Carbontribe Methodology
Clean Water Projects

1. Introduction

Ocean debris poses a significant threat to ecosystems, biodiversity, and human livelihoods. Each year, millions of tons of waste, including plastics, metals, and other materials, enter aquatic environments, disrupting marine and freshwater systems. This debris not only harms wildlife through entanglement and ingestion but also contributes to the degradation of habitats and the contamination of water resources. The persistence of these materials in the environment exacerbates global challenges related to pollution, climate change, and ecosystem health.

This Methodology on Clean Water projects provides a comprehensive framework for projects focused on the collection and sustainable disposal of debris from aquatic environments, including oceans, deep-sea zones, coastal areas, rivers, and lakes. This methodology aims to address the pressing issue of man-made waste materials—such as plastics, metals, glass, and textiles—that harm ecosystems and biodiversity.

By establishing a standardized approach to debris collection, monitoring, and disposal, the methodology supports environmental restoration efforts while promoting global sustainability goals, including those outlined in the United Nations Sustainable Development Goals (UN SDGs). Key objectives include mitigating ecological damage, fostering incentivized mechanisms for debris removal, and ensuring the effective quantification of environmental benefits through credit systems.

The methodology is structured into key sections to guide project implementation. It begins with outlining the scope, objectives, boundaries, and stakeholder engagement. Baseline Definition and Additionality ensure that projects address debris accumulation beyond existing efforts. The Quantification of estimated removals ensures transparency and measurable impact and the methodology concludes with a section on monitoring and verification.

2. Project Design

2.1 Project Description

This chapter outlines the foundational framework for designing and implementing projects aimed at reducing aquatic pollution through the collection and removal of ocean debris. The principles of project design outlined here align with the broader phases of a Carbontribe project, as described in our common methodology.

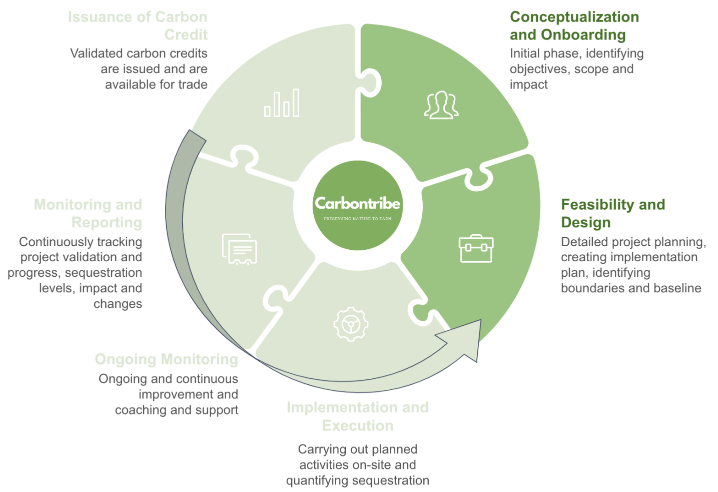

Figure 1: Initial Phases of the Project Cycle

Focusing on the initial stages of project development, specifically conceptualization and design (see Figure 1), our project design provides an in-depth overview of the key components of Carbontribe's framework for ocean debris projects. This methodology serves as a foundational guide for applicants, ensuring their projects are accurately described, justified, and validated. To support this process, a comprehensive application form has been developed, aligning with our methodology and guidelines. This form, provided in a separate document, must be completed prior to project commencement to confirm eligibility and compliance with our standards.

2.1.1 Project Scope and Eligibility

This methodology applies to projects that collect and remove anthropogenic debris from aquatic environments, including oceans, deep-sea zones, coastal areas, rivers, and lakes. Eligible waste materials include plastics, metals, glass, textiles, and other debris that pose ecological harm. Projects must be able to demonstrate that debris collection is an additional activity, meaning it increases overall removal capacity beyond existing efforts. Collection may be conducted manually or with electro-mechanical equipment. The project must ensure that collected waste originates from verifiable sources that, in the absence of the project, would remain in the environment, be dumped, or be incinerated without energy recovery.

Collected waste must be transferred to authorized end destinations, which may include:

- Recycling or reprocessing facilities
- Mechanical or chemical recycling

- Incineration with energy recovery
- Approved landfills meeting environmental safeguards (minimized use preferred)

Projects must document waste quantities using dry weight measurements and maintain transparent records, such as receipts from receiving entities. Any unauthorized disposal methods—such as open burning, uncontrolled dumping, or incineration without energy recovery—are strictly prohibited.

