, seasonal influences, sedimentation, dispersion, re-suspension, subduction); chemical processes (e.g. chemical precipitation of carbonate or secondary minerals, oversaturation, possible side reactions with main reactant or other chemicals present); and biological processes (e.g. calcification, biological precipitation);
- .2 the anticipated changes in concentration of matter introduced/redistributed into the ocean over time and space;
- .3 other information necessary to describe the spatial and temporal extent of exposure processes (e.g. advection to sensitive areas);
- .4 other direct or indirect impacts on or changes to the physical environment (including temperature and buoyancy effects, as well as the effect of the physical apparatus) during the alkalinity enhancement activity;
- .5 other unintended potential impacts of the delivery method (e.g. formation of hot spots of high alkalinity);
- .6 any potential exposures if the matter reaches an unintended area;
- .7 consideration of other legitimate uses of the sea, such as navigation, fisheries, recreational activities, ocean infrastructure, other scientific research;
- .8 the potential for cumulative exposure from repeated or other alkalinity enhancement activities, other marine geoengineering activities or other human activities including known past and present and reasonably foreseeable activities; and
- .9 any hazards due to ship operations or any structure to be located at sea (e.g. waste management, noise both above and below the waterline, exhaust gases).

Effects assessment

4.7 The rigorous effects assessment assembles the information from the exposure assessment to describe the predicted short- and long-term response of the marine environment and connected environments (atmospheric, coastal) due to the proposed alkalinity enhancement activity for each assessment endpoint. This section considers elements for the development and evaluation of impact hypotheses.

4.8 The effects assessment should consider changes to marine ecosystem structure and dynamics including sensitivity of species, populations, communities, habitats, and processes, within and outside the area with enhanced alkalinity including physiological changes and changes in state and rate variables. The level of detail required for each element should be appropriate to the nature of the proposal, including what, where, how and when it is proposed, and the extent to which each consideration contributes to the overall risk and complexity of the proposed study.

4.9 When evaluating potential effects, relevant standards/indicators should be used where available, such as water and sediment quality criteria, biodiversity indices and habitat and organism health indicators.

4.10 Methodologies (including models, pre-existing data, targeted measurements) for assessing effects should be described, including the sensitivity to underpinning assumptions, uncertainties and data gaps such as:

- .1 limited information about experimental baseline;
- .2 natural variability within the risk assessment baseline;
- .3 longevity of the response; and
- .4 lack of long-term monitoring in previous activities.

Identification of potential effects

4.11 Specific potential effects that should be considered in the effects assessment include:

- .1 biogeochemical changes (e.g. nutrients, oxygen, pH, carbonate system, dissolved organics);
- .2 biogeochemical fluxes (e.g. dissolved and particulate carbon, trace elements);
- .3 organism responses (e.g. population responses):
 - .1 response of primary producers and of calcifiers; and
 - .2 potential response of other organisms (e.g. bacteria, planktonic species, fish, reptiles, seabirds, marine mammals, benthic species);
- .4 ecosystem considerations:
 - .1 any intended or unintended transport of organisms;

- .2 community composition and biodiversity;
- .3 food-web interactions (e.g. grazing responses, predator/prey relationships);
- .4 potential for bioaccumulation and biomagnification of any toxins and contaminants in organisms;⁷ and
- .5 potential for acute or chronic effects from toxins or contaminants; and
- .5 human health considerations, including food chain effects.

4.12 The assessments of potential effects should contextualize risks within the framework of ongoing environmental changes. Marine systems are experiencing directional changes in temperature, pH, oxygen levels, and species distributions. These trends affect both the baseline state of ecosystems and their capacity to respond to additional stressors. When estimating effects and risks of alkalinity enhancement projects, evaluations should consider how projected future environmental conditions may modify ecosystem sensitivity and the magnitude of potential impacts.

4.13 In considering the effects listed above, the following potential adverse effects should be discussed with a level of detail that is appropriate to the proposed activity and its level of potential risk:

- .1 short- and long-term primary production changes, leading to impacts to fisheries, protected species, ecosystem services, or;
- .2 areas with increased turbidity due to the addition of particulate material;
- .3 hot spots of high alkalinity;
- .4 short- and long-term ecosystem changes, such as changes in community structure and/or diversity;
- .5 cumulative effects from repeated or other ocean alkalinity enhancement activities, other marine geoengineering activities, or other human activities including known past and present and reasonably foreseeable activities if relevant;
- .6 in case the alkaline matter is placed on the sea floor changes to sediment and benthic habitat; and
- .7 other societal, cultural and economic impacts including visual amenity.

⁷ When evaluating potential effects from toxins and contaminants, information provided by project proponents should, where feasible, include results from acute and chronic ecotoxicity tests (e.g. EC50, LC50 and relevant sub-lethal endpoints like specific biomarkers) obtained for marine species that are representative of the receiving environment, in particular planktonic and other marine organisms relevant to the proposed region and region of potential impact, rather than relying solely on generic reference values.

