Policy and technical advice on beneficial uses of dredged marine sediments in Colombia, including Nature-Based Solutions.

Formulate procedural guidelines to determine feasible and suitable uses of dredged marine sediments in Colombia, including nature-based solutions.

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PARTNERS FOR WATER
CO-CREATING IMPACT

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The project "Policy and technical advice on beneficial uses of dredged marine sediments in Colombia, including nature-based solutions" is part of the collaboration between the Government of the Netherlands, through the Partners for Water program, and the Colombian Ministry of Environment, the National Planning Department (DNP) and the Ministry of Transport. The project was executed by a consortium formed by Arcadis, Fundación Herencia Ambiental Caribe, JESyCA and Netics, in conjunction with government entities from both Colombia and the Netherlands.

Contents

List of Abbreviations and Acronyms

Table 0-1 : List of Abbreviations and Acronyms

Abbreviation	Description
BwN	Building with Nature
TOC	Total Organic Carbon
Comagdalena	Corporación Autónoma Regional del Río Grande de la Magdalena ("Río Grande de la Magdalena" is the historical name used in colonial times).
CONAMA	Conselho Nacional do Meio Ambiente (National Council for the Environment) (Brazil)
CONPES	Consejo Nacional de Política Económica y Social (Colombia)
SQG	Sediment Quality Guidelines
DNP	National Planning Department (Colombia)
PAH	Polycyclic Aromatic Hydrocarbons
INVIAS	National Roads Institute (Colombia)
INVEMAR	Marine and Coastal Research Institute "José Benito Vives de Andreis".
MinAmbiente	Ministry of Environment (Colombia)
MinTransport	Ministry of Transportation (Colombia)
PCB	Polychlorinated biphenyl
PNDM	National Plan for Maritime Dredging (Colombia)
NbS	Nature-based solution(s)

1 Introduction

Background

Within the collaboration between the Government of Colombia and the Government of the Netherlands on water issues and climate change adaptation, the beneficial use of dredged materials has been established as one of the priorities, at the specific request of the Colombian Ministries of Transport (MinTransport), Environment (MinEnvironment) and the National Planning Department (DNP). In Colombia, dredged marine sediments are still not used for beneficial uses and dredged materials are dumped in offshore deposition areas previously approved by the environmental authority. In order to promote the beneficial use of dredged materials and strengthen the applicable regulatory framework in Colombia, this project aims to provide policy and technical advice for the use of dredged marine sediments, including nature-based solutions (NBS).

The policy partnership with the Government of Colombia on the issue of dredging and beneficial use of dredged materials has a long history, supported through several projects over the last decade:

- The National Maritime Dredging Plan (PNDM, 2017) consisted of a conceptual analysis and main recommendations to achieve, in the short, medium and long term, improvements in: (i) institutional order, (ii) technical and environmental regulations, (iii) financing, (iv) dredging contracting methodologies in maritime access channels to ports and (v) maintenance dredging strategy by port area and capital dredging strategy for the two coasts, Atlantic and Pacific, including the beneficial use of dredged material. The PNDM also included an international comparison on the above aspects, in order to have a reference that would allow the Colombian Government entities to make qualified decisions, among which the use of dredged materials occupies a prominent place. Specifically mentioned were the lack of uniformity in the basic criteria for the formulation of designs and works, the lack of clarity on the final disposal or beneficial use of dredged material, the additional costs for unnecessary transportation to dispose of materials that could be reused at sea, and the lack of precision on the final values of the projects.
- A series of webinars on dredging and the use of dredged materials in Colombia to support stakeholders on dredging, including key principles such as Building with Nature and the use of dredged materials for other purposes (2020/2021).
- In the project "Beneficial use of dredged materials in the Colombian context", opportunities to expand the range of beneficial uses of dredged materials were analyzed, including examples of legal frameworks and regulatory requirements in other countries. Additionally, a case study was included for opportunities for beneficial uses of dredged materials resulting from capital and maintenance dredging activities at the Buenaventura port area, as well as an analysis of barriers and facilitators for the use of dredged materials in Colombia (2022).

As a result of these projects, the National Development Plan 2022-26 indicated in its article 240 the need to use dredged material, complying with the environmental regulations issued for this purpose, prioritizing the uses in the recovery of areas affected by coastal erosion, and in the recovery of mangrove areas or areas affected by flooding. In addition, in July 2023 the Colombian government issued CONPES 4118 (National Port Policy), which states that the disposal of dredged materials offshore or onshore may have a negative impact on marine and coastal ecosystems. Given these statements in these normative instruments, it is the responsibility of MinAmbiente to establish a regulatory framework of environmental and technical guidelines for the use of dredged marine sediments in Colombia.

Based on this need, the governments of the Netherlands and Colombia agreed to launch the current project "Policy and technical advice on beneficial uses of dredged marine sediments in Colombia, including nature-based solutions".

Project objectives

The project focuses on generating isumos to enrich the normative guidelines for the use of dredged marine materials in Colombia, such as the 'Guide for environmental management of infrastructure projects, maritime and fluvial modes' (INVIAS 2022), and including a case study for the port area of Barranquilla showing what can be done with dredged material.

The basis for providing technical advice is to present the standards and practical parameters for the beneficial use of dredged material, drawn from the experience of the Netherlands and other countries. Accompanying this technical advice is capacity building of key stakeholders in Colombia in relation to the main technical components of the study.

The project consists of 5 main deliverables:

1. Standards and parameters applied in the Netherlands for dredging and use of dredged materials.
2. Standards and parameters applied in other countries: Australia/New Zealand, Japan, Brazil, Peru, Mexico, USA (Florida), Canada, Spain, Costa Rica and Panama.
3. Assessment of sediment chemical quality in the Barranquilla port area, and recommendations for establishing sediment quality guidelines for Colombia.
4. Procedural guidelines for determining suitable and feasible uses of dredged materials.
5. Case study of the Barranquilla port area.

Objective of this deliverable

The general objective of this deliverable 4 is to provide inputs for a Colombian national public policy for the beneficial use of dredged material (sediments), including the definition of international chemical thresholds, port zone diagnostics and inter-institutional governance schemes. These inputs correspond to procedural guidelines for determining suitable and feasible uses of dredged materials, including nature-based solutions. The specific objectives of the deliverable are listed below:

i. Identify and analyze the physical, chemical and biological parameters proposed to be considered for each use, both in the dredged marine sediments, as well as in the sites where they are to be used.
ii. Identify and analyze the socio-economic and governance considerations that are proposed to be taken into account when making decisions regarding the uses of dredged marine sediments.

Nature and scope of the proposed guidelines

This document is a technical proposal of a guiding nature, developed to enrich the national guidelines. The adoption of its contents and its eventual incorporation into normative instruments or administrative acts is the responsibility of the competent national authorities, within the framework of their functions. In this sense, the guidelines presented here are complementary and do not replace the legal and environmental requirements in force in Colombia. The end user should verify the applicable technical and environmental regulations in force at the time of implementing the guidelines proposed in this report.

Reader's manual

In this report, Chapter 2 presents an analysis of the existing guidelines and/or in process of elaboration regarding the management of dredged material, including its beneficial use.

Chapter 3 contains proposals for procedural guidelines of potential national application by type of *supply* (volumes and chemical, biological and physical quality of sediment), *demand* (type of beneficial use) and *social* and *governance aspects*.

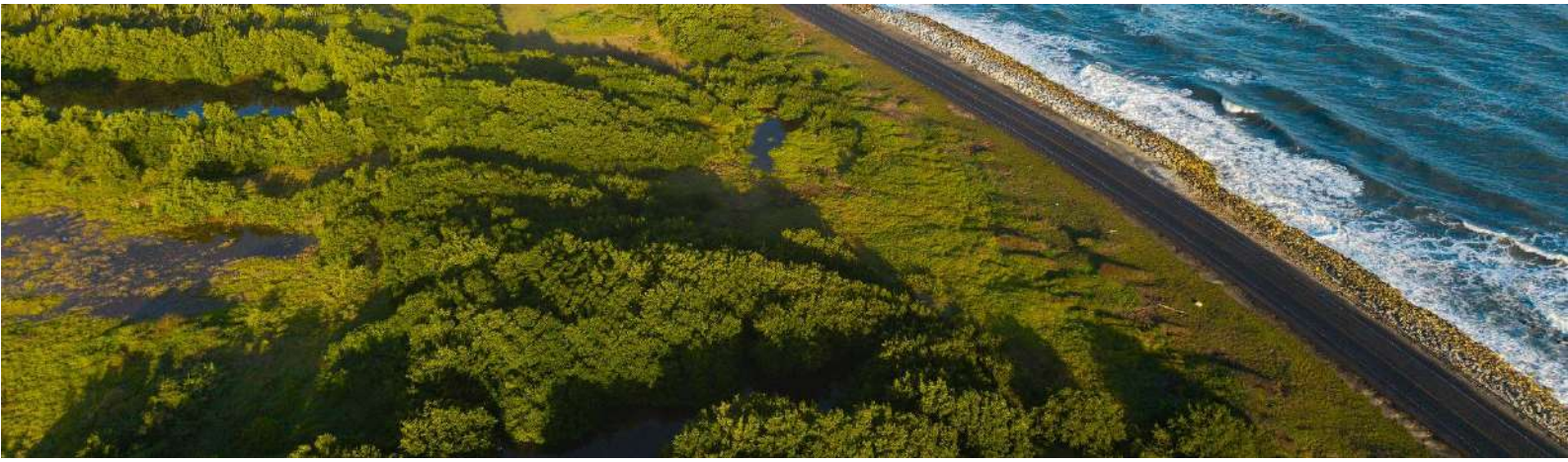
Section 4 proposes the steps to be followed to arrive at a regulatory framework and procedural guidelines for the beneficial use of dredged material, incorporating the issues mentioned in section 3.

Chapter 5 includes a technical glossary and references to documents and other sources used for this study.

The appendices contain:

a. the proposed thresholds compared with those included in the draft decree currently being prepared by the Ministry of Environment and Sustainable Development;
b. a diagnosis of the main port areas of the country with respect to the volumes to be dredged and potential beneficial uses;
c. a synthesis of recommendations regarding social and governance issues, based on the different aspects of the INVIAS Environmental Guide (2022); and
d. a proposed eligibility tool for the use of dredged material with a community benefit approach.

2 Summary of Colombia's guidelines on dredged material management



Chapter 2 - Executive Summary

The 2022 update of the *Environmental Management Guide for infrastructure projects in maritime and fluvial modes* (Resolution 2335/2022) establishes technical and regulatory guidelines to prevent, mitigate, correct or compensate environmental and social impacts in works that do not require an environmental license, but an Environmental Guide Adaptation Plan (PAGA). The guide is structured in six volumes covering legal framework, project classification, baseline methodologies, management measures, monitoring and guidelines for the preparation of the PAGA, including specific provisions for the management of dredged material, its disposal on land and water, and its beneficial use in activities such as restoration and resilience. Complementarily, Resolution 1536 of 2022 regulates the procedure for the incorporation of new technologies in transportation infrastructure, establishing stages from registration and experimental validation to the adoption of General Construction Specifications, applicable to road, river, rail and maritime modes. MinAmbiente is developing an additional chapter to Decree 1076/2015 on the physical, chemical and biological quality requirements of dredged materials to make uses of these. The scope of the additional chapter to the decree regarding sediment characterization and sediment utilization is broader and more specific compared to the other guidelines summarized.

The main conclusions are:

- The updated Environmental Management Guide (Resolution 2335/2022) establishes a comprehensive framework for marine and riverine projects that do not require an environmental license, applying the Environmental Guide Adaptation Plan (PAGA) as a mandatory instrument.
- The management of dredged material requires specific measures: prior analysis of contaminants, site approval by the environmental authority, safe confinement on land, control of dispersion in water, and prohibition of dumping contaminated sediments. The beneficial use of dredged material is promoted in activities such as raw material substitution, remediation of contaminated sites, land reclamation, habitat restoration and reinforcement of coastal defenses.
- Resolution 1536/2022 regulates the incorporation of new technologies in transportation infrastructure, establishing a national procedure that culminates in the adoption of General Construction Specifications, applicable to road, river, rail and maritime modes. The technical regulation process includes critical stages: registration and pre-selection, documentary contribution, experimental validation in test sections and follow-up, guaranteeing the standardization and safe application of innovations.
- The decree being prepared by the Ministry of Environment and Sustainable Development (MinAmbiente) on the physical, chemical and biological quality requirements for dredged materials with respect to beneficial use is not yet published. However, the thresholds proposed in this report have been compared with those included in the draft decree. Most of the thresholds proposed in the draft decree are comparable to the thresholds proposed by the consortium. However, there are still some gaps and/or differences that should be analyzed in more detail before suitable thresholds can be proposed.

Below is a description of the existing guidelines in Colombia for the management of dredged material, which are included in the Environmental Management Guide for Infrastructure Projects - Maritime and Fluvial Modes (INVIAS, 2022), and in Resolution 1536 of 2022 (INVIAS). While the INVIAS environmental management guide includes general indications for the disposal of dredged material on land or in water, as well as some examples of uses of dredged material, Resolution 1536/2022 does not refer specifically to dredged materials, but describes technical criteria on new technologies applicable to transportation infrastructure, for which it considers the possibility of using dredged material as construction material. In addition, this chapter presents a brief description of the decree being prepared by MinAmbiente on the physical, chemical and biological quality requirements for dredged materials with respect to beneficial use.

2.1 The Environmental Management Guide for Infrastructure Projects: Maritime and fluvial modes (INVIAS)

2.1.1 General description

Resolution 2335/2022 adopted the update of the Environmental Management Guide for infrastructure projects - maritime and fluvial modes. This guide is a technical instrument that indicates the environmental management requirements to be met in the execution of each maritime or fluvial work or activity, which does not require an environmental license but an Environmental Guide Adaptation Plan (PAGA). The objective of these requirements is to prevent, mitigate, correct or compensate the negative environmental and social impacts that the work or activity may generate.

In relation to the preliminary version of the guide, the 2022 update is distinguished by a greater integration between the technical, environmental, social and economic dimensions. This update was prepared by personnel from the Sustainability Subdirectorate of INVIAS and the Universidad Distrital Francisco José de Caldas, and the document is made up of *six volumes* that are briefly described below (I-VI):

I - Legal and normative conceptual framework of the guidelines.

It begins with some general considerations on the legal nature of the guide, followed by a section on the Conceptual Framework in which the Paris Agreement, national guidelines and policies on sustainability, green growth and other criteria, and Colombian manuals/guidelines for environmental studies, compensation and licenses are described. This section of the Conceptual Framework is followed by other sections on the Regulatory Framework, legal and regulatory standards for the abiotic environment, legal and regulatory standards for the socioeconomic environment, and special standards of the Regional Autonomous Corporations.