2.1.2 Purpose and Objectives

The primary goal of this methodology is to mitigate environmental damage in aquatic ecosystems by removing debris that poses significant threats to biodiversity and ecological balance. This includes fostering sustainable practices for waste management and incentivizing debris removal through a system of collection credits.

Projects applying this methodology must clearly define their objectives, including measurable reductions in aquatic debris, improvements in ecosystem health, and broader environmental benefits. These objectives should align with global sustainable development goals, particularly SDG 6 (Clean Water), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 14 (Life Below Water). Furthermore, projects should demonstrate a commitment to advancing ecosystem resilience, raising awareness about the global challenge of aquatic debris, and supporting long-term sustainability through responsible and innovative waste management practices.

2.1.3 Project Boundaries

The geographical boundaries define the physical areas where debris removal activities will occur, encompassing marine and freshwater environments. Clearly delineating these boundaries ensures the project's scope is precise and avoids overlap with other initiatives targeting debris collection or ecosystem restoration.

The project boundaries must fall within one or more of the following categories:

- **Ocean and Deep-Sea Areas:** Open ocean, gyres, offshore areas, and deep-sea zones beyond the continental shelf.
- **Coastal Zones:** Areas within 5 km of the high tide line, including beaches and estuaries.
- **Riverine Systems:** Rivers, tributaries, estuaries, and adjacent floodplains that carry debris into larger water bodies.
- **Lakes and Reservoirs:** Natural or artificial freshwater systems, including their shorelines.

To facilitate validation, project developers are required to provide geographic information in a standardized format, detailing the specific areas targeted for debris removal in the application form.

2.1.4 Stakeholder Engagement

Involving local communities, authorities, industry stakeholders, and environmental groups helps ensure the project meets local needs and has broad support. Projects should involve stakeholders throughout the entire process, from planning to execution and monitoring. This can be done through meetings, consultations, and opportunities for feedback. Evidence of this engagement, such as consultation records or agreements, should be provided. Ongoing communication should be maintained to keep stakeholders informed and involved. This includes ensuring fair labor practices, providing proper compensation, and following safety protocols for all workers. By working closely with stakeholders, projects can build trust, address concerns, and ensure long-term success in tackling ocean debris.

2.2 Baseline Description

The baseline represents the state of the aquatic environment prior to the implementation of the debris removal project. This is crucial for measuring the environmental benefits of the project and establishing the conditions that would have existed without intervention. For ocean debris projects, the baseline should demonstrate that debris would continue to persist in the environment, exacerbating pollution and harming ecosystems and biodiversity. It is essential to identify the sources of debris, including urban runoff, fishing activities, industrial discharge, and other factors contributing to pollution. The baseline assessment must also include data on debris accumulation rates and the environmental risks associated with these materials. In the absence of the project, debris would continue to accumulate, potentially causing long-term harm to marine and freshwater ecosystems.

To ensure the baseline is accurate, projects must document existing pollution levels and the absence of effective debris collection initiatives. This includes verifying that no substantial cleanup operations are in place in the project area and that waste management infrastructure is inadequate to address the scale of debris accumulation. By establishing a clear baseline, the project can better measure its success and demonstrate additionality, ensuring that debris removal would not have occurred without the intervention.

2.3 Additionality

In ocean debris removal projects, additionality ensures that the debris removal activities result in tangible, measurable environmental benefits that would not have occurred without the project. To demonstrate additionality, the project must implement actions that go beyond existing practices and address debris accumulation that would persist in the absence of intervention. To establish additionality, the following steps must be taken:

1. **Regulatory Surplus**
   Project proponents must prove that their collection activities go beyond existing regulations or expand upon current compliance. They must:
   a. List Relevant Laws & Regulations – Identify binding national, regional, and local waste collection regulations. Policies without legal status are excluded.
   b. Assess Enforcement & Compliance – Demonstrate if laws are systematically enforced and if non-compliance is widespread (compliance rate <50%). Compliance rates can be determined via surveys or certified secondary data.
2. **Description of Activities**
   Projects should outline specific activities such as debris collection, removal methods, and post-removal management. These activities must be distinct from what is already happening in the project area and should target areas with high debris accumulation.
3. **Comparison with Existing Efforts**
   The project must demonstrate how its activities exceed any current cleanup efforts. This includes verifying that there are no substantial, ongoing cleanup programs or that existing efforts are insufficient to address the scale of debris in the region. Historical data, local government reports, or assessments from environmental groups can be used to establish this.
4. **Infrastructure Assessment**
   Projects should assess the current waste management infrastructure and show that it is inadequate to prevent or manage debris accumulation. Evidence of inadequate waste disposal systems or ineffective recycling programs should be presented to ensure the project's actions are necessary.