Conceptual site model

4.14 Activity-specific exposure and effects information can be used to develop a conceptual site model (CSM) for the proposed project. More than one CSM may be necessary to accurately capture the complexity of the proposed activity, and the level of effort required for the CSM, and subsequent analyses of its components, should be proportional to the complexity of the proposed activity.

4.15 The CSM(s) should include:

- .1 initial **Impact Hypotheses**; and
- .2 a description of gaps and uncertainties relative to the conceptual model, including implications of limiting knowledge of risk assessment baseline conditions, and any activities planned to address these gaps and uncertainties should be identified.

Risk characterization

4.16 The information from the exposure assessment and effects assessment is integrated into a risk characterization to provide an estimate of the *likelihood* for adverse impacts and the *magnitude* of those impacts described in the initial impact hypotheses. The principal products of risk characterization are a series of evidence-supported predictions about the risks posed by a proposed ocean alkalinity enhancement activity and a clear description of the uncertainties.

4.17 Considerations:

- .1 the risk characterization should consider site-specific information;
- .2 information gleaned from desktop, laboratory, mesocosm studies and other past field experiments that can be extrapolated to characterize the risk of the proposed project should be utilized to the extent possible;
- .3 a weight of evidence approach⁸ may be applied by using the information produced during the exposure and effects assessments to develop lines of evidence supporting specific conclusions about how the proposed alkalinity enhancement activity could influence the assessment endpoints:
 - .1 multiple lines of evidence will be used to describe the physical, chemical, and biological processes relevant to changes in each assessment endpoint and conclusions regarding the magnitude of potential changes and the likelihood of those changes. For example, results from previous field observations, modelling results, and laboratory or mesocosm experiments could provide independent lines of evidence supporting a specific conclusion that relates some aspect of the proposed alkalinity enhancement activity and the assessment endpoints;

⁸ This Weight of Evidence Approach should be applied using a level of effort and detail that is appropriate to the complexity, certainty, level of concern and potential level of risk associated with a research project.

- .2 the strength of any conclusion will be a function of the "weight" of evidence supporting it. Used in this sense, weight is the result of the degree to which independent lines of evidence support specific aspects of the conclusion and the amount of information, overall, supporting the conclusion; and
- .3 in general, the greater number of independent lines of evidence and information supporting the conclusion, the greater the weight of evidence. However, evidence of more severe or drastic effects could be given more weight than evidence of minor effects, though even here, the validity and reliability of the evidence is important to consider and several lines of evidence pointing in the same direction should be given more importance; and
- .4 for each assessment endpoint, integration of the magnitude of the effect and the probability, or likelihood, of the effect occurring will yield an estimation of risk (information under "Assessment of magnitude and likelihood of effects" section). Both of these components are likely to be, at best, semi-quantitative so will represent judgements based on the available knowledge and experience.

Identification of potential risks

4.18 Risks are characterized in terms of the assessment endpoints. Potential risks that could be considered for a particular field research project include:

- .1 physical examples include:
 - .1 [creating non-mixing bodies of water due to a change in local chemistry];
- .2 chemical examples include:
 - .1 magnitude and duration of changes in pH resulting from ocean alkalinity enhancement. Ocean alkalinity enhancement is intended to increase the pH of seawater at the site of alkalinity enhancement;
 - .2 creating alkaline hot spots (elevated alkalinity that is unequilibrated – high pH, low CO₂- at and around the injection site) potentially leading to oversaturation and (unwanted) secondary side reactions near the injection/release site; and
 - .3 severe carbonate chemistry and chemical equilibrium perturbations (depending on location it could take years for replenishment if CO₂ via the air-sea flux);
- .3 biological examples include:
 - .1 altering the biogeochemical cycling of elements and associated impacts on the marine ecosystem given the permanence of these chemical changes;

- .2 alkaline matter added could contain trace elements (e.g. Ni leaching from olivine) or other toxic substances that could harm marine organisms and pose a threat to human health by accumulating in the food chain;
- .3 alkaline matter added could contain nutrients (e.g. silicate and micro-nutrients such as Fe, Mg, Si, Ni) and could lead to phytoplankton blooms;
- .4 when applying particulate or dissolved minerals, turbidity enhancement could impact light climate ("white waters") with effects on plankton production and macrophytes (and reduction of the biological carbon pump) and impacts on light-dependent organisms (e.g. effects on visual foragers such as fish and seabirds);
- .5 impact of increased alkalinity on phyto- and zooplankton and associated risks of perturbation of the food web (e.g. if silica-rich olivine is added shifts in phytoplankton functional group composition favouring diatoms could occur, coccolithophores might be promoted when carbonate-based minerals are used resulting in "white waters");
- .6 changes in nutrient and oxygen dynamics through changes in the mixing characteristics due to a change in local water chemistry and associated impacts on organisms and food webs;
- .7 direct impacts on benthic ecosystems when either placing particulate alkaline matter directly on the sea floor (e.g. smothering, mechanical impacts – scouring; chemical impacts from increased alkalinity) or particulate alkaline matter sinking through the water column to the sea floor; and
- .8 indirect impacts on benthic ecosystems through sinking and deposition of changed plankton community;
- .4 societal, economic and cultural including:
 - .1 induced changes in economic resources and activities (e.g. fisheries);
 - .2 impact on local traditional sites or degradation of landscape;
 - .3 impacts on other local projects with other objectives, notably nature-based solutions; and
 - .4 other legitimate uses of the sea; and
- .5 cumulative impacts may be anticipated as a result of other activities, e.g.:
 - .1 multiple activities in the same water body, e.g. aquaculture, offshore ocean infrastructure; and
 - .2 multiple alkalinity enhancement, other marine geoengineering or other human activities including known past and present and reasonably foreseeable activities in the same water mass over a period of time.