II - Classification of infrastructure projects: maritime and inland waterway modes

Describes typologies of projects by requirements in the formulation of environmental studies, and by competencies of the entities involved in the administrative aspects, among other typologies. Additionally, this volume includes classifications of projects by stages of execution, by type of intervention, and by scope of activities associated with social management. Among the types of intervention, a distinction is made between maintenance dredging and river improvement dredging, and a classification of dredging by type of technologies used is also shown.

III - Baseline and impacts by type of project

Describes the following methodologies, guidelines and requirements: 1) Methodology for defining the area of influence of a project; 2) Guidelines for the elaboration of the baseline of abiotic, biotic and socioeconomic components; 3) Guidelines for the elaboration of cartography and geographic databases; 4) Requirements for requesting authorizations for the use of natural resources and wastewater discharges; 5) Guidelines for identification of environmental and socioeconomic impacts and for environmental assessment. Activities that impact the abiotic, biotic and socioeconomic environments include maintenance dredging.

IV - Management measures by project type

This volume describes management measures for 12 programs: 1) Project management (related to conformation and training of the working group, and legal requirements); 2) Management of construction activities; 3) Water and atmospheric management; 4) Biodiversity and ecosystem services; 5) Management of machinery and temporary facilities; 6) Local development; 7) Ethnic communities, heritage preservation and sites of socio-cultural interest; 8) Social management of infrastructure, land and public services; 9) Accessibility; 10) Participation, governance and social inclusion; 11) Budget for implementing the management measures proposed in the PAGA; 12) Recommendations for implementing sustainability criteria.

V - Follow-up, control and monitoring program

This volume gathers the follow-up and control requirements to the following activities: 1) administrative management (complying with environmental regulations); 2) construction activities; 3) water and atmospheric management; 4) management, recovery and protection of biodiversity and ecosystem services; 5) management of machinery and temporary facilities; 6) local development activities; 7) archeology program, protection of heritage (cultural, geological and paleontological), and prior consultation with ethnic communities; 8) social management of infrastructure, land and public services; 9) population accessibility and territorial integration; and 10) participation, governance and social inclusion.

VI - Guidelines for the preparation and submission of the PAGA document

It first describes the guidelines for the preparation of the PAGA document, for each type of project according to its level of complexity (low, medium-low, medium-high, and high); these guidelines consist of the required baseline contents, and the formulation of environmental and social management measures for the projects. Subsequently, the volume presents guidelines for the presentation of the PAGA document, which are the annexes of this plan, and the environmental and social compliance reports.

2.1.2 Management and disposal of dredged material

These contents apply to maintenance dredging and river improvement dredging material, for which the environmental license requirement does not apply, but rather the preparation and compliance of a PAGA. The information in the guide on dredged material management is part of "Program 2: Management of construction activities", which is part of Volume IV; in this program the information is described in "Subprogram 3: Environmental management of maintenance dredging and river improvement dredging activities". Taking into account that in this subprogram one of the impacts to be managed corresponds to changes in sediment composition, among the actions to be developed are first mentioned those related to the planning phase of the activities. Among these actions one of them is an "Analysis of sediment characterization results, in order to identify whether the quality of sediment evaluated in light of international standards or standards issued by the Ministry of Environment and Sustainable Development, and the needs of the intervention area, can be a beneficial use of dredged material.

In addition, further on in subprogram 3 it is mentioned that the sites for the disposal of the material must be previously approved by the competent environmental authority, and that management measures must be taken into account. Among these management measures there is a section called "Disposal of dredged material", in which these measures are distributed in four categories: General conditions, Land disposal, Water disposal, and Beneficial use of dredged material.

The measures in these categories are mentioned below inTable 2-1 , and it should be noted that these are repeated in "Subprogram 6: Integrated waste management", with some variations in wording.

Table 2-1 : Categories and measures for the disposal and beneficial use of dredged material.

DISPOSAL OF DREDGED MATERIAL	
General conditions	• Disposal sites for dredged material may not be located in places that favor erosion, sliding of deposited materials or morphological alterations in general, nor in places that obstruct or contaminate natural drainage. • Maintenance dredging of access channels to maritime ports and docks must make use of dumpsite areas defined in a previous environmental authorization or license. • Land disposal sites must be previously approved by the competent environmental authority and permission must be obtained from the holders and/or owners of the property where the material is to be disposed of. • Before disposing of the dredged material, the contractor will carry out basic tests to determine whether or not the sediments are contaminated, such as: organic matter, nitrogen, phosphorous, cadmium, chromium, copper, lead, mercury or zinc; except in cases where previous studies show that there are no such contaminants. • Avoid dredging or discharging dredged material in areas of reproduction, feeding or high production of aquatic species or during their reproduction periods.
LAND DISPOSAL	• For confinement, barriers are required to allow the passage of water but prevent fine material from draining or leaking back into the channel or spreading in undesirable places, which is why works must be carried out for these purposes, such as the construction of barriers around the perimeter of the disposal area using wooden posts and geo-synthetic materials or containment structures such as gabions, soil-cement bags, dikes, sheet piles, etc. • The area of the dumps should be adequate for the volumes of materials to be deposited and areas of agricultural, fish or livestock productivity should be avoided. The area for disposal of materials must be outside the river's hydraulic round or outside the beach in the case of marine works, unless the material is required for the construction of control or protection works, or filling. • The sites will be located in nearby areas that have sterile soils, without any type of vegetation cover or apparent use; if this is not possible, sites covered by grasses should be sought that do not have tree vegetation or require isolated tree felling. • Sediment disposal requires prior analysis for heavy metals to avoid soil contamination. If the concentrations are above the parameters established by the competent environmental authority, they must be deposited in an impermeable and confined area to prevent leachate leakage. • Once the material has been disposed of, it will be adequately managed in terms of landscaping and morphology by profiling and leveling.
DISPOSAL IN WATER	• For the deposit of dredged material in water, the dump areas defined in a previous environmental authorization or license must be used. • In the process of dumping the dredged material, the dispersion of the material should not go beyond the limits of the approved area, and it should be monitored that the dispersion plume does not affect the coastal zone and especially nearby ecosystems such as mangroves and beaches. • Disposal should be carried out as far as possible in deep waters where it is guaranteed by sampling that there are no coral or benthic communities of ecological importance due to their abundance or danger of extinction; in the case of rivers, the outlet plume of the pipeline or the discharge site of the barges should not be located at a distance of less than 1 kilometer upstream of water intake structures or bifurcations that could alter the fluvial dynamics. • Material contaminated by heavy metals may not be dumped in water, in which case it must be disposed of on land, with adequate confinement and burial in terms of impermeability, in accordance with the indications of the intervention and the measures established by the competent environmental authority for these cases.
BENEFICIAL USE OF DREDGED MATERIAL	• In the event that the results of the sediment characterization in comparison with international standards or the regulations issued by the Ministry of Environment and Sustainable Development establish the viability in the use of dredged material, the possibility of implementing the following applications, among others, may be evaluated: o Raw material: Substitution of virgin manufactured construction materials or soil material/fertilizers/aggregates. o Remediation: Cleanup of contaminated sites, brownfields or closure of landfills and mines. o Reclamation: Creation of new land or expansion of existing land for human/commercial development activities. o Restoration: Creation of habitat to support aquatic organisms and wetlands to improve water quality. o Resilience: Shoreline (and/or levee) reinforcement for flood and climate change defense.

2.2 Technical regulation of new technologies for transportation infrastructure.

In accordance with the options for proposing the use of dredged material and meetings/workshops with public stakeholders of the project, the content of Resolution 1536 of May 6, 2022 of the National Roads Institute (INVIAS) was reviewed, through which the procedure for the technical regulation of new technologies applicable to transportation infrastructure is established.

The Resolution has two objectives: the first is to establish the mandatory guidelines that must be complied with for the regulation and technical regulation of new technologies for transportation infrastructure in the national territory; and the second is to obtain the General Construction Specifications. The achievement of these specifications is the final stage that allows the standardization and subsequent application of innovations in infrastructure projects under the responsibility of INVIAS and the transportation sector in general.

The technical regulation procedure for new technologies is applicable throughout the national territory. The scope of INVIAS regulation includes road, river, rail and maritime transport modes. The specific infrastructure to which these new technologies apply is defined, among other regulations, by Law 1682 of 2013 (adopting measures and provisions for transportation infrastructure projects and granting extraordinary powers) and covers a broad spectrum of components:

- The automotive land transport road network, including its exclusion zones.
- Bridges, viaducts, tunnels and road accesses, both in border areas and in port and airport terminals.
- Rivers, seas, navigable water channels and associated public property.
- Sea and river bridges and their access roads and canals.
- Cable Transportation Systems (cable car, aerial cable, funicular) built in public space or intended for cargo or passenger transportation.
- Intelligent Transportation Systems (ITS) networks.

The procedure to enter the INVIAS regulatory process begins with the Innovation and Sustainability Rounds, where innovators (natural or legal persons) must register and submit their proposals for pre-selection by the INVIAS Technical Regulation and Innovation Subdirectorate. This sub-directorate may form technical tables to verify and classify the technologies, the result of which is reflected in a report sent to the Technical and Structuring Directorate for approval and publication. Only approved proposals advance to the Documentary Contribution and Selection phase. Technologies already in the regulatory process cannot participate. However, INVIAS may apply a direct selection process for strategic or mature technologies, with prior approval from the Technical and Structuring Directorate, which allows speeding up procedures and adjusting documentary requirements according to their degree of maturity or previous validations.

Next, inTable 2-2 andIllustration 2-1 the stages for the procedure of using the new technology of the proposed material and obtaining the General Construction Specification authorized and regulated by INVIAS are presented:

Table 2-2 : The stages of the procedure for the use of the new technologies of the proposed material and to obtain the General Construction Specification authorized and regulated by INVIAS.

STAGE		CRITICAL APPROACH	KEY OUTCOME
I	Registration and Pre-selection	Participation in "Innovation Roundtable" or Direct Track.	Pre-selection Report (DTE Approval).
II	Documentary Contribution and Selection	Presentation of complete dossier (30 days). Includes APU and experimental plans.	Selection Report (Termination due to documentary non-compliance).
III	Documentary Validation	Evaluation of Maturity Level and Cost/Benefit ratio. Use of Research Entities.	Definition of the Experimental Plan (Lab, Modeling or Test Tranche).
IV	Segment Definition for Test Segment	Selection and formalization of the test location.	Formalization or termination act due to non-achievement of the segment.
V	Formalization with the Innovator	Subscription of Special Cooperation Agreement (CEC) for complex validations. Technology use authorization to INVIAS.	CEC (including Risk Matrix and Guarantees) or Letter of Commitment.
VI	Experimental Validation	Execution of tests, modeling or construction of the Test Section.	Technical Suitability Report or completion of the process.
VII	Test Section Follow-up	Monitoring of the performance in the field. Maximum limit of 1 year of follow-up.	Final report with regulatory recommendation.
Final (VIII)	Regulation and Regulation	Development of General Construction Specification.	Adoption of the Public Character Specification.

A total of seven (7) rounds of innovation and sustainability have been conducted. In the last report, published in February 2025, in the River and Maritime category, it was identified that new technologies have been presented for the construction of sustainable floating jetties with recycled material, eco-friendly electric boats and a software that allows the identification of the composition of underwater soils called "Aquares". The latter is the only one that is in a stage subsequent to "documentary validation", the previous ones remained in the pre-selection stage. According to the technology selection report, it describes Aquares as a tool used to plan dredging in the sea or rivers, allowing the structuring of field research projects prior to dredging and the identification of the classification and description of soils. This facilitates the proper planning for the contracting of the dredging of a channel or waterway in all its stages, from excavation to the final disposal of the dredged material.

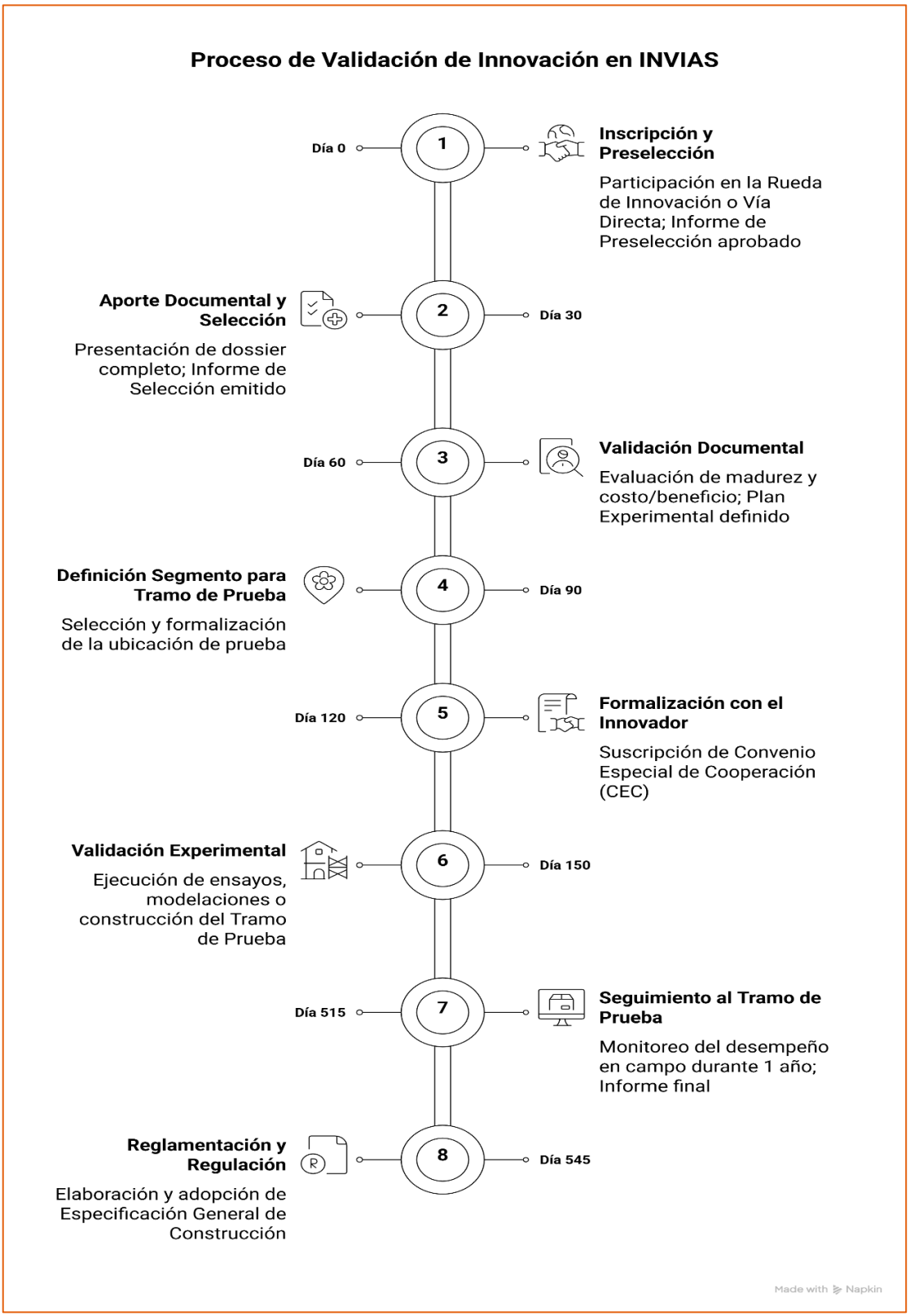


Illustration 2-1 : Graphical representation of the procedural steps of the uses of the new technologies of the proposed material and how to obtain the General Construction Specification authorized and regulated by INVIAS.