2.4 Leakage Analysis

Leakage in ocean debris projects refers to the unintended consequences that may occur when debris removal efforts result in the displacement or transfer of debris to other locations, without reducing the overall environmental impact. For a debris removal project to be truly effective, it is critical to ensure that the debris removed is either recycled, properly disposed of, or destroyed in a way that does not contribute to further pollution or environmental degradation. To minimize leakage, the following steps must be taken:

1. **Proper Disposal and Recycling**: Ensuring that debris is disposed of or recycled properly is vital in preventing it from returning to the environment. Projects should have clear systems in place for managing the debris in a way that avoids re-entry into aquatic ecosystems.
2. **Tracking and Documentation**: Projects must establish transparent systems to track the movement of debris from collection sites to disposal or recycling facilities. This

ensures that the debris is managed correctly and does not end up in locations where it could cause harm.
3. **Monitoring and Reporting**: Continuous monitoring is necessary to ensure that no debris removed from the environment is inadvertently relocated to other regions. Projects should have mechanisms in place to document the handling of debris, ensuring it is properly managed and not contributing to pollution elsewhere.

2.5 Monitoring and Verification

2.5.1 Monitoring

A combination of photo documentation and advanced object detection technology provides robust verification of debris collection and sorting processes.

Waste sorting and weighing
Project participants must submit clear photographic evidence for each material type collected. Photos must:

- Clearly show the sorted debris material.
- Display the weight reading on a scale.
- Include metadata such as timestamps and, where applicable, GPS location data.

These photos form the foundational evidence for verifying material quantities and sorting accuracy.

Waste disposal or recycling
Project participants must provide clear and verifiable documentation of waste disposal or recycling. Acceptable evidence includes:

- Photographic proof showing the waste at an authorized disposal or recycling facility.
- Official certificates or receipts from the facility, confirming the waste's receipt, along with recorded weight and disposal or recycling method.

Object Detection Validation
To enhance accuracy, submitted photos are processed using object detection algorithms. This validation ensures that debris has been sorted by material type in compliance with project requirements. If inconsistencies are detected, they must be addressed and documented prior to submission for crediting.

Object Detection Model Requirements
To maintain high accuracy and reliability, the object detection model must adhere to the following criteria:

- **Model Architecture**: Utilize high-performing models such as DETR, YOLO, EfficientDet, or RetinaNet as base architectures.
- **Training Datasets**: The base model must be pre-trained on comprehensive datasets like COCO (Common Objects in Context) and fine-tuned using project-specific datasets.

Object Detection Report
A report detailing the model's performance must accompany the detection results, including:

- The model's ability to identify relevant debris categories.
- Reviewable outputs for audit purposes to validate detection accuracy.

By integrating photographic evidence and advanced object detection technologies, Carbontribe's monitoring framework ensures reliable and verifiable data for ocean debris collection projects. Other helpful visualization including bounding box outputs and class labels are optional.

2.5.2 Verification

Verification is a critical process that ensures the accuracy, transparency, and credibility of the ocean debris project. It involves independent auditing by a third-party verifier, typically an accredited organization, to validate the project's data, including debris collection totals, classification, and disposal outcomes. Annual reports must include key metrics such as the total weight of collected debris, its breakdown by ecosystem type (e.g., coastal, river, lake), and the disposal or recycling outcomes. This information must align with the methodology's guidelines and demonstrate any resulting emissions reductions. The verifier's role is to ensure compliance with the methodology, check data integrity, and validate carbon credit calculations. The verification process not only ensures the project is achieving its objectives but also builds trust among stakeholders and enhances the credibility of the carbon credits generated.