Assessment of magnitude and likelihood of effects

4.19 Risk is a function of the magnitude of an adverse effect and its likelihood. For each assessment endpoint, information relating magnitude of exposure and magnitude of effect should describe the risk to that endpoint, such as exemplified in figure 2a, and that together with the likelihood of effects, should be used to determine the risk conclusion through the following considerations:

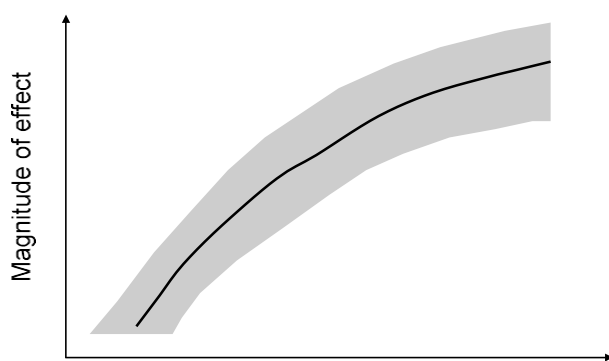
- .1 number of effects: the number of effects identified as assessment endpoints by the problem formulation will vary on a case-by-case basis. All else being equal: the greater the number of effects predicted, the greater the overall risk;
- .2 magnitude: in the environmental assessment, it is necessary to distinguish conclusions about the magnitude of an effect from conclusions about the likelihood for an effect of a particular magnitude (figure 2b). This distinction acknowledges the uncertainty associated with the relationship between magnitude of exposure and magnitude of effect and is depicted as the shaded area around the line representing the relationship in figure 2a:
 - .1 temporal scale: the duration of the effects could be transient, such as a phytoplankton bloom that occurs over a matter of days or is more sustained; or the introduction of structures into the marine environment creating physical barriers and potentially causing long-term effects. Temporal responses may also involve time lags so that the effects may be delayed. All else being equal, the longer the predicted duration of effect, the greater the risk;
 - .2 spatial scale: the geographical scale of the effect can be near-field (local) or far-field (remote) in relation to the proposed operation. It should be taken into account that the area with enhanced alkalinity can and will move over time in three spatial dimensions. All else being equal, the larger the area over which effects are manifested, the greater the risk;
 - .3 in general, risk increases with the magnitude of the effect, the size of the area over which it occurs, and the longer its duration. However, it should be considered that widespread, prolonged low-level effects may have greater potential for cumulative impact than contained, brief high-level effects; and
 - .4 acute and chronic effects on human health or sensitive marine organisms should have the highest magnitude rating. National Action Lists could be used in this regard;⁹ and
- .3 likelihood: conclusions regarding the likelihood for effects of a given magnitude are developed from evidence regarding the strength of relevant cause-and-effect relationships (e.g. between a specific exposure process and a given effect, as determined by the exposure and effects assessments), uncertainties associated with these relationships and the role of natural variation in these processes in the environment.

⁹ See for instance document LC/SG 32/2.