2.3 Draft of the additional chapter to decree 1076/2015.

MinAmbiente is developing regulations on "Environmental management for the use and disposal of dredged material", which is planned to be incorporated as an additional chapter to decree 1076/2015. This normativity consists of a procedure to establish the thresholds of mineral and organic substances that are acceptable to be able to make two types of uses of dredged materials (ecosystemic uses and non-ecosystemic uses).

This decree is made in accordance with the action plans of the National Port Policy (CONPES 4118/2023), and regulates Article 240 of the National Development Plan 2022-26, referring to the use of dredged materials.

The additional chapter deals with the environmental management for the use and disposal of dredged materials in projects, works or activities of the transportation infrastructure sector that involve deepening and maintenance dredging, maritime and fluvial, and fluvial improvement dredging. It also establishes the technical and environmental criteria for their management, use, exploitation, deposit and final disposal.

The scope of the additional chapter to the decree regarding sediment characterization and sediment utilization is broader and more specific compared to the other guidelines summarized.

According to the draft of the additional chapter to the decree, any natural or legal person carrying out maintenance, deepening or improvement dredging activities must prepare a technical document containing, as a minimum:

- The technical and environmental justification of the need to carry out the dredging;
- The detailed description of the dredging activities to be carried out in accordance with the provisions of this decree;
- The studies and other information required in this decree to evaluate the feasibility of the use of the dredged materials;
- The detailed description of the environmental management for the handling, use, exploitation, deposit and final disposal of dredged materials in accordance with the provisions of this decree and taking into account: compatibility between the dredged sediment and the receiving area, the methods to carry out the exploitation and/or disposal that are considered viable and the management, monitoring and follow-up measures in the process of exploitation and/or disposal;
- Environmental monitoring plan to establish the effects of dredging activities on abiotic and biotic components;
- The supports of the different activities or actions carried out in the dredging process and their characterization, such as chains of custody of the samples taken, laboratory reports, photographic records of the actions, etc.

2.3.1 Characterization of dredged material

It is proposed that the executor of any project, work or activity that involves dredging must perform the physical, chemical and biological characterization of the material to be dredged, which includes:

- Physical characterization: granulometry, temperature and pH;
- Chemical characterization: organic compounds, hydrocarbons, metals and metalloids, pesticides (organochlorine and organophosphorus);
- Biological characterization: benthic community;
- Microbiological characterization: thermotolerant coliforms and fecal Enterococcus, Helminth eggs, Giardia and Cryptosporidium .

The physical, chemical and microbiological and biological characterization of the sediments should be carried out contemplating at least the variables in theTable 2-3

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Table 2-3 : Variables required for sediment characterization (source: draft Decree).

VARIABLE PARA EVALUAR EL SEDIMENTO	UNIDAD
Caracterización física	
Granulometría	%
Temperatura	(°C)
pH	Unidades de pH
Caracterización química	
Compuestos orgánicos	
Carbono Orgánico Total (COT)	mg/kg
Grasas y aceites	mg/kg
Materia orgánica total	mg/kg
HAPs	
Naftaleno	ppb
Antraceno	ppb
Fenantreno	ppb
Fluoranteno	ppb
Benzo(a)antraceno	Ppb
Criseno	Ppb
Benzo(k)fluoranteno	ppb
Benzo(a)pireno	ppb
Benzo(ghi)perileno	ppb
Indeno(1,2,3-cd) pireno	ppb
∑HAPs	ppb
PCBs	µg/kg
PCB-28	µg/kg
PCB-52	µg/kg
PCB-101	µg/kg
PCB-118	µg/kg
PCB-138	µg/kg
PCB-153	µg/kg
PCB-180	µg/kg
Total PCBs	µg/kg
Otras Sustancias	
organoclorados	µg/kg
Organofosforados	µg/kg
TBT	µg/kg
Pentachlorobenzene	µg/kg
Hexachlorobenzenze	µg/kg
Lindane (γ-HCH)	µg/kg
Metales y Metaloides	
Arsénico (Ar)	mg/kg
Bario (Ba)	mg/kg
Cadmio (Cd)	mg/kg
Cobre (Cu)	mg/kg
Cromo (Cr)	mg/kg
Estroncio (Sr)	mg/kg
Hierro (Fe)	mg/kg
Mercurio (Hg)	mg/kg
Níquel (Ni)	mg/kg
Plata (Ag)	mg/kg
Plomo (Pb)	mg/kg
Selenio (Se)	mg/kg
Vanadio (V)	mg/kg
Zinc (Zn)	mg/kg
Caracterización biológica	
Comunidad bentónica	Ind/m^2
Caracterización microbiológica	
Coliformes termo tolerantes	NMP/100 ml
Enterococcus fecales	NMP/100 ml
Huevos de helminto	# de huevos/gr
Giardia	# individuos/gr
Cryptosporidium	# individuos/gr

2.3.2 Possible uses of dredged material

Dredged material that meets the quality criteria finally established in the decree must or may, depending on whether or not its use is mandatory, be used for one of the following purposes:

- Ecosystemic uses
  - Regeneration of beaches and creation of artificial dunes, especially in areas affected by coastal erosion;
  - Creation, ecological restoration or improvement of degraded mangrove ecosystems or flood zones.
- Non-ecosystemic uses
  - Landfilling for human, commercial or port development purposes and coastal engineering works;
  - Construction of submerged berms and other underwater structures;
  - Construction of dikes and earth dams;
  - Confinement of other sediments that are contaminated;
  - Remediation of contaminated soils;
  - Production of fertilizers for agricultural and livestock use;
  - Construction of civil works.

A comparison was made of the thresholds analyzed as most suitable in this report (see provided3.2) with those included in the draft decree. This comparison can be found atApéndice A . It turns out that many of the thresholds proposed in the draft decree are comparable with the thresholds proposed by the consortium, since the same sources are used. However, there are still some gaps and/or differences that should be analyzed in more detail before suitable thresholds can be proposed.

3 Proposed procedural guidelines for determining feasible and suitable uses of dredged materials

Chapter 3 - Executive Summary

Maintenance dredging in Colombia's access channels is an essential activity for the operation and competitiveness of maritime trade in Colombia. Historically, dredged sediment has been managed as a residual by-product, with a predominant focus on offshore disposal. However, this practice wastes a strategic resource with the potential to generate future economic, social and environmental value. To determine the suitability of dredged material, a decision tree is presented to assess the characteristics of dredged material supply, demand for beneficial uses, and social and governance aspects. Five main categories of use are identified: raw material, remediation, reclamation, restoration and resilience, the selection of which depends on the local socioeconomic and environmental context.

Key findings are:

- The beneficial use concept, endorsed by CEDA and PIANC, promotes sustainable applications such as coastal protection, ecosystem restoration, and territorial development.
- The Building with Nature framework enables the design of solutions that harness natural forces, fostering multifunctional and resilient projects.
- Five key categories have been identified for the beneficial use of dredged material.
- The selection of the appropriate application depends on the local context and the environmental and socioeconomic objectives of the project.
- Based on an international analysis, existing thresholds in Florida and Brazil are considered the most appropriate as a starting point for the development of Colombian thresholds.
- An analysis and recommendations were made regarding social and governance issues.

This chapter presents a methodology for identifying the most appropriate applications of dredged material. This methodology combines a rigorous analysis of supply (quantity and quality of sediment) and demand (local environmental and socioeconomic challenges), ensuring that the proposed solutions are fully adapted to Colombian ecosystem conditions.

The methodology for determining the supply of dredged material with respect to beneficial use, taking into account volumes and physical, chemical and biological quality of the sediment, is described below. This beneficial use approach, supported by leading organizations such as CEDA and PIANC, defines it as a key opportunity for sustainable development, protection of maritime or river coasts and ecosystem restoration. To integrate this vision into infrastructure planning, the Nature-Based Solutions conceptual framework is becoming increasingly popular. This methodological approach allows the design of multifunctional solutions that take advantage of natural processes to maximize the benefits of dredged sediment applications, such as land reclamation, habitat restoration, and increased coastal resilience.

3.1 Introduction and definitions

The supply of dredged material is determined by current and projected dredging activities, including the location of dredging, dumping locations, volumes of dredged material, as well as its physical, chemical, and biological quality, and the costs of dredging activities.

- Understanding dredging activities helps determine **the supply** of material for future use.
- Quantities of dredged material vary depending on whether dredging activities are capital or maintenance.
    - Capital dredging is, for example, to deepen a harbor access channel; these activities have large amounts of dredging.
    - Maintenance dredging is a continuous process in which smaller amounts of sediment are removed to maintain port access.
- The physical, chemical and biological quality determine the usability of the dredged material for beneficial use.
- The dredging location and the distance to the disposal site are determining factors in terms of performance, costs and environmental impact.

The demand for dredged materials depends on local challenges, including environmental challenges (e.g. coastal or bank erosion, flooding, biodiversity loss, etc.), socio-economic challenges (land use, land scarcity, water scarcity, poverty, etc.) and specific local needs for construction materials. Assessing local challenges helps to identify appropriate uses, as multiple efforts can be combined and recognize needs and future challenges. An analysis should consider both general or global challenges, such as climate change and climate change adaptation, as well as approaching the local context. Assessing these challenges (environmental, social and economic) provides insight into needs and allows decision-makers to identify opportunities for linkages. These assessments also ensure that communities are part of the process and that governance and land rights are respected.

Prior to dredging, a decision must be made as to whether the dredged material will be temporarily stockpiled, treated or permanently deposited. Assume that the dredged material is temporarily stockpiled and treated. In this case, the storage location will also have to be evaluated, as well as the transport to the site (by ship or truck), the type of treatment (dewatering or maturation) and the environmental effects. Once the material is treated, it can be removed from storage or it can be transported to the new destination. At the destination, the material can be deposited, disposed of in a certain way or reused, for example, for construction or building blocks. Transportation costs are one of the most important factors in the dredging chain; therefore, their use in the imminent dredging environment can save costs.

Accordingly, Figure 3-1 presents a structured decision path diagram that integrates supply and demand criteria to determine whether dredged material can be beneficially used or should be disposed of in a ZODME (Zone of Disposal of Contaminated Material) to ensure the sustainability of maintenance dredging operations.

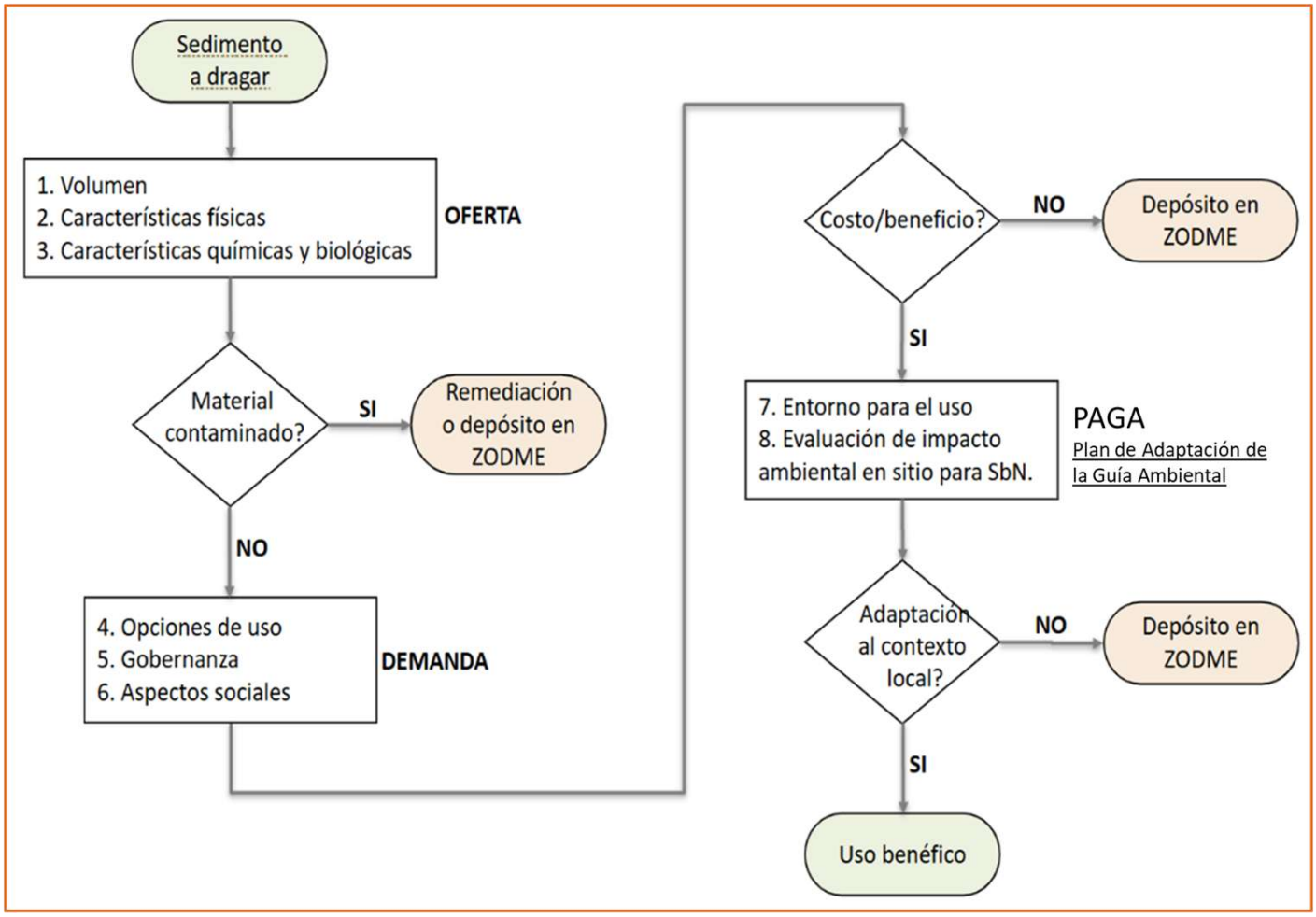

Illustration 3-1 Assessment of suitability of dredged material for beneficial uses.