3. Quantification of Estimated Removals

The chapter below outlines the process of quantifying the estimated removals from ocean debris collection projects. This includes a detailed process flow, methods for calculating debris collection credits, and the application of environmental impact factors (EFs) to assess the ecological benefits. The chapter also discusses how to calculate custom EF values tailored to specific project conditions.

3.1 Process Flow

A structured process flow is essential for accurately quantifying the impact of ocean debris removal. It ensures transparency, consistency, and traceability throughout the project, from collection to verification. This approach helps track debris removal and its environmental benefits, linking each action to measurable outcomes.

Step 1: Data Acquisition and Preprocessing
Collect satellite imagery, aerial photos, and real-time data from drones or ROVs (remotely operated vehicles). Conduct site surveys to identify debris accumulation in various aquatic environments, including coastal, riverine, and deep-sea zones. The data undergoes preprocessing, including image correction, georeferencing, and noise removal to ensure compatibility with analysis models.

Step 2: Collection Techniques
Utilize targeted collection methods based on the ecosystem type:

- **Ocean and Deep-Sea Collection:** Employ ROVs, underwater drones, or trawling systems for debris retrieval from deep-sea areas.
- **Coastal Cleanup:** Use manual collection by volunteers or mechanical equipment for larger debris in coastal zones.
- **Riverine Collection:** Deploy floating barriers, trash booms, and skimmers to trap and collect debris before it reaches the ocean.
- **Lake Cleanup:** Utilize boats with netting or skimming systems for debris removal.

Step 3: Sorting, Drying, and Weighing

- **Sorting:** Classify debris by material types (plastic, metal, glass, textiles) and recyclability.
- **Drying:** Ensure debris is thoroughly dried to eliminate moisture content and obtain accurate weight measurements.
- **Weighing:** Use calibrated scales and document measurements with timestamps and location data.

Step 4: Monitoring and Verification

- **Photo Documentation:** Take clear photos of sorted debris, weight readings, and timestamp metadata.

- **Object Detection:** Use AI algorithms (YOLO, EfficientDet) to verify material classification accuracy. Validate detection outputs and resolve inconsistencies before submission for verification.

Step 5: Sustainable Disposal

- **Recycling & Upcycling:** Recycle plastics, metals, and glass where possible.
- **Waste-to-Energy:** Use incineration with energy recovery for materials unsuitable for recycling.
- **Composting:** Organic waste is composted if appropriate.
- **Fallback Disposal:** If sustainable options are unavailable, follow local waste management regulations.

Step 6: Blockchain Storage
Store all data on a decentralized blockchain, including collection reports, monitoring results, and carbon sequestration estimates. This ensures data integrity and traceability.

Step 7: Digital Asset Creation
Create NFTs (Non-Fungible Tokens) for each carbon sequestration result, linking to data such as detected debris, recycling methods, and environmental impact. These digital assets provide transparency and reduce the risk of fraudulent claims, backed by verified data and IPCC-compliant methodologies.

3.2 Quantification of Debris Collection

3.2.1 Calculation of Net Waste Collection

To enhance transparency and accuracy, separate credits will be issued for each material type collected. Each type of debris will generate its own credit category, directly reflecting the material recovered. The formula used for calculating the net waste collected is:

$$N_{i,y} = (D_{i,y} - B_{i,y})$$

Where:
$N_{collected,y}$ = Net waste collected in cycle *y* (tonnes).
$D_{i,y}$ = Waste of material type *i* collected by the project in cycle *y* (tonnes)
$B_{i,y}$ = Baseline waste collection for material type *i* in cycle *y* (tonnes)
n = Total number of material types

Project waste collection is the amount of waste that is collected by the project activity after drying. Baseline waste collection is the amount of waste that would have been collected in the absence of the project activity. For a new activity, baseline waste collection equals zero $B_{i,y}$ = 0.

3.2.3 Data and Parameters Monitored

The following parameters must be monitored and recorded during the crediting period.

Parameter	Unit	Definition	Source type
$D_{i,y}$	tonnes/cycle	Amount of waste of material type *i* collected by the project activity in cycle *y*	Direct measurement of weight on a dry basis at the collection site.

Waste collection verification relies on photo documentation, weighing, and object detection technology. Participants must provide photos with weight readings and timestamps, along with disposal or recycling proof (e.g., receipts or certificates). Object detection algorithms verify material classification, with models meeting high-performance standards and providing audit-ready reports.

For detailed methodology, see Section 2.5.1 Monitoring.

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