4.20 Risk characterization methods:

- .1 risk assessment matrix: the appropriate authority should use a risk assessment matrix (figure 2b) to inform, and to provide a consistent approach to, decision-making. Separate sets of criteria are defined for both the magnitude and the probability of effects according to the parameters of the assessment endpoint. These are then brought together in a matrix to identify relative degrees or categories of risk. Impacts may range from low probability and low magnitude to high probability and high magnitude. The boundaries of the significance of the risk indicated in the matrix can be summarized using categories (e.g. "high", "medium", "low") or on a numerical scale:
 - .1 in addition to the exposure-effect relationship, other factors contributing to conclusions about the magnitude of risk include the spatial extent over which the effect will occur, as well as the duration of the effect. Evidence concerning magnitude, spatial extent, and duration of the effect is used to reach conclusions about the magnitude of a change in the assessment endpoint, i.e. the relative positions along the horizontal axis in figure 2b; and
 - .2 evidence-based conclusions regarding magnitude of effect and likelihood are used to identify the cells, in figure 2b, representing the risk conclusion for the assessment endpoint under consideration. Following this approach, a version of figure 2b would be prepared for each assessment endpoint evaluated in the environmental assessment. It should be acknowledged here that the presentation of risks in figure 2b is only one of several different approaches that could be used, depending on the needs and uses of the assessment;
- .2 integrating across endpoints to produce an overall description of risk: once the appropriate authority reaches conclusions regarding the risk to each assessment endpoint, an overall risk conclusion should be developed that integrates those risks across all **assessment endpoints**. This integration step would take into consideration the nature of the risks and the differences in emphasis, importance, or weight that may be attached to the risks under consideration. Integration across endpoints informs risk management decision-making to evaluate the sensitivity of the ultimate decision(s) to changes in key elements of the integration process:
 - .1 different logic frameworks may be used to accomplish this integration in the practice of environmental risk assessment (e.g. multi criteria decision analysis). Obviously, the approach selected by a Contracting Party will be selected to satisfy both national and international requirements. Approaches can range from narrative presentation of arguments to more formal, quantitative frameworks such as the application of decision analysis methods; and
 - .2 regardless of the approach taken, the purpose of the integration is to inform the decision-making processes of risk management.

- .3 characterization of uncertainties: in addition to describing and communicating the risks posed by the proposed alkalinity enhancement activity, the environmental assessment should also provide a description and summary of the uncertainties associated with its conclusions. Such a description is to include a listing of the significant/consequential assumptions, data gaps, and sources of variation in exposure and effect processes. If modelling is used, the uncertainties and outputs of a sensitivity analysis should be included. Furthermore:
- .1 this element of the environmental assessment should go beyond a simple list and provide an evaluation of the uncertainties such that it is sufficient to inform decision makers regarding the limitations and constraints associated with the risk conclusions, including the means for decision makers to inform themselves about the implications for decision-making posed by those identified uncertainties; and
 - .2 this treatment of uncertainty will also provide a source of input for identifying future monitoring and/or research activities through which uncertainties can be reduced, and future risk assessments can be supported.



a) Magnitude of effect and exposure

Increasing acceptability →	Consequences			
	Severe	Moderate	Mild	Negligible
Probability				
High	High	High	Medium/Low	Very low
Medium	High	Medium	Low	Very low
Low	High/Medium	Medium/Low	Low	Very low
Negligible	High/Medium /Low	Medium/Low	Low	Very low

b) Risk assessment matrix

Figure 2: Relationship between magnitude of effect and exposure (a) and risk assessment matrix (b).

5 RISK MANAGEMENT AND CONTINGENCY PLANNING

5.1 The results of the Initial Assessment and Environmental Assessment, and the outcomes from Consultations and/or peer-reviews should be used to develop risk management recommendations. Taken together, this information will inform decisions in the "Decision-making" section about whether a proposed project represents "legitimate scientific research" that would not be contrary to the aims of the LC/LP.

5.2 Risk management procedures are necessary to ensure that, as far as practicable, environmental, societal and economical risks are prevented or reduced to a minimum. Relevant measures, following best environmental practices, need to be in place in line with a precautionary approach.

5.3 Risk management procedures are developed through mitigation and contingency planning. The results from the environmental assessment, including the risk characterization, should be used to evaluate whether and how the risks identified can be prevented or otherwise reduced to a minimum through implementation of specific risk management strategies for a proposed project. Through this process, the number of potential effects, cumulative effects and interactions between effects should also be considered.

5.4 Strategies to manage or mitigate risks need to be appropriate for the risks under consideration. Risk management measures may be imposed as additional conditions by the appropriate authorities of Contracting Parties or included as an intrinsic part of a proposed project design.

5.5 Such risk management strategies may include:

- .1 temporal restrictions: (e.g. restrictions during certain oceanographic conditions or biologically important times for species of concern or to avoid conflicts with other ocean uses);
- .2 spatial restrictions: (e.g. size of area with enhanced alkalinity, proximity to areas of special concern and value);
- .3 operational restrictions: (e.g. delivery method; type, form, and amounts of matter; use of tracers; timing, repetition, and duration of release or redistribution of matter);
- .4 monitoring plans: monitoring programmes should have clearly defined objectives and methods. Revisions or additions to the monitoring plan may be needed to ensure that appropriate environmental and research endpoints are monitored and that the monitoring techniques or methods are expected to produce scientifically valid results for the research aims as well as the environmental impact monitoring. The type, frequency and spatial and temporal extent of monitoring will depend on the impact hypotheses and local and regional consequences. Specific categories of monitoring include:
 - .1 impact monitoring: to monitor the short- and longer-term environmental impacts of the project within the region of impact, and verify that the assumptions and predictions made during the assessment of the proposed activity review were correct and sufficient to protect the environment, human health, and other ocean uses. Impact monitoring should take into account relevant research and modelling information in evaluating the design and requesting modification of impact monitoring programmes and should specifically seek to:
 - .1 confirm or refute impact hypotheses; (e.g. what testable hypotheses can be derived from the impact hypotheses? what measurements (type, location, frequency, performance requirements) are required to test these hypotheses?; and how should the data be managed and interpreted?);