3.2 Supply-side guidelines

3.2.1 Projected volumes of sediment to be dredged.

Colombia has nine (9) port zones in which different foreign trade activities are carried out, in each of these there are different port concessions that are used for loading and unloading or cargo handling. A port concession contract allows the temporary and exclusive occupation and use of the beaches, shores, low tide lands and accessory areas for construction and operation, in exchange for an economic consideration in favor of the Nation and the municipalities where they operate.

Below, inIllustration 3-2 shows the location of the country's port areas:

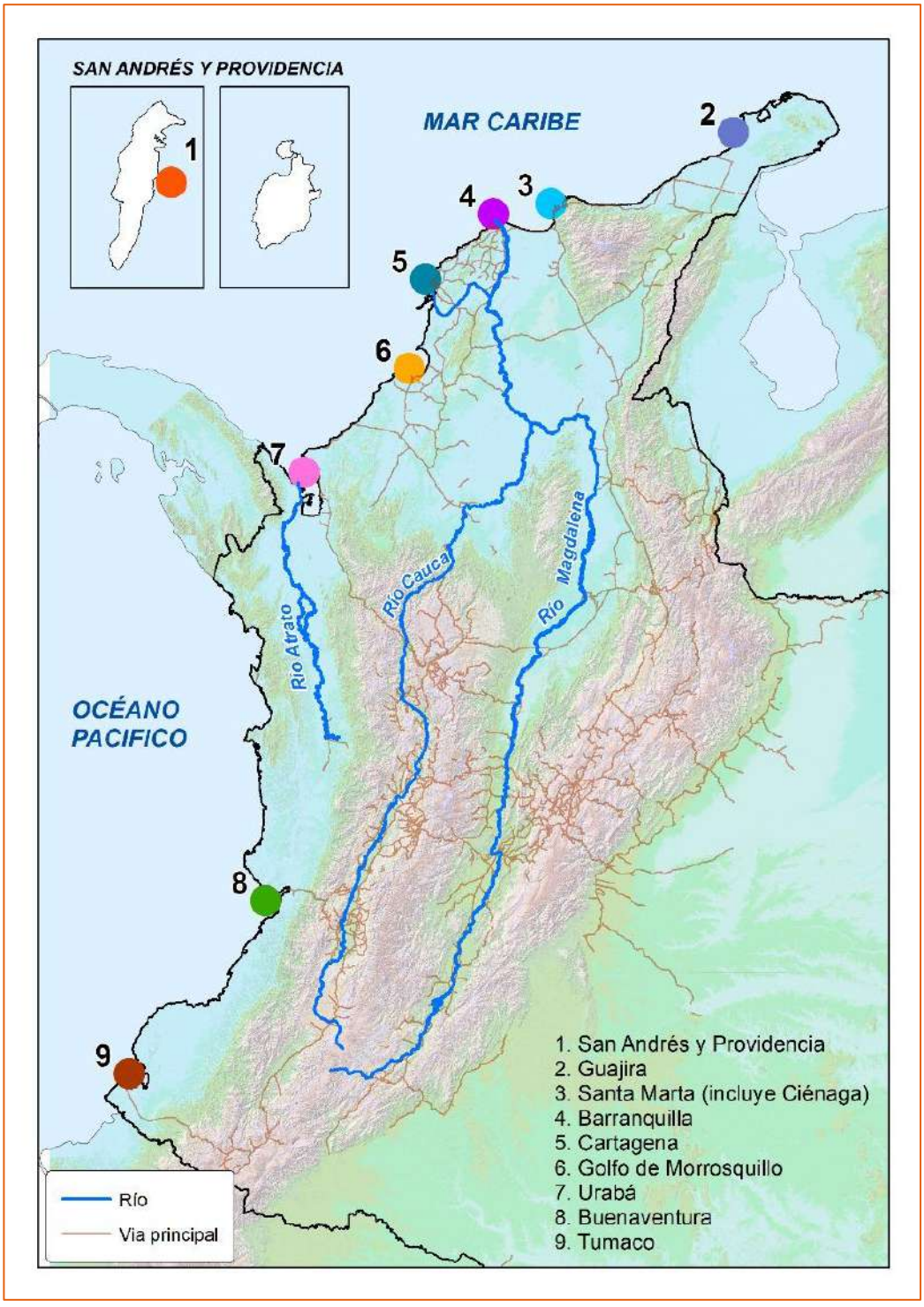

Illustration 3-2 Location of Colombia's port areas.

For each public access channel, a summary of the annual maintenance requirements for each of the country's port areas is presented in*Table 3-1* . In the case of private ports, the data presented are based on the experience of consultants and advisors, as well as on the responses provided by the different private operators in the completion of the National Maritime Dredging Plan.

Table 3-1 : Summary table of annual maintenance requirements for each of the country's port areas.

ID	PORT ZONE	ANNUAL MAINTENANCE DREDGED VOLUME (M3)		
		PUBLIC ACCESS CHANNEL	**PRIVATE ACCESS CHANNEL**	**TOTAL**
ZP1	San Andres Access Channel	18.500	No existing	18.500
	Providencia Access Channel	7.500	Not existing	7.500
ZP2	Cerrejón	Not existing	319.000	319.000
	Puerto Brisa	Does not exist	320.000	320.000
ZP3	Santa Marta	Not applicable* Not applicable* Not applicable* Not applicable* Not applicable* Not applicable* Not applicable* Not applicable* Not applicable	Does not exist	
	Ciénaga (Pto Nuevo, Pto Drummond, PNSR)	Does not exist	315.000	315.000
ZP4	Barranquilla Access Canal	3.600.000	1.000.000	4.600.000
ZP5	Cartagena Access Canal	Not applicable** 250,000	250.000	250.000
ZP8	Buenaventura Access Canal	2.180.000	800.000	2.980.000
ZP9	Tumaco Access Canal	160.000	Does not exist	160.000
Annual Maintenance Volume		**5.966.000**	**3.004.000**	**8.970.000**

* Santa Marta Port Zone is located in a deep bay, therefore, it does not require maintenance dredging.

** Cartagena Port Zone, the access channel does not require annual maintenance dredging, the last deepening dredging was performed in 2014 and 2015.

In terms of volumes, the port areas of Barranquilla and Buenaventura appear the most relevant with respect to the potential beneficial use of dredged material. A more detailed analysis by port zone regarding dredged volumes and potential beneficial uses is presented inApéndice B .

3.2.2 Chemical, biological and physical characteristics of the sediment to be dredged.

Activities to identify potential uses of the sediment to be dredged, according to its physical characteristics and its chemical and biological quality, are determined based on the following three types of assessment:

- Preliminary evaluation;
- Comprehensive evaluation of sediment quality, and
- Further evaluation of physical characteristics.

As a first step, it is suggested to perform a preliminary assessment, which consists of determining the risk of chemical contamination in the sediments, based on information from previous studies and reports on the physicochemical quality of the sediment and sources of contamination. A preliminary assessment is essential to ensure that the subsequent

comprehensive assessment of the quality of the sediment to be dredged is carried out correctly. More information on the preliminary assessment is provided at3.2.2.1 .

As for the comprehensive assessment of the quality of the sediment to be dredged, this is carried out in order to determine whether it is feasible to use this material based on its chemical and biological quality. First, it is necessary to evaluate the chemical quality of the sediment to be dredged, for which it is suggested to take into account the sensitivity of the organisms present in the sediment or soil of the candidate site for the use of the dredged material (Ecoshape, 2025), whether in a coastal, freshwater or inland ecosystem. Optionally, the abundance of fecal bacteria in the sediment pore water can be assessed, which only applies in cases where the sediment to be dredged is to be used adjacent to recreational areas or water catchment areas for human consumption or aquaculture (ICES, 2021). Further detailed descriptions of the comprehensive assessment of the quality of the sediment to be dredged are described below at3.2.2.2 .

Subsequently, after determining when the use of the sediment to be dredged is viable, according to its chemical and biological quality, the next step in the decision process is an additional evaluation of the physical characteristics of the material, to determine which uses are suitable according to the requirements of these types of characteristics (PIANC, 1992; ICES, 2021). This part of the evaluation, related to the type of beneficial use, is discussed briefly in section3.2.2.3 and, in more detail in section .0

InIllustration 3-3 the three types of assessment are presented in a decision tree, which represents in more detail stages 2 and 3 of the assessment of suitability of dredged material for beneficial uses, described in*Illustration 3-1*

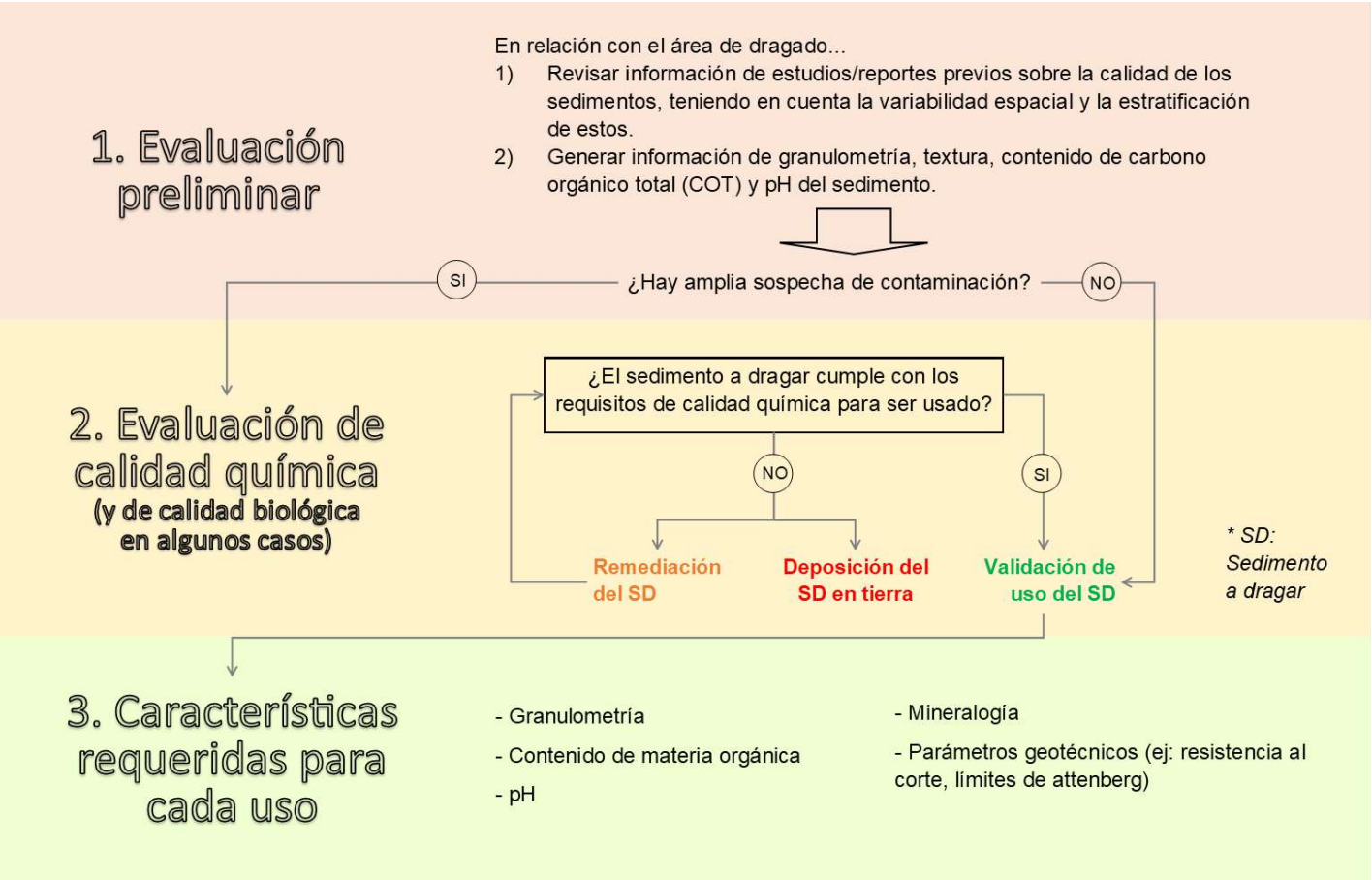

Illustration 3-3 Decision tree for physical, chemical and biological characteristics of dredged material.

3.2.2.1 Preliminary assessment

Preliminary assessment of dredged material, as applied internationally, serves to determine whether the sediment is suitable for dredging operations and for possible use or disposal. This assessment typically includes the following:

- A review of secondary information related to the dredging area, including analysis of historical background on industrial activities, shipping, dumping and previous sediment studies. The objective is to identify potential contaminants present, develop a source map, and determine if the sediment has been previously cleaned, remediated, or subjected to other quality controls. With the sediment quality information, the following activities need to be performed:
    1. Chemical analysis, focusing on small samples of common contaminant groups, such as heavy metals, hydrocarbons, PCBs, and other persistent contaminants; additional substances may be included when site history indicates specific risks. Many international guidelines also require consideration of biological effects or toxicity testing when contamination levels approach regulatory thresholds.
    2. Assessment of spatial variability and sediment stratification, ensuring that the sampling plan captures potential "hot spots" and ensuring that sampling is representative.
    3. Physical characterization, conducted to determine grain size, sediment mineralogy, density and volume, as these factors influence both dredgeability and potential options for uses of the dredged material.
    4. Outline viable management pathways, such as beneficial use of the material, confined disposal, or open water deposition, and identify data gaps that need to be addressed in more detailed research. This integrated, risk-based approach helps authorities and project developers decide whether the material can be safely reused, requires treatment, or should be managed as contaminated sediment.

This phase makes it possible to determine whether there is a strong suspicion of contamination in the sediment to be dredged, which is highly dependent on the clay and organic matter content, as these components influence the bioavailability of most mineral and organic substances. Since these substances have negative electrical charges[1] , especially at high pH in the case of organic matter and regardless of pH in the case of clay, the higher the clay and organic matter content, the greater the amount of substances attached to the sediment/soil (Simpson and Batley, 2016; Blume et al., 2016; Garavito, 2024). Depending on changes in the environmental conditions of the location where the dredged material is used, as well as the chemical composition of the water in contact with it, there is a risk that these substances are released into the water and consumed by organisms.

Based on the above, it is suggested to perform a basic assessment based on the information of the granulometry and organic carbon content of the sediment to be dredged. On the one hand, for the <2 mm fraction of this material it is necessary to estimate the clay content (<0.002 mm), in relation to the sand and silt contents (Adapted from ICES, 2021), and on the other hand it is necessary to determine the total organic carbon content of the TOC material (seeIllustration 3-4). This can be measured or determined qualitatively during the description of sediment types during field visits or by performing preliminary sampling and subsequent analysis.

[1] Cation exchange capacity.

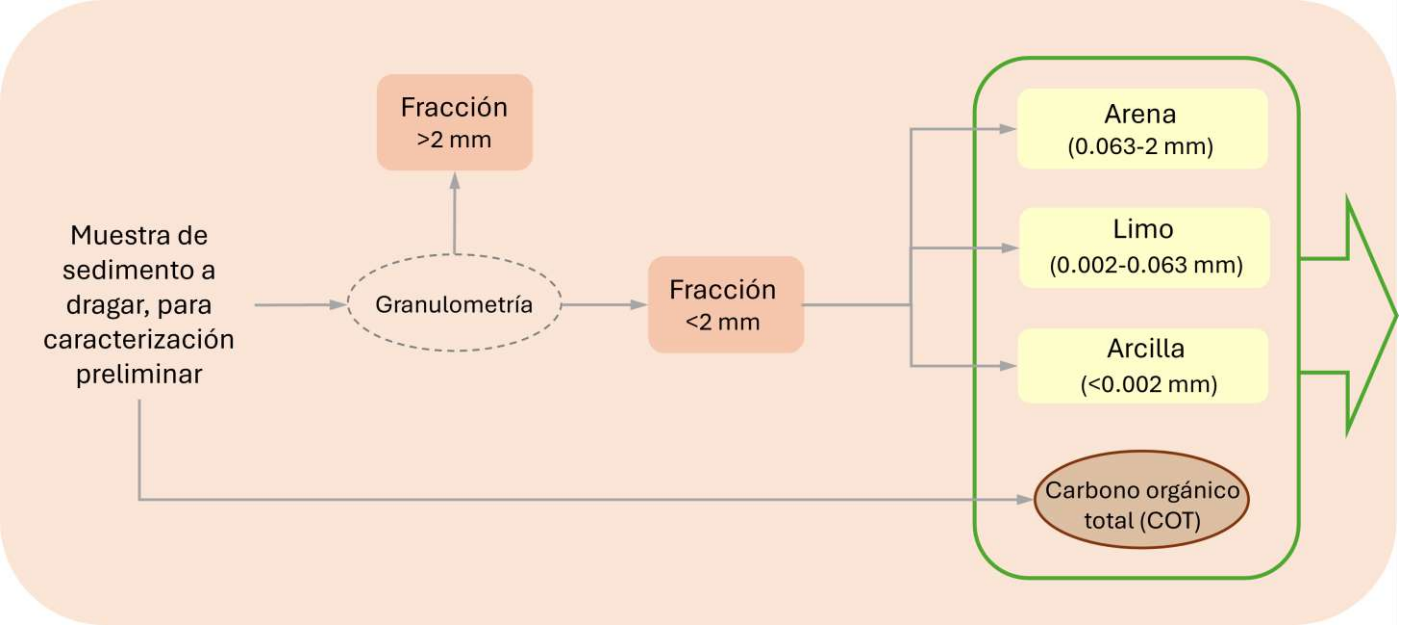

Illustration 3-4 Procedure for determining the sand, silt, clay and total organic carbon contents of the <2 mm fraction of the sediment to be dredged.

In summary, the preliminary study consists of:

a) information from previous studies or technical reports, which demonstrate that they have been made from a representative sampling of the area where dredging is carried out
b) generate new estimates of grain size and organic matter content prior to dredging . [2]

The latter information should be analyzed in relation to data from information from previous studies or technical reports (horizontal and vertical variability of the content of substances of concern in the sediments, and toxicity risks of the intended end use of the sediments after dredging). In cases where no risk to the potential use is identified (e.g., when pure sand is used for spreading at sea), it is common practice to waive additional chemical analysis.

However, this practice is based on a customized approach to many qualitative parameters and therefore cannot be translated into threshold values alone. Since the preliminary assessment cannot rely on such thresholds alone and the absence of standardized qualitative rules could leave room for discretionary decisions, it is recommended to establish clear qualitative criteria, accompanied by a risk matrix.

If the dredged material does not meet the requirements of the preliminary assessment, or if this assessment does not allow to conclude with sufficient certainty about the quality of the sediment and the risks associated with its end use, then a comprehensive sediment quality assessment is required.

3.2.2.2 Comprehensive sediment quality assessment

For this assessment, it is first necessary to perform a characterization of the concentrations of substances that pose a risk of toxicity at the candidate sites for use of this sediment. To determine this risk, it is necessary to compare the results of this characterization with the respective thresholds that serve as a reference for the different levels of contamination.

In deliverable 2 of this consultancy, it was mentioned that these thresholds are indicated in documents known as Sediment Quality Guidelines (SQG), which are established by country or region. The thresholds correspond to two concentration levels for each substance; the first level, in many cases called threshold effect level (TEL[3]), indicates the

[2] In addition to requiring information on sand, silt, and clay content for this first phase of the comprehensive sediment quality assessment, this information is also needed later to determine which uses are appropriate based on physical characteristic requirements (see).3.2.2.3
[3] Threshold Effect Level.

concentration above which the first signs of adverse biological responses begin to appear; the second level, usually known as probable effect level (PEL[4]), marks the concentration above which significant toxic effects are consistently observed in a large proportion of organisms.

In deliverable 2 of this project, it was also mentioned that some countries' SCDs include their own thresholds, determined on the basis of empirical evidence and modeling, based on the application of one or more research approaches (MacDonald, 1994). For their part, the SCD of other countries have adopted the thresholds of one or more of the above-mentioned types of countries.

As for the regions for which own thresholds have been determined, this has been done based on the type of environment in which the sediment is found, either for coastal or freshwater ecosystems, with the objective of using the information as one of the inputs to assess the state of health of the ecosystem (MacDonald, 1994; Moreira et al., 2021 and 2022; Dutch Soil Quality Regulation, 2022). In addition, the Dutch Soil Quality Regulation (2022) also indicates thresholds taking into account the types of sites where dredged material can be applied (intended purpose). This was described in deliverable 1 of this consultancy, where it is mentioned that this Dutch regulation includes thresholds for spreading the material in surface waters (fresh or salt), in deep freshwater bodies, and on land (of natural ecosystems and agricultural areas, as well as residential and industrial areas).

Although thresholds from other regions or countries have been determined as an input to evaluate the state of health of the ecosystem, the same type of thresholds can serve as a reference to determine the feasibility of incorporating dredged materials in the same type of ecosystem where there is interest in using them. Given that in Colombia the Ministry of Environment (MinAmbiente) is leading the process to determine the country's own thresholds for the uses of dredged materials, and that in the meantime this Ministry needs to establish a regulation based on thresholds from other regions or countries, a proposal of thresholds to be temporarily adopted is presented below.

The sediment quality thresholds to be adopted should correspond to those of regions with environmental conditions similar to those of Colombia, and these conditions depend on the influence of geological resources, climate and benthic community composition, among other factors. Regarding the thresholds to be adopted for sediments of coastal ecosystems, ideally these should be representative of the environmental conditions of the Pacific and Atlantic coasts of Colombia, but in the American continent the only proper thresholds for regions of the tropical zone, or close to it, are those of the states of Florida - USA (MacDonald, 1994), Ceará - Brazil (Moreira et al., 2021) and São Paulo - Brazil (Moreira et al., 2022). However, the thresholds for the Brazilian states of Ceará and São Paulo are so far academic proposals, while the Florida thresholds are approved by the Florida Department of Environmental Protection .[5]

Coastal ecosystems

Based on the above, for the uses of dredged materials in the coastal ecosystems of Colombia, it is recommended to temporarily adopt the thresholds for the following components corresponding to the Florida thresholds (MacDonald, 1994):

- Each of the trace metals and metalloids.
- Each of the polycyclic aromatic hydrocarbons (PAH).
- Sum (total) of polychlorinated biphenyls (PCBs).
- Each of the pesticides.

Details on the methodology to establish these thresholds for Florida are described in deliverable 2 of this consultancy, and the thresholds are mentioned in table 4.1 of the same deliverable. Furthermore, since the thresholds for PFAS/PFOA substances have only been determined in the SCD of the Netherlands, the values for the Netherlands for saline surface waters can also be included (see Appendix H of deliverable 1 of this consultancy). As an additional note, in case it is verified that there is no risk from the concentrations of the above mentioned constituents, an optional measure is to determine the concentrations of nutrients such as N, P, S, K, Ca and Mg, in case it is desired to know the fertility of the material for NbS applications in coastal areas.

[4] Probable Effect Level.
[5] Sediment Guidelines - Florida Department of Environmental Protection

Access channels and other freshwater ecosystems

Regarding dredged sediments in access channels and other freshwater ecosystems, and if there is interest in incorporating these sediments in the same type of ecosystem, the region with its own thresholds and with more similarity in terms of environmental conditions to those of Colombia, is Florida (MacDonald et al., 2003). In addition, Brazil adopted the freshwater sediment thresholds of the US and Canadian SCD, through CONAMA Resolution 454 (2012), and some of these values are stricter than those of Florida. In view of this, it is recommended that, while the Colombian MinAmbiente determines the country's own values, the ministry temporarily adopts for each substance of interest the most stringent threshold between those of Florida and Brazil.

Based on the above, for the uses of dredged materials in freshwater ecosystems in Colombia, it is recommended to *temporarily* adopt the thresholds for the following components, choosing for each component the most stringent threshold between those of Florida (MacDonald et al., 2003) and Brazil (CONAMA Resolution 454, 2012).

- Each of the trace metals and metalloids.
- Each of the polycyclic aromatic hydrocarbons (PAH).
- Sum (total) of polychlorinated biphenyls (PCBs).
- Each of the pesticides.

These thresholds are mentioned in Appendix B of deliverable 3 of this consultancy, where they were used to evaluate the chemical quality of sediments in the access channel to the port of Barranquilla. In addition, since the thresholds for PFAS/PFOA substances have only been determined in the SQG of the Netherlands, the values of this country for fresh surface waters can also be included (see Appendix H of deliverable 1).

As additional notes it is important to note that:

- Due to the salinity levels of dredged materials in coastal areas, their use in freshwater ecosystems is not suitable;
- If the dredged material is to be used in the construction of artificial wetlands as fish habitat, it is necessary to perform a toxicity risk assessment for ammonia, phosphate and sulfur, since in Florida and Brazil SCD there are no thresholds for these substances in lentic ecosystems, which can generate eutrophication;
- If the dredged material is to be used in the construction of artificial wetlands for wastewater treatment, it is not necessary to carry out the toxicity risk assessment described above, and the same can be taken into account for uses in lotic ecosystems (rivers, canals, etc.), as long as these do not lead to lentic ecosystems.

In the case of sediments dredged in freshwater ecosystems, and which are of interest for use on non-floodplains as an agricultural amendment/fertilizer, thresholds for non-floodplains need to be taken as a reference. However, such thresholds only exist in the SQG of the Netherlands, which were determined from an equilibrium partitioning approach, and can be corrected with the Dutch equation based on clay and organic matter content (see section 3.2.5 of deliverable 1 of this consultancy). This Dutch equation does not take into account pH as another factor that influences the bioavailability of substances and, considering the variability of pH in Colombian soils, it is not recommended to adopt these Dutch thresholds. Therefore, the use of dredged material as an agricultural amendment/fertilizer can only be approved once the Colombian thresholds for non-floodable soils are determined. In this regard, as a transitional measure (while specific Colombian thresholds for non-floodplains are developed), it is recommended that enhanced post-application monitoring, based on strict precautionary criteria, be implemented to safely evaluate the agricultural use of dredged material.

Analyzing the recommended thresholds with those included in the draft additional chapter to Decree 1076/2015 (seeApéndice A), it turns out that a large part of these thresholds are comparable, given that the same sources are used. However, there are still some gaps and/or differences that should be analyzed in more detail before suitable thresholds can be proposed.

Assessment of the biological quality of sediments for some uses

In the context of countries such as Colombia, it should be taken into account that in some places domestic wastewater is still not effectively treated before being discharged into watercourses, leading to risks to the water quality of rivers that flow into port areas. Therefore, when dredged material is to be used for ecosystem uses at sites adjacent to recreational areas or water catchment areas for human consumption or aquaculture, it is recommended to determine the abundance of fecal bacteria in the sediment pore water (Adapted from "ICES, 2021"). To determine whether the use of sediment is

validated or not, the fecal bacteria abundance thresholds in recreational water (article 2.2.2.3.3.3.3.9.7 of decree 1076/2015) can be taken as a reference.

Moreover, as an additional biological characteristic, the possibility that the sediments to be dredged contain seeds or tissues of invasive species, and that these may spread when the materials are used elsewhere, is also taken into account (ICES, 2021).

3.2.2.3 Evaluation of physical characteristics

Evaluation of the physical characteristics of the sediment to be dredged is also essential to determine **what the potential uses of this material are**. Factors such as granulometry, organic matter content and mineralogy directly influence the suitability of sediments for each type of use (Ecoshape, 2025). In this section this type of assessment is briefly discussed. More details can be found at .0

Granulometry

While basic information on the granulometry of the sediment to be dredged is required in the preliminary evaluation of this material, additional granulometric analysis is needed to determine what types of uses the material is suitable for. It is recommended that, after differentiating the contents of the >2 mm and <2 mm fractions of the sediment it is determined for the texture of the <2 mm fraction, from the contents of sand, silt and clay, according to the corresponding textural class category of the USDA triangle[6] . In relation to this, it is necessary to clarify that, while in soil studies silt is considered as the size fraction between 0.002 and 0.050 mm, in sediment studies the size of this fraction is considered to be between 0.002 and 0.063 mm (Simpson and Batley, 2016; Blume et al., 2016; Garavito, 2024).

Other physical properties

In addition to grain size, geophysical parameters of sediments are also of utmost importance for specific applications. For example, to use clay material in dike construction, Attenberg limits or specific shear strength measurements are required. The dewatering of geotextile pipes requires knowledge of consolidation, dewatering and liquid limits. In addition, detailed understanding of compaction degree and density is needed in infrastructure applications. These are just a few brief examples of all the different requirements involved in sediment reuse in specific applications, which is poorly documented by world experts on this topic.

3.2.3 Risk assessment for implementing an ecosystem-based use of dredged material

The following are recommendations for risk assessment requirements for any candidate area for an ecosystem use[7] . These requirements should be evaluated based on the volume of material to be used and the technique for incorporating it.

Requirement to assess the risk of instability of the material to be incorporated after it is deposited.

It is necessary to compare the grain size and organic carbon content of the sediment in the candidate area for use and of the dredged material to be used. If both characteristics are similar in both types of material, there is a higher probability that the dredged material to be incorporated will remain stable after being deposited in the candidate area for use, which would allow validation of the use of the dredged material. As described in the section0 , this applies both to the incorporation of sandy material in beach regeneration and the construction of artificial islands (Dean and Rosati, 2010), and to the incorporation of silt/silt in areas to restore coastal ecosystems (Ecoshape, 2025).

Requirements for assessing risk to organisms

The following requirements are suggested for assessing risks to organisms:

[6] U.S. Department of Agriculture
[7] In the case of temporary deposition or use of dredged material on the land surface, outside of the EIA requirements at the location where each type of activity is planned, no other requirements are considered necessary.