- .2 provide relevant data to inform future scientific research or environmental assessments; and
- 3 provide data with sufficient spatial and temporal resolution to evaluate potential effects on assessment endpoints over relevant spatial and temporal scales;
- .2 compliance monitoring: to verify that any conditions imposed by the Contracting Parties are met, including operational, temporal, and spatial restrictions, and to validate the project's consistency with the initial assessment (section 3.2);
- .3 contingency monitoring: to ensure that appropriate measurements or monitoring are conducted to identify trigger points for the timely implementation of contingency plans; and
- .4 monitoring time frames and regions should be appropriate with respect to the temporal and spatial scales of potential ecosystem impacts, given that they may manifest over multi-decadal timescales and far from the proposed site, which would include downstream ecosystem impacts and transboundary impacts. Monitoring design should account for the challenge of distinguishing intervention signals from natural climate variability and ongoing directional environmental changes;
- .5 contingency plans: contingency plans will need to be developed and implemented in response to monitoring in cases where the impact hypotheses are found to be incorrect. This may include the cessation of alkalinity enhancement activities, particularly in the case of multiple additions over time, or appropriate remedial actions;
- .6 risk management strategies should be developed for use following the cessation or during temporary suspension of the project. Those strategies could include measures to maintain ecosystem integrity, such as removal of any man-made structures at sea installed and/or used for research purposes; and
- .7 recordkeeping and reporting procedures: plans for recording and reporting on the operational and research aspects of the activity ensure that the activities are well documented and that data and information from the research activity are preserved for future scientific use.

6 DECISION-MAKING

Decision-making criteria

6.1 A decision by the Contracting Party that a proposed activity represents legitimate scientific research that is not contrary to the aims of the LC/LP should only be made if each of the successive steps of the Framework are completed, including:

- .1 the appropriate consultation and communication considerations;

- .2 the consideration of the outcome of the peer review process; and
- .3 the appropriate risk management procedures to ensure that, as far as practicable, environmental disturbance and detriment would be prevented or reduced to a minimum.

6.2 Additional considerations include:

- .1 a determination that the proposed activity is not contrary to the aims of the Convention or Protocol should only be issued for defined periods of time and defined regions;
- .2 consent should be sought from all countries with jurisdiction or interests in the Region of Potential Impact, without prejudice to international law including as reflected in the relevant provisions of UNCLOS;
- .3 that the scientific benefits are maximized; and
- .4 [the Contracting Party should take into account substantive comments received during the consultation process, as appropriate including revisions to the project description].

6.3 If the risks and/or uncertainties are deemed unacceptable, with respect to the protection of the marine environment, taking into account the precautionary approach, then a decision should be made to seek revision of or reject the proposal.

Authorization or denial of a project

6.4 Considering the above, the Contracting Party should make a decision to allow or deny the proposed project:

- .1 authorization of the project: authorization of the project includes the duration and location of the activity, the requirements for monitoring and reporting, and any other conditions required by Contracting Parties. The assessment and authorizing documentation should be publicly available at the time the decision is made;
- .2 denial of a project: if the risks and/or uncertainties are deemed unacceptable, with respect to the protection of the marine environment, taking into account the precautionary approach, then a decision should be made to seek revision of or reject the proposal; and
- .3 the decision made should be communicated to:
 - .1 the LC/LP Secretariat: it is recommended that relevant documents produced by Contracting Parties as part of their efforts to address the needs outlined in the Framework should be catalogued by the Secretariat and maintained for use in future assessments. Contracting Parties should provide summaries of the assessment in English to the Secretariat; and
 - .2 relevant countries and potentially affected stakeholders, including those who were consulted.

7 REVIEW OF RESULTS OF PROJECTS

7.1 Collection and use of information resulting from monitoring informs future decision-making and can improve assessments of future proposed projects.

7.2 A report of any impacts of the alkalinity enhancement activities, including results of monitoring, should be communicated in writing to the Secretariat and made publicly available on the Contracting Parties' website.

7.3 As new results become available, monitoring requirements should be reviewed at appropriate intervals in relation to the objectives and can provide a basis to:

- .1 modify or terminate the impact monitoring;
- .2 modify or revoke the authorization;
- .3 redefine or close the authorized site; and
- .4 modify the basis on which proposals to conduct alkalinity enhancement activities are assessed.

8 GLOSSARY

Alkalinity: Ocean alkalinity is defined as the capacity of seawater to neutralize acids, essentially acting as a natural buffer against changes in pH and acidification. In ocean water, carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) dominate the alkalinity, making up the vast majority of the acid-neutralizing capacity.

Assessment endpoint: The physical, biological or chemical attributes of the ecosystem to be protected, which may be adversely affected by the action of the experiment.