- Determination of the pH of the water and sediments in the candidate area for use and, based on the pH of the dredged material to be used, assess the risk that hazardous substances attached to the dredged material may be released into the water of the candidate area. This should be assessed in relation to the particle size and organic carbon content of the dredged material.
- Develop a baseline of biological communities amenable to burial, depending on the volume of dredged material to be used and the technique for incorporating it into the candidate area for use (Speybroek et al., 2006; ICES, 2021). This includes specific protection of rare and vulnerable species by law, as is done in some countries (e.g., the Netherlands).
- Identify potential negative effects of suspended solids during and after deposition of dredged material, in areas near the candidate area for use of the material, which are wildlife habitats, fishing or aquaculture areas, or areas of tourism/recreational use. Possible cumulative or synergistic effects with other sources of suspended solids should be taken into account (ICES, 2021).

On the other hand, it is necessary that any ecosystemic use be carried out at the time of the year when there is less presence of wildlife (e.g. migratory birds) (interview with Marcel Rozemeijer - WUR). Consistent with the above, it is recommended that an ecological calendar of the area be included as an input for planning ecosystem uses of dredged material to ensure wildlife safety.

Requirements for post-implementation monitoring plan

For each dredged material ecosystem use option, it is recommended that a post-implementation monitoring plan be included to verify the stability of the material and the absence of undesirable impacts. This plan should include chemical, biological and physical indicators, adjusted to the characteristics of the implementation site and the volume of dredged material incorporated.

3.3 Guidelines related to demand

Traditionally, material dredged from access channels in Colombia is perceived as excess material destined for offshore disposal. However, this sediment is a valuable resource, beneficial use, which can contribute to sustainable development, coastal or river protection and ecosystem restoration, depending on the specific demand. The beneficial use of sediment should also be evaluated. Beneficial use of sediments is defined as "the utilization of dredged or natural sediments in beneficial applications and in harmony with development (human and natural)" (CEDA & PIANC, 2020).

3.3.1 Types of beneficial uses

Demand for dredged materials depends on local challenges, including environmental challenges (e.g., coastal or bank erosion, flooding, biodiversity loss, etc.), socioeconomic challenges (land use, land scarcity, water scarcity, poverty, etc.), and specific local needs for construction materials. Assessing local challenges helps to identify appropriate uses, as multiple efforts can be combined and recognize needs and future challenges. An analysis should consider both general or global challenges, such as climate change and climate change adaptation, as well as approaching the local context. Assessing these challenges (environmental, social and economic) provides insight into needs and allows decision-makers to identify opportunities for linkages. These assessments also ensure that communities are part of the process and that governance and land rights are respected.

Therefore, prioritizing their use and assessing local opportunities embedded in the natural system can generate economic value and help restore natural functions. This principle is valid even for contaminated dredged sediments, subject to appropriate treatment. To identify the most appropriate use of dredged material, it is essential to know the various application options. The Central Dredging Association (CEDA, 2021) identifies five main categories of use, seeTable

Building with nature (hereafter BwN) is an approach to developing nature-based solutions in water infrastructure. BwN maximizes the use of natural processes to enhance the economic, environmental and social benefit of engineering projects. To evaluate the use of dredged material, BwN concepts are used to evaluate additional opportunities and how they can be integrated into the natural system in the Colombian context.

Following this method allows the identification of opportunities for the use of dredged material. The selected solution is adapted to the local context, as local supply and demand are reflected in the methodology that combines multiple efforts. The use of dredged material should take advantage of the BwN as much as possible to increase both environmental and socioeconomic benefits. Analyzing the opportunities in more detail, the chain of activities to use the dredged material according to its predefined use should also be taken into account.

Generally BwN encourages multifunctional projects that generate additional benefits, such as increased resilience and functionality of the environment. CEDA application types 3, 4 and 5 (Reclamation, Restoration and Resilience) stimulate natural functions and are inherently more integrated into the natural system than categories 1 and 2 (Raw Material and Land Cover). The selection of a specific application will always depend on the desired outcomes and the local socio-economic-environmental context.

The landscape type or understanding of the system refers to the characteristics of the landscape (e.g., city, harbor, rivers and estuaries, lowland lakes, muddy shores or sandy shores). In the analysis of a potential beneficial use, the environmental system is described, including, for example, the presence and location of mangroves, the type of shoreline flora (sandy or muddy), and so on. These descriptions contribute to the understanding of the natural system and the ecological factors that can be supported by the dredged material, but also how the natural system will react to a morphological change. In addition to the understanding of the natural system, the current use of the potential site is taken into account, e.g., restoration projects may enhance aquaculture and provide additional use or provide more sustainable use in the future. The current use may also already provide an indication of the potential use of the dredged material. The beneficial use of dredged material in urban areas (cities and harbors) has to provide different functions, than in a natural environment (coast). Once the natural system has been analyzed, ongoing dredging activities and local challenges can be assessed, allowing the broader socio-environmental context to be evaluated.

Table 3-2 : Main categories identified by the Central Dredging Association (CEDA, 2021)

CATEGORY		DESCRIPTION	FOCUS
1. Raw materials		Substitution of virgin building materials, soil, fertilizer or aggregates.	Industrial use/substitution
2. Land Cover		Landfill and mine closure.	Land cover
3. Reclamation		Creation of new land or expansion of existing land for human or commercial development.	Land expansion
4. Restoration		Creation of habitats (aquatic and wetlands) to support organisms and improve water quality.	Ecological enhancement
5. Resilience		Shoreline and levee reinforcement for flood defense and climate change adaptation.	Infrastructure and shoreline protection

3.3.2 Granulometry by beneficial use

Based on the categories in theTable 3-2 , the following requirements can be listed:

1. Raw material

The suitability of sediments as substitutes for raw materials also depends on their particle size. This application can be divided into the following categories, depending on the degree of dependence on particle size.

- Direct sale as certified primary material (full dependency): possible if the dredged material qualifies as primary material directly, e.g. when the sand is pure enough to be used directly as sand in the construction market. In that case, national and international standards for building materials (in the Netherlands, the RAW standards), which set requirements in terms of grain size, percentage of organic matter, water content and geotechnical requirements, must be met. Where not suitable directly, the same specification can also be obtained by separating fractions of the material.
- Direct use in existing applications: Instead of selling the material directly, direct application of a mixed fraction material in existing applications can be considered (moderate dependency).
- Transformation into construction materials (limited dependence): Transformation of sediment into construction materials requires specific processing steps and therefore does not impose direct requirements on the physical state.

In general, it can be stated that clay bricks can be manufactured when there is sufficient clay (<2 um). Compressed (GEOWALL technology) or molded blocks from sediments can be effectively produced when the organic matter content is low enough (<10 %) to be able to effectively stabilize the sediment and convert it into a building material. It can also be constructed with geotextile tubes, which have no specific physical requirements for use, but benefit from a coarse particle size.

2. Ground cover

The suitability of dredged sediments for remediation depends entirely on the specific application in mind. For example, to use dredged sediments as backfill for mining operations, specific geotechnical properties that give stability to the caverns must be taken into account. These considerations are not included in this report.

3. Reclamation

Regarding the construction of artificial islands, it is suggested to use sand and gravel with low silt and clay content, since, in case of a higher content of these finer particles, the cost of separating them is high. Sand and gravel are used for the construction of the side slope of the artificial island, and coastal engineering techniques are applied for the respective designs, including the use of armor blocks that serve to keep the side slope stable (Dean, 2010), seeIllustration 3-5 . In addition to sand, finer sediments may also be suitable for use in artificial islands or land reclamation using advanced techniques such as geotextile tubes or stabilization options (biological, chemical or physical) to create the outer parts of islands. In contrast, the inner zone of artificial islands can also be filled with fine sediments, although these take longer to consolidate.

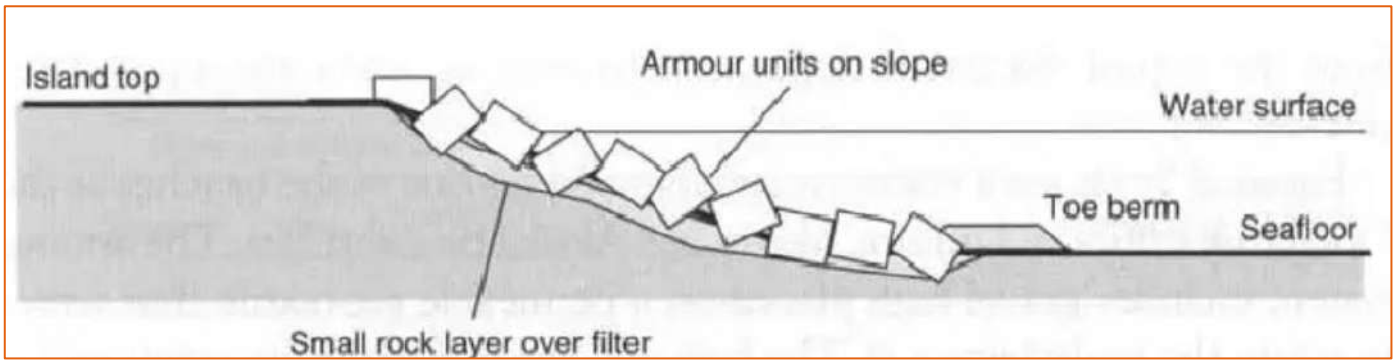

Illustration 3-5 Use of conventional armor blocks to protect the side slope of an artificial island (Dean, 2010).

4. Restoration

Furthermore, considering that fine sediments are attributed with a higher content of bioavailable nutrients (Simpson and Batley, 2016; Blume et al., 2016; Garavito, 2024), in addition to the fact that this type of sediment favors the restoration of salt marshes and mangroves (Ecoshape, 2025), it can also favor plant nutrition in agriculture and fishery resources in aquaculture (PIANC, 1992). The general requirements for this are sufficient fertility, indicated by a high content of clay (<2 um) and organic matter, and a low gravel content (>2 mm). Suitability for fertilization also depends to a large extent on the chemical status of the material, which directly affects vegetation growth.

5. Resilience

Sandy or coarser sediments can be used directly for beach regeneration projects and reclamation/construction of islands for coastal protection (PIANC, 1992; Ecoshape, 2025). In the case of beaches, except those of low gradient that serve as recreational space or nesting habitat for sea turtles and other wildlife (Dean and Rosati, 2010), sandy beaches can also be regenerated/created with dunes, which serve as resilient buffer zones against storms and hurricanes (Ecoshape, 2025). As for the construction of artificial islands, these can serve both for coastal protection and habitat creation (Ecoshape, 2025).

According to Dean and Rosati (2010), the regeneration of a beach results in a system that is out of equilibrium due to a change in the morphology of the terrain, and with such an imbalance, sediment flows occur both along the coast and transversely to it, which tend to reestablish equilibrium. With this in mind, for beach backfilling, the grain size of the sand to be incorporated, relative to that of the native sand, is a critical factor in the performance of the project in terms of stability of the width of the dry beach terrain. If the fill is made with sand that is finer or coarser than the native sand, with the influence of waves, the sand in the dry beach area tends to move seaward or in the opposite direction, respectively[8] . In addition, del Valle et al. (1993) pointed out that, according to the relationship between the mean sediment grain diameter and the sediment transport coefficient, the finer the material, the more susceptible it is to transport. SeeIllustration 3-6

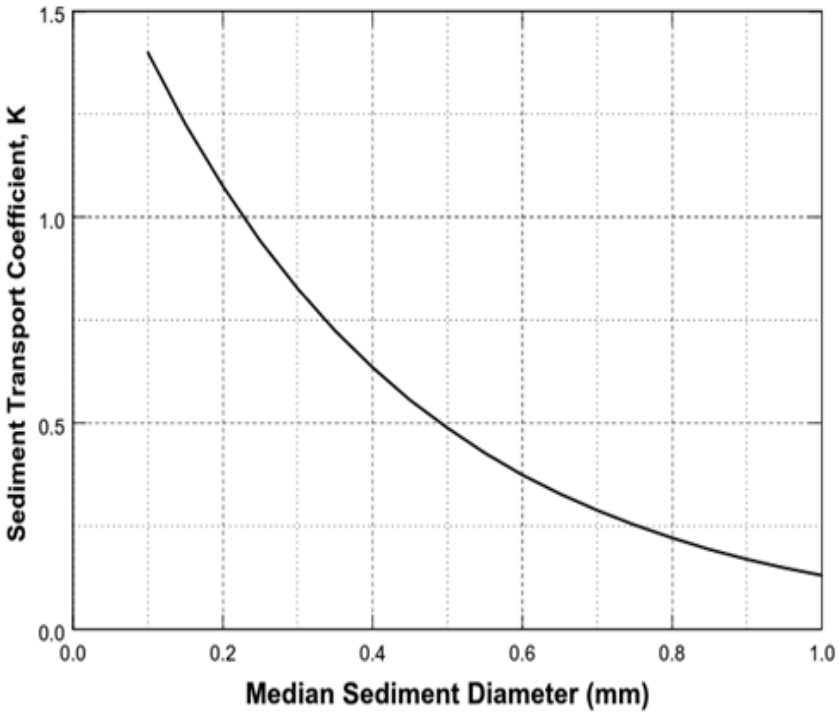

Fig. 30.3. Relationship of sediment transport coefficient with median grain diameter, D_{50}. From del Valle *et al.*,[13] published with permission from the American Society of Civil Engineers.

Illustration 3-6 Dependence of sediment transport coefficient (K) on mean sediment grain diameter (modified version of Valle et al., 1993, elaborated by Dean & Rosati, 2010, with permission of the American Society of Civil Engineers).

On the other hand, finer, softer sediments can be used for habitat restoration (Ecoshape, 2025). As a "building with nature" concept, the "Silt Engine" method, based on the use of fine dredged material, was evaluated in a pilot study to enhance the development of a salt marsh (Baptist et al., 2019). Such a method consists of depositing these materials as a semi-continuous source of sediment in a tidal channel, which allows natural processes to disperse the sediments into nearby salt marshes. In this way, the incorporated dredged material supports the growth of salt marsh vegetation without directly disturbing the salt marshes, thus maintaining the natural biology and geomorphology of this ecosystem type (Baptist et al., 2019). According to Ecoshape (2025), this method can favor the restoration not only of salt marshes, but also of mangroves.

[8] When the wave hits the beach/island, this water movement lifts some of the particles from the beach surface. Then, when the water recedes back into the sea, the lifted particles are deposited again.

3.3.3 Economic and financial conditions

In addition to the available supply of dredged material and the physical and chemical characteristics of the material, other economic and financial conditions that play a role in the business case for the use of dredged material must be taken into account:

- Port consideration: it is mainly framed by the Statute of Maritime Ports (Law 1 of 1991). It corresponds to the payment made by the port companies to the Nation and the municipalities where their activity is located, in order to be able to make the usufruct of the public use goods for the construction and development of the port activity; the use is allowed by a long term contract.
- Concession: it is a form that seeks to generate private investment in the use of dredged material for coastal protection, it is governed by Law 1106 of 2006, and corresponds to a State contract that assigns to a private party the exploitation of a public service for a period of time in exchange for the private party making a remuneration to the State.
- Public-private partnership: it is a public-private financing scheme to finance infrastructure projects and public services with Law 1508 of 2012. The process generally has a term of 30 years, which makes an investment attractive since the private sector resources enter in the pre-feasibility, pre-construction and construction stage; and the public resources are invested later.
- Current price for dredging material: the current price per m3 of dredging for the city of Barranquilla is set at 23,000 - 31,000 COP/m3, values expressed in current prices for the year.
- Value of dredged material transportation: the value of transportation is based on the tariff policy for intermodal freight transportation services, and is calculated at 179.5 COP /Tonne/Kilometer (Mintransporte, 2020) .

In the report of Element 5 (Development of a theoretical case study for the use of marine sediments dredged from the port area of Barranquilla, for the execution of environmental protection works through NbS) the financial and economic conditions are listed in more detail.

3.4 Guidelines social and governance aspects

3.4.1 Feedback Environmental Guidelines for Infrastructure Projects Maritime and Waterway Modes

In order to formulate procedural recommendations on the social and governance components for the beneficial use of dredged material in maintenance dredging projects, the need was identified to review and provide feedback on the "Environmental Guide for Infrastructure Projects Maritime and Riverine Modes" of the year 2022" given that it constitutes the current instrument that guides the technical, environmental and social management of projects in the maritime and riverine sectors that do not require an environmental license for their execution.

In this context, the Guide applies for the maritime mode to maintenance dredging of access channels, and for the fluvial mode to maintenance dredging of navigable channels and improvement dredging. All these projects must prepare an Environmental Management Guide Adaptation Plan (PAGA).

This feedback is developed with the objective of incorporating elements that strengthen the social and governance components in the aforementioned projects, promoting a more participatory, transparent and sustainable management of dredged material.

A synthesis of the Guide's feedback on general and, in particular, social and governance aspects is presented in theTable 3-3 and theApéndice C contains more detailed recommendations.

Table 3-3 : Synthesis of the Guide's feedback on social and governance issues

Volume	Topic / Component	Key Comment	Main recommendation
Conceptual, Legal and Regulatory Framework Volume 1.	Eco-efficiency and dredging.	Dredged material has been erroneously treated as waste.	Incorporate the use of dredged material as a resource with environmental, social and economic benefits.

	Community rights.	Recognition of the rights of fishing communities	Guarantee prior, informed and consensual participation in dredging and BNS projects.
	Environmental regulatory framework (biotic environment).	Decree on sediment exploitation is missing.	Include the MADS decree to update and strengthen legal security.
	Socioeconomic environment - productive projects.	Lack of focus on dredging use.	Incorporate dredged material as a generator of community economic benefits.
Volume 2. Infrastructure Classification	Areas of environmental interest (AEIA).	OMEC are not included.	Incorporate OMEC as a conservation and sustainable development measure.
Volume 3. Baseline and impacts	Area of influence - methodology.	Lack of community accompaniment in the field.	Conduct reconnaissance of the area with local leaders.
	User communities.	Exclusion of itinerant communities.	Include associated and non-associated fishermen within the area of influence.
	Social participation.	Participation limited to certain actors.	Broaden participation to CABs and social organizations (ethnic, women, victims, etc.).
	Socioeconomic baseline.	Insufficient demographic information.	Use SISBEN statistics.
	Ethnic groups.	Not adequately characterized.	Include ethnic identification and characterization in major and minor TUs.
	Spatial component.	Incomplete social cartography.	Incorporate areas for the provision of plant material for handicrafts.
	Economic component.	Green businesses.	Include collective use of sediments as green business.
	Livelihoods.	Lack of local economic information.	Include ethnic productive projects and livelihoods linked to water.
	Cultural component.	Cultural use of water not considered.	Incorporate the symbolic and cultural value of water bodies.
	Organizational component.	Incomplete social actors.	Include JACs, transporters, artisans, women, youth, victims, among others.
	Identification of impacts.	Limited focus.	Incorporate affected socioeconomic and cultural dynamics.
	Social conflicts.	Impact not considered.	Include "conflict generation or exacerbation" as an impact.
Volume 4. Management Measures	Staff training	Lack of socio-cultural context.	Include local socioeconomic and cultural dynamics.
	Dredging - environmental impacts.	Ichthyofauna and mobility not addressed.	Incorporate these impacts and management measures.
	Beneficial use of dredging.	Lack of regulatory support.	Include MADS decree on sediment use.
	Local labor.	Limited institutional coordination.	Include the Public Employment Service.
	Green business.	Dredging not considered.	Include dredging material as Green Business.
	Attention to the community.	Limited accessibility.	Locate service office in an accessible place.
	Community participation.	Weak representation.	Elect representatives through democratic community processes.
	Gender focus.	Insufficient training.	Incorporate national and international legislation on women's rights.
	Governance.	Excluded actors.	Include organizations of victims of the armed conflict.
Volume 5. Follow-up and Monitoring	Manpower - follow-up.	Lack of institutional articulation.	Include the Public Employment Service in monitoring and control.

3.4.2 General social and governance considerations for maintenance dredging projects that include the use of dredged material.

The use of dredged material is understood as the planned and sustainable use of sediments extracted in dredging activities in maritime and river water bodies. Far from being considered waste, this material can be transformed into a useful resource with multiple applications, such as the recovery of beaches, wetlands and mangroves, the improvement of agricultural soils, the generation of nature-based solutions for coastal protection and habitat restoration, as well as its use in infrastructure works and landfills. This approach not only contributes to reducing the environmental impacts associated with the final disposal of sediments, but also promotes social, economic and ecological benefits by integrating them into sustainable development and territorial management processes.

From the social and governance component, the guidelines for the beneficial use of dredged material guide the active participation of local communities, institutions and territorial stakeholders in decision-making on its use. It also promotes governance agreements that guarantee transparency, environmental sustainability and collective benefit, incorporating mechanisms for environmental education, social appropriation of knowledge and capacity building for responsible sediment management.

The report corresponding to Element 5 presents recommendations for the incorporation of stakeholder participation in the formulation and execution of projects that consider the use of dredged material, as well as the cross-cutting principles that should guide such participatory processes.

3.4.3 Procedural guidelines

In the flow chart presented inIllustration 3-7 , the stages that require social participation and inter-institutional articulation, coordination and management processes for their adequate implementation are identified. As a complement,Table 3-4 details the requirements associated with these processes and the results expected to be achieved with their development. This scheme seeks to guide decision making, promote the sustainability of the selected alternatives and ensure that the actions undertaken respond to the needs and dynamics of the territory.

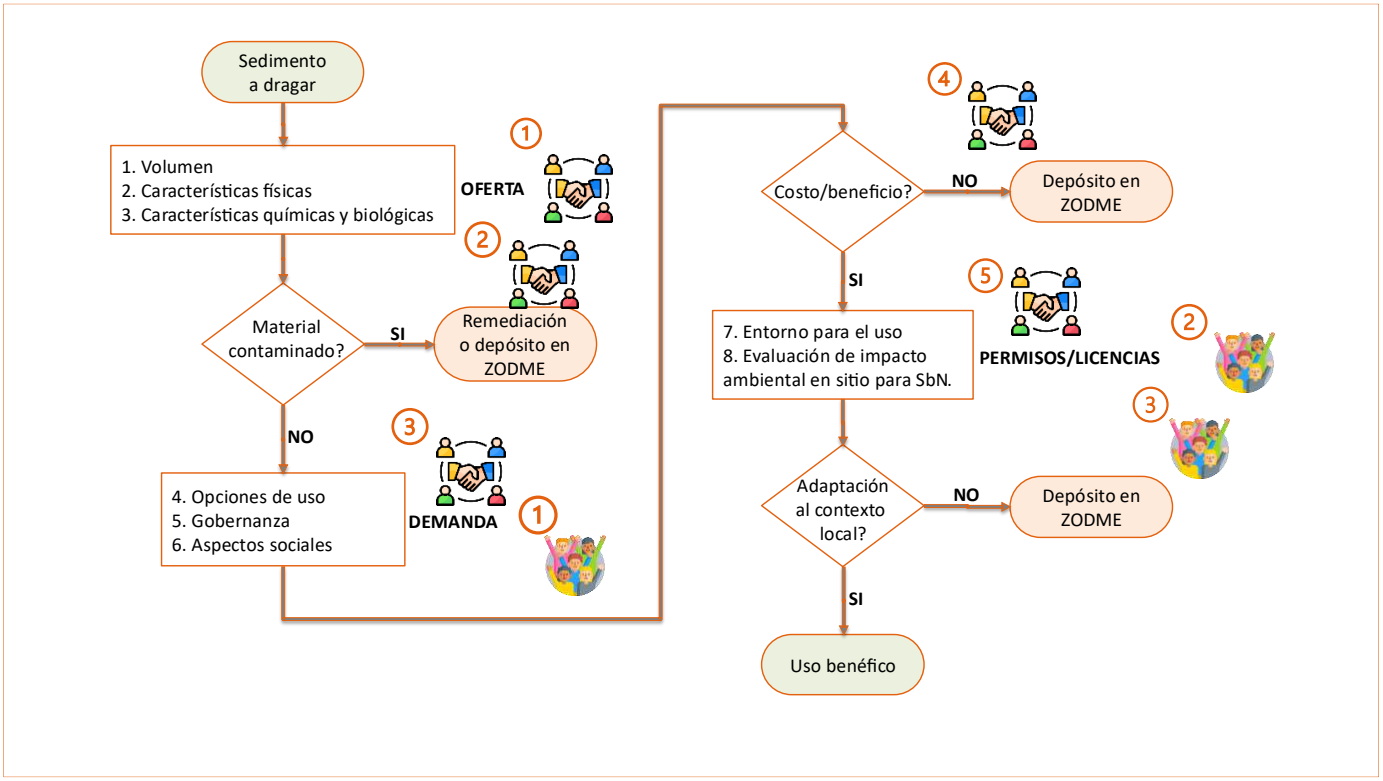

Illustration 3-7 : Flow chart of beneficial use of dredged material with requirements for social participation, coordination and inter-institutional management.

Table 3-4 : Explanation of requirements for social participation, coordination and inter-institutional management for the beneficial use of dredged material.

Interagency coordination and management	Social participation
	
① In order to define the volumes and physical, chemical and biological characteristics of the sediments, a process of coordination and joint management between the competent entities must be carried out. It is recommended that an **interinstitutional technical coordination and articulation table** be formed, made up of environmental, port, maritime, and fluvial entities, as well as the corresponding territorial authorities. The functioning of this space will ensure the technical and regulatory coherence of the studies, avoid duplication, strengthen the transparency of the process, and guarantee that the physical, chemical, and biological characterization of sediments complies with current technical, regulatory, and environmental guidelines.	① A social participation process should be carried out to define, agree and approve the options for the use of dredged material, guaranteeing the inclusion of the communities involved and the construction of agreements that respond to the needs and dynamics of the territory.
② In the event that the sediment is contaminated, it must be subjected to a specific management route, including its detailed characterization and classification according to the level and type of contamination, in order to define the most appropriate alternative for its management. Depending on the results of this evaluation, the sediment may be deposited in a duly authorized Dredged Material Disposal Zone (ZODME), or undergo remediation, treatment or confinement processes, in accordance with the technical and environmental criteria in force. The management route must contemplate, at least, the following stages: 1. Technical evaluation of contamination levels; 2. The entire process must be carried out in coordination with the competent environmental authorities, guaranteeing their approval, control and follow-up, as well as compliance with applicable environmental regulations.	② The related communities must participate in the evaluation of the viability of the use defined for the sediment in their environment, as well as in the identification of the possible social, economic, cultural and environmental impacts that it may generate. This participation strengthens the legitimacy of decisions, promotes community ownership and prevents possible conflicts, guaranteeing that the selected alternatives respond to the dynamics and needs of the territory.
③ The definition of use options must be structured in projects formulated jointly between the competent entities and the related communities, taking into account the social, cultural, environmental and economic context of the territory.	③ Local communities must have decision-making capacity to determine whether the proposed use of the sediment fits the socioeconomic, cultural and environmental context of the territory. Granting this decision-making power ensures that the selected alternatives respond to community dynamics, priorities and expectations, strengthening territorial governance and promoting participatory and sustainable management processes.
④ The cost-benefit evaluation of the use to be determined for the dredged material must be carried out by the competent entities , considering the social and environmental needs of the project's area of influence. This evaluation must weigh the associated socio-environmental benefits and define the financing strategies that will guarantee the viability and sustainability of the selected alternatives.	

5 The administrative and environmental authorities must issue a concept on the viability of the proposed use of the sediment, considering the characteristics of the local environmental, social, economic and cultural environment. Likewise, they must ensure that this use is in harmony with the provisions of the land use and territorial planning instruments. The environmental authorities must ensure that the use of dredged material in mangroves, wetlands and marine ecosystems, among others, is carried out under the BNS approach, guaranteeing that its application does not alter the ecological dynamics or affect the provision of ecosystem goods and services. Additionally, they must ensure that such use does not promote the filling of wetlands for the purpose of land development for housing or for the development of productive activities.	

3.4.3.1 Definition of options for the use of dredged material

In order to determine the options for the use of dredged material, the following aspects should be considered:

- Prioritize that the use of dredged material generates direct benefits for the communities settled in the intervened areas: promoting improvements in their quality of life, local infrastructure, livelihoods and environmental conditions. This implies ensuring that the defined uses respond to the needs of the territory, contribute to community well-being, and promote sustainable development processes in the project's area of influence. These uses include: control of coastal or river erosion, implementation of geo-bags to protect riverside populations from flooding, production of construction materials, preparation of compost, preparation of land for crops, restoration of ecosystems (e.g., mangroves) to maintain or improve their goods and services, improvement of rural roads, among others. A traffic light type eligibility tool for the use of dredged material with a community benefit approach is proposed atApéndice D .
- Adaptation to the local context: relevance of the proposed use according to the environmental characteristics of the territory, the socio-cultural and economic conditions of the related populations and local capacities. It is recommended that the following standard of participation be considered:
  - Participants: communities related to the intervention area (settled and users), representative community organizations, local authorities, competent environmental authority and project executor.
  - Documentation: socialization and agreement minutes, attendance records, technical and social memory of the process and graphic supports when applicable.
  - In case of disagreement: a new round of dialogue will be held. If the disagreement persists, documented records will be left and the use of the dredged material will not be implemented until social acceptability or the definition of an alternative endorsed by the competent authority.
  - Consultation mechanism: A roundtable or participatory space with plural representation, clear and culturally appropriate information, neutral facilitation, consensual decision-making criteria, and follow-up on agreements.
- Generation of local employment: This involves evaluating how each alternative can stimulate the local economy, promote the hiring of labor from neighboring communities and strengthen local capacities through training and active participation.
- Technical, economic and logistical feasibility: accessibility of the area, means of transportation, costs, required technology and availability of labor or allies for implementation.
- Promote nature-based solutions (NBS) that contribute to climate change adaptation of related populations: through the use of dredged material in interventions that strengthen the resilience of ecosystems and communities. This may include actions such as mangrove restoration, wetland restoration, bank stabilization, creation of natural barriers for flood or erosion protection, and other measures that integrate environmental, social and risk reduction benefits. The environmental authorities must ensure that the use of dredged material in mangroves, wetlands and marine ecosystems, among others, is carried out under the BNS approach, guaranteeing that its application does not alter the ecological dynamics or affect the provision of ecosystem goods and services. Likewise, they must guarantee that such use does not promote the filling of wetlands for land development for housing or for the development of productive activities.
- Harmonize the uses of dredged material with what is established in the planning and land management instruments of the related territorial units: the established uses must consider the environmental and risk guidelines established in the Land Management Schemes and Plans (EOT and POT), the Watershed Management and Management Plans

(POMCA), Integrated Management and Management Plans for Coastal Environmental Units (POMIUAC), and the Environmental Management Plans for protected areas or strategic ecosystems.