[Best environmental practices (BEP): the application of the most appropriate combination of environmental control measures and strategies, for purposes of ensuring the effective protection of the Marine Environment [against pollution], and based on the Best Available Scientific Information and Best Available Technology that will change with time in the light of improved knowledge, understanding or technology, as well as the incorporation of the relevant traditional knowledge of Indigenous Peoples and local communities.]

Climate-Active Gases: Gases which affect the climate, including, but not limited to greenhouse gases (CO_2 , CH_4 , N_2O), stratospheric ozone-depleting substances (CH_3Br , CH_3Cl , CHBr_3 , etc.), aerosol-forming gases (DMS , NH_4) and volatile organic compounds which impact tropospheric photochemistry.

Conceptual site model (CSM): A CSM is a visual and narrative description of the physical, chemical and biological processes occurring, or that have occurred, or will occur, at a site. CSMs are dynamic and iterative and will be able to convey the understanding of the current dynamics of the site and how different components and interactions are expected to change throughout different phases of the research activity.

Contingency plan: a backup plan designed to address unexpected events or risks, including, but not limited to, emergencies.

Ecosystem services: the benefits humans receive from nature, such as clean air and water, food, pollination, flood control, and recreation.

Experimental baseline: A description of conditions specifically relevant to the experiment, including a description of those conditions that are representative of the period directly preceding the experiment. This should include data representative of natural variability, e.g. diurnal, seasonal and inter-annual.

Area with enhanced alkalinity: The surface area of the ocean into which matter is introduced. This area will change over time as matter is transported.

Volume with enhanced alkalinity: The volume of the ocean in which concentrations of matter have been purposefully elevated. This volume will change over time as matter is transported or transformed.

Impact hypotheses: Concise statements of the expected consequences, as defined in Annex 2, paragraphs 12 to 15, to the LP.

Marine Protected Areas (MPAs): Any oceanic region which has been designated by national or international law to protect part or the entire enclosed environment.

Proposed region: The area of the ocean in which the proposed site is located.

Proposed site: The surface area of the ocean into or through which matter is planned to be introduced.

Region of potential impact: The maximal area of the ocean in which detectable changes (effects) would be expected to occur as a result of introductions of matter.

Region of impact: The area of the ocean in which detectable changes (effects) have occurred as a result of introductions of matter.

Risk assessment baseline: Refers to an initial assessment of the risks of an activity. A description of conditions collected over a longer period of time, which is used to draw conclusions about the potential for adverse impact resulting from the activity. This baseline should include data representative of natural variability, e.g. diurnal, seasonal and inter-annual.

Weight of evidence (WoE) approach: a method for decision-making that combines and systematically evaluates multiple lines of evidence to reach a conclusion, especially when a single test or piece of data is insufficient.

APPENDIX 1

List of relevant project information

- 1 Relevant project information includes:
 - .1 information about entities involved in the [planned/proposed] activity:
 - .1 names, affiliations, [nationalities], and contact information for all entities involved in the proposed project activities, including for the researcher(s)/principal investigator(s) and the entities anticipated to be involved in transporting and releasing the matter into the ocean or redistributing the matter in the ocean;
 - .2 statement disclosing potential conflicts of interest related to the proposal for all involved entities together with a description of measures that will be taken to eliminate, mitigate or otherwise manage any such conflicts;
 - .3 information on the financial resources available to fulfil the programme work prior to commencement of the proposed activity; and
 - .4 the flag State(s) of the vessel(s) involved and the port State(s) where the matter will be loaded aboard the vessel(s);
 - .2 description of the operational aspects of the project:
 - .1 the received proposal should include a description of the activity falling within the definition of ocean alkalinity enhancement, including the type of ocean alkalinity enhancement activity (see the subcategories above in section 1.3);
 - .2 the method, timing, [location] and duration of both addition/redistribution of matter and collection of data, including:
 - .1 anticipated transit route and method for transporting the matter;
 - .2 mode of application, mechanical description/method of delivery including the methods for controlling the rates and locations of releases or redistribution of matter;
 - .3 rate and periodicity of addition or redistribution of matter (e.g. volume or weight of matter per unit of time);
 - .4 intended initial concentration of the matter in the volume with enhanced alkalinity;
 - .5 depth in water column of addition or redistribution;
 - .6 duration of the alkalinity enhancement process (including number of and interval between additions); and

- 2 A description of proposed monitoring programmes, including:

3 The proposal should include data and information necessary to evaluate the physical, geological, chemical, and biological conditions at the proposed site and region of potential impact, including natural variability in those conditions (e.g. diurnal, seasonal and inter-annual variability). When characterizing baseline conditions, it should be recognized that marine ecosystems are dynamic and undergoing changes driven by multiple environmental and climatic stressors. The sensitivity and resilience of key species and communities may already be affected by these environmental and climatic stressors, and should be considered when evaluating the potential additional effects of ocean alkalinity enhancement activities.

4 Uncertainties in the data and information provided should be discussed. Site characterization information may be drawn from literature reviews, existing data from other activities, or targeted oceanographic surveys.

5 Figure A1 depicts the planning and implementation stages of an ocean alkalinity enhancement activity, including a visualization of the proposed site/region and the region of potential impact.

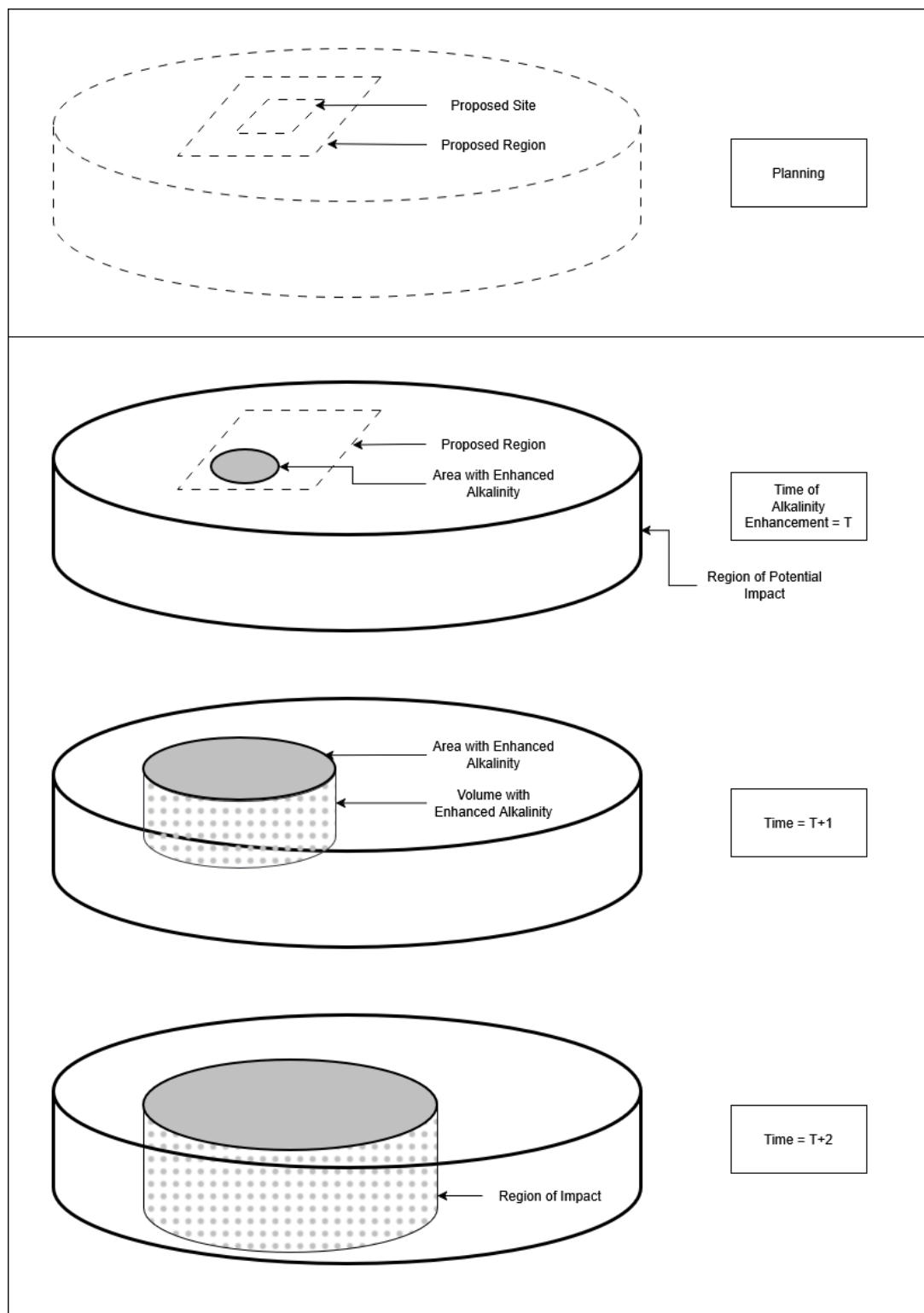


Figure A1: A simplified depiction of the planning and implementation stages of an ocean alkalinity enhancement project. At the time of alkalinity enhancement (time = T), the activity occurs at a location within the Proposed Region of the ocean (i.e. Area with Enhanced Alkalinity). As time progresses the Area with Enhanced Alkalinity and volume will change (shown as Time = T+1). The Region of Impact refers to the area of the ocean in which detectable changes (effects) occur as a result of the ocean alkalinity enhancement activity shown as (Time = T+2). Note that in reality the Area with Enhanced Alkalinity, volumes and Region of Impact(s) will be more complex and involve varying degrees of uncertainty.

- 6 Site characterization information should include:
- .1 locations, including geographic coordinates and maps, of:
 - .1 the proposed site(s) where alkaline matter would be introduced into the ocean;
 - .2 the proposed region within which the proposed site(s) are located;
 - .3 the region(s) of potential impact, including the predicted area with enhanced alkalinity and volume with enhanced alkalinity (size and depth);
 - .4 proposed locations where monitoring activities would occur, including control sites;
 - .5 structures or equipment deployed in the ocean that would be associated with the proposed activity; and
 - .6 other locations or regions relevant to the proposed activity;
 - .2 physical characteristics of the proposed region and region of potential impact:
 - .1 water column attributes;
 - .2 water depth;
 - .3 depth range of light penetration;
 - .4 temperature and salinity distributions;
 - .5 depth of mixed layer; and
 - .6 naturally occurring pH;
 - .3 transport and mixing considerations, including any seasonal variations:
 - .1 intensity of vertical and horizontal mixing;
 - .2 currents – surface, mid-depth, and bottom water (where relevant) current direction and velocity; and
 - .3 exchange regime with the surrounding media, including the atmosphere;
 - .4 chemical characteristics:
 - .1 dissolved oxygen and climate-active gases;
 - .2 carbonate system, pH, alkalinity, etc., and dissolved organic carbon;
 - .3 particulate loading and fluxes; and
 - .4 contaminants;

- .5 biological and ecological characteristics:
 - .1 pelagic species and habitats, in particular plankton community composition and dynamics; the presence of ecologically, culturally, and/or economically important species and vulnerable, endemic, protected and/or migratory species (including marine mammals and seabirds); and
 - .2 in case the alkaline matter is spread on the sea floor benthic species and habitats, in particular the presence of vulnerable ecosystems and sensitive/protected species; as well as areas of special concern and value;
- .6 sediment and seabed characteristics:
 - .1 characteristics of sediments and seabed features in the region of potential impact;
 - .2 bottom sediment transport to areas of special concern and value or coastal zones; and
 - .3 the potential for re-suspension of added matter;
- .7 meteorology (where relevant to installed structures or dispersal systems):
 - .1 temporal/seasonal conditions and wind variability that influences physical conditions at the proposed site; and
 - .2 wave period and height;
- .8 proximity to and characteristics of other uses of the sea, including fishing, navigation, engineering or energy uses, areas of special concern and value, and traditional uses of the sea;
- .9 multiple stressors and cumulative effects:
 - .1 an evaluation about the level at which organisms and ecosystems in the Proposed Region and Region of Potential Impact are already affected by multiple stressors, such as warming, acidification and deoxygenation, which may alter the sensitivity of key species and communities;
- .10 an overall rationale for choosing the proposed region(s) should be provided. Proposals should rank potential sites in order of preference. Criteria for rationale and ranking should include:
 - .1 suitability for testing the hypotheses;
 - .2 suitability for preventing or reducing undesirable effects to a minimum, and
 - .3 avoiding proximity to areas of special concern and value.

7 The characterization of the proposed activity should also include a *characterization of the material* that is introduced as follows:

- .1 the mass and/or volume of matter to be loaded and discharged or redistributed in the ocean;
- .2 source of the matter, such as the process or location where the matter is generated (e.g. mining, industrial by-product, product of an electrochemical process); and
- .3 a detailed description of the full composition and form of matter to be added or redistributed, including:
 - .1 physical properties and form of each matter (e.g. solid, particle size, liquid solution, initial concentration, density);
 - .2 chemical characterization of each type of matter (including tracers, etc.) (e.g. chemical composition, chemical properties, concentrations of matter, including any trace impurities or incidental contaminants); and
 - .3 hazardous or toxic properties of the matter, including any impurities or incidental contaminants.

8 An overall rationale should be provided for the type, amount and form of matter to be added or redistributed to the ocean. Specifically, an explanation should be included for why the proposed research goals could not be achieved with a smaller amount of material or an alternative type of material which may have less adverse environmental impact.

9 Further relevant project information includes:

- .1 preliminary assessment of potential impacts (see also "Environmental assessment" section):¹⁰
 - .1 a preliminary assessment of potential impacts should include a description of the expected fate and transport of the matter and the potential impacts of the proposed project activities on ocean physical and chemical processes, biogeochemical fluxes, biological communities, ecological systems, human health, and other ocean uses. Sections of "Exposure assessment" and "Effects assessment" of the Framework list specific exposures and effects for consideration; and
 - .2 the assessment should be specific to the proposed region and should consider potential impacts resulting from the operational activities (e.g. release methods) and from the alkalinity enhancement activities. Uncertainties and implications of gaps in information should also be characterized; and

¹⁰ The preliminary assessment of potential impacts would assist project proponents in identifying potential mitigation opportunities during the proposal development and would provide information for the Contracting Party or other responsible entity to consider when conducting its Initial assessment section and Environmental assessment section of the proposed project.

- .2 proposed contingency and mitigation measures:
 - .1 a list of mitigation measures or contingency actions that could be taken to ensure that risks to the environment, human health, and other uses of the oceans are prevented, avoided or minimized, to the extent practicable.
-