3.4.3.2 Institutional actors

The governance guidelines for the use of dredged material require recognizing the entities involved in this area, their responsibilities and functions, as well as promoting regulatory and institutional coordination to facilitate shared, coordinated and intersectoral management.

In theTable 3-5 are presented the institutions identified during the meetings and trainings carried out within the framework of the project, which are considered to be involved in the technical, administrative and regulatory aspects related to the use of sediments in maintenance dredging projects to be developed in the country.

Table 3-5 : Institutional actors involved in the use of dredged material

Entity	General role	Competencies related to dredging and use of dredged material
Ministry of Environment and Sustainable Development (MinAmbiente)	Guiding environmental and natural resources policy; directs the SINA.	- Defines the environmental regulatory framework for the use and disposal of dredged material. - Leads the specific regulations on environmental management of dredged materials. - Determines criteria for safe disposal of contaminated material.
Ministry of Transportation (MinTransport)	Leads the transport and infrastructure sector.	- Formulates policies for dredging associated with port, maritime and fluvial infrastructure. - Guarantees the safe and efficient operation of river and maritime transportation. - Participates in the regulation of dredging in navigable channels and ports.
Ministry of Mines and Energy (MinMinas)	Formulates, directs and coordinates public policy related to the mining and energy sector.	- Determines whether extracted sediments (sands, gravels, silts) can be classified as construction materials or other minerals. When applicable, the material becomes subject to the mining regulatory framework. - Establishes whether the dredged material can be commercially exploited (e.g., in civil works, infrastructure or restoration). - Defines conditions for productive use, commercialization and payment of considerations, if applicable.
National Planning Department (DNP)	Coordinator of development planning and public investment.	- Defines strategic guidelines through the PND, CONPES and sectoral plans. - Establishes guidelines for the beneficial use of dredged material. - Articulates intersectoral policies on dredging and sustainability.
National Roads Institute (INVIAS)	Executor of transportation infrastructure projects.	- Formulates and supervises the Environmental Management Guide for maritime and fluvial projects without an environmental license. - Follows up on the application of the PAGA in maintenance dredging projects.
Regional Autonomous Corporation of the Río Grande de la Magdalena (CORMAGDALENA)	Integral manager of the Magdalena River and its basin.	- Executes dredging to guarantee the navigability of the Magdalena River. - Manages the use of dredged material and erosion mitigation works. - Administers permits and concessions in its jurisdiction.
General Maritime Directorate (DIMAR)	National maritime authority.	- Authorizes, controls and supervises dredging works in maritime and fluvial zones under its jurisdiction. - Guarantees maritime safety and navigation depths. - It issues prior technical concepts for dredging projects.
INVEMAR	Marine and coastal scientific research.	- Performs physical and chemical analysis of sediments (LABIMA and LabCAM). - Evaluates contaminants and characteristics of dredged material.

		- Supports technical decisions on use and disposal.
Humboldt Institute	Biodiversity and ecosystem research.	- Biological characterization of dredged sediments. - Evaluates ecological risks and feasibility of restoration-oriented uses. - Issues scientific guidelines to protect biodiversity.
Colombian Geological Service (SGC)	Generates geoscientific knowledge.	- Analyzes the physical, chemical and mineralogical composition of sediments. - Identifies possible uses and risks of dredged material. - Supports the sustainable valorization of sediment.
National Environmental Licensing Authority (ANLA)	Environmental licensing authority.	- Grants environmental licenses to projects that require the use of dredged material. - Verifies compliance with environmental regulations in licensed projects.
IDEAM	Technical and scientific support to SINA	- Defines quality criteria for sediments. - Performs hydrological monitoring and physicochemical characterization. - Establishes standards for environmental laboratories.
Academia - Universities	Knowledge generation and training	- Performs multidisciplinary sediment analysis. - Develop methodologies and applied studies. - Provide technical and scientific advice to public and private entities.
Regional Autonomous Corporations (CAR)	Regional environmental authorities	- Evaluate and authorize dredging activities in their jurisdiction. - Follow up on management plans and environmental obligations. - Verify alternatives for use or disposal of dredged material.
Colombian Institute of Anthropology and History (ICANH)	Protection of archaeological and cultural heritage	- Authorizes and supervises preventive archeology programs. - Protects archaeological heritage in rivers, coasts and marine areas. - Issues concepts for projects that may affect archaeological property.
Governorships	Lead and coordinate the development of the departments, acting as a bridge between the national level and the municipalities.	- Territorial planning and articulation. - Governance and institutional coordination. - Environmental management and ecosystemic approach. - Promotion of productive and social uses. - Resource management and project support. - Participation and social acceptance.
Mayors' offices	Leading public management at the municipal level, guaranteeing local development, service provision and community welfare.	- Territorial planning and management. - Identification of needs and projects. - Institutional and community articulation. - Environmental management and regulatory compliance. - Resource management and capacity building, - Social acceptability and local benefits.
Municipal Risk Management Offices	Prevent, reduce and manage disaster risks, protecting life, property and development of the territories.	- **Technical-preventive** and articulation role, ensuring that the use of dredged material contributes **to** reduce risks and not to generate new threat scenarios in the territory.

3.4.3.3 Governance for the use of dredged material

Governance for the use of dredged material requires institutional and regulatory harmonization and coordination between the entities mentioned above and others that are relevant to the processes of dredged material use, such as mayors' offices, governments, NGOs, and urban environmental authorities, in order to ensure the proper implementation, monitoring, relevance and sustainability of the uses assigned to dredged material. In order to operationalize institutional and regulatory harmonization and articulation, the following instruments are proposed:

Regulatory and public policy instruments.

- Inter-institutional technical-regulatory guidelines: a framework document that establishes common criteria for the use of dredged material (permitted uses, environmental restrictions, technical standards, social and sustainability approaches), aligned with environmental, land-use planning and risk management regulations.
- Agreed and unified technical protocols for:
  - Physical, chemical and biological characterization of dredged material.
  - Environmental and social risk assessment.
  - Definition of uses (landfills, ecological restoration, coastal protection, infrastructure, among others).
- Incorporation in planning instruments: explicit inclusion of the use of dredged material in:
  - Land Management Plans (POT, PBOT, EOT).
  - Watershed Management Plans (POMCA).
  - Integrated Management and Management Plans for Coastal Environmental Units (POMIUAC).
  - Regional and Urban Environmental Management Plans.
  - Territorial and sectoral development plans.
  - Environmental Management Plans for protected areas or strategic ecosystems.

Institutional and coordination instruments

- Inter-administrative agreements and/or memorandums of understanding (MOU): between environmental authorities, territorial entities, port authorities, sectoral entities and other relevant actors, to define:
  - Roles and responsibilities.
  - Technical and administrative coordination mechanisms.
  - Financial and technical contributions.
- Permanent inter-institutional technical roundtable: Formal coordination space to:
  - Evaluate proposals for the use of dredged material.
  - Resolve technical or regulatory conflicts.
  - Follow up on the implementation of agreements.
- Procedures and one-stop shop: definition of a clear and standardized route for permits, technical concepts and authorizations, reducing duplication and gaps in competence between entities.

Technical and operational management instruments

- Specific plans for the use of dredged material: for each project or area of intervention, with:
  - Technical-environmental diagnosis.
  - Analysis of use alternatives.
  - Environmental and social management plan.
  - Monitoring and follow-up scheme.
- Shared information system: inter-institutional platform that consolidates:
  - Information on volumes, quality and location of dredged material.
  - Authorized and current uses.
  - Environmental and social monitoring results.

Participation and control instruments

- Protocols for social and intersectoral participation: guidelines for consultation with communities, social organizations and NGOs, ensuring informed, transparent and culturally relevant processes.
- Joint monitoring and evaluation mechanisms: technical, environmental and social indicators defined in an inter-institutional manner, with periodic reports and spaces for accountability.

Proposed minimum institutional arrangement

- Lead coordinating entity: responsible for convening, articulating and following up on the implementation of the instruments (proposed to be the Ministry of Environment and Sustainable Development - MinAmbiente).
- Inter-institutional technical committee: with representation of the institutional actors mentioned in theTable "Institutional actors involved in the use of dredged material", urban environmental authorities, the port sector, mayors' offices and governors' offices.
- Technical Secretariat: in charge of operational management: minutes, follow-up of agreements, administration of the information system and technical support for decisions.

It is also necessary to establish governance agreements for the use of dredged material that guarantee transparency, environmental sustainability and collective benefit, which should contemplate, as a minimum, the guidelines presented in theTable 3-6

Table 3-6 : Governance guidelines for the use of dredged material

Guideline	Minimum clause	Responsible actors	Instruments / mechanisms	Monitoring and verification
Roles and responsibilities	Define roles, competencies and obligations of each actor in the planning, execution, follow-up and sustainability phases.	Environmental authorities, mayors' offices, governors' offices, technical operators, social organizations.	Inter-institutional agreements, coordination minutes, RACI matrices.	Progress reports, follow-up minutes, compliance evaluation.
Financing	Establish funding sources, co-financing schemes and rules for the execution and control of resources.	Territorial entities, sectoral entities, operators, cooperating partners.	Agreements, approved budgets, financial plans.	Budget execution, financial reports, audits.
Transparency and access to information	Ensure public and timely disclosure of technical, environmental and financial information.	Public entities, coordinating authority.	Institutional portals, repositories, public reports.	Review of publications, compliance with schedules.
Oversight and social auditing	Incorporate mechanisms for social control and citizen participation.	Communities, citizen watchdogs, NGOs, public entities.	Oversight regulations, minutes, accountability spaces.	Oversight reports, minutes of public hearings.
Indicators	Define technical, environmental, social and governance indicators.	Coordinating authority, inter-institutional technical roundtable.	Indicator framework, technical sheets, baseline.	Periodic reports, control panels.
Monitoring and evaluation	Establish monitoring, evaluation and technical, environmental and financial auditing schemes.	Environmental authorities, control entities, operators.	Monitoring plan, internal and external audits.	Audit reports, improvement plans.
Conflict resolution	Define preventive and corrective conflict management mechanisms.	Consultation table with the participation of institutions, territorial entities, municipal offices and communities.	Mediation protocols, consultation committees.	Minutes of resolution, traceability of agreements.
Review and adjustment	Establish periodicity and criteria for review and adjustment of agreements.	Coordinating authority, signatory actors.	Review clauses, periodic evaluations.	Review minutes, documented adjustments.

4 Recommendations for next steps

This report has analyzed the existing Colombian guidelines and/or those under development regarding the management of dredged material and more specifically the use of dredged material. In addition, concepts of guidelines have been analyzed and formulated with respect to supply, demand, social and governance issues within the context of dredged material utilization.

One of the most relevant elements identified is the additional chapter that MinAmbiente is developing to complement Decree 1076/2015, which will define the physical, chemical and biological quality requirements that dredged sediments must meet. It is recommended that this chapter constitutes the technical and regulatory basis of the Colombian model, as it will allow standardizing characterization criteria, facilitate decisions based on scientific evidence and ensure that the country has clear and consistent standards to determine the viability of the use or the need for final disposal. The consolidation of this technical component is a fundamental step towards the transition from an approach focused exclusively on removal and disposal to a sustainable management of sediment as a strategic resource.

Additionally, it is considered pertinent that the guidelines proposed in this advisory, together with the recommendations related to supply, demand, social component and governance aspects, be incorporated in the construction, revision and approval stages of Decree 1076/2015. Such guidelines provide a comprehensive view of the management cycle of dredged material, allowing to understand not only its physical characteristics, but also its potential as an input for different productive sectors, the social implications associated with its management and the need to have a clear institutional organization. Integrating these perspectives into the regulations will help ensure that the Colombian regulatory framework evolves towards a multidimensional approach, capable of considering environmental, economic, social and governance factors in decision-making.

Finally, the most operational issues regarding the process of analysis of the use and/or disposal of dredged material can be incorporated into the Environmental Management Guide (INVIAS). The inclusion of these elements will standardize procedures in the field, facilitate their application by contractors and infrastructure operators, and ensure consistency between the technical guidelines of the Ministry of Environment and operational practices in dredging projects.

5 Technical glossary and references

Technical glossary

Term	Definition
Use of dredged material	Use of material from dredging in a place other than the extraction site to be used for a purpose.
Areas of special environmental interest	A delimited geographic space that, because of its importance for biodiversity and ecosystem services, is legally recognized and subject to a special management regime to ensure its long-term conservation.
Protected areas	Geographically defined area that has been designated, regulated and managed in order to achieve specific conservation objectives (Decree 1076 of 2015).
Bioavailability	Degree to which contaminants present in sediments are available for uptake by aquatic organisms, influencing their actual toxicity.
Access channel	Existing or to be constituted natural or artificial public channel giving access to port areas administered by the National Roads Institute - Invias or by a port concessionaire.
Total organic carbon (TOC)	Measure of the total amount of carbon present in organic compounds in the sediment.
Dredging	Hydraulic engineering work. Mechanical procedure by which material is removed from the bottom or bank (of a river system or any body of water in general, to be disposed of in a place where the sediment will presumably not return to its place of origin. In the National Marine Dredging Plan, dredging is the removal of bottom material from a body of water to expand the natural dimensions (greater depths or enlargement of areas), generally for the purpose of improving navigation or providing anchorage, waiting, quarantine or maneuvering sites for vessels.
Maintenance dredging	Periodic activity aimed at removing accumulated sediments to maintain the depth and operability of channels, ports or rivers. Its main objective is to ensure navigation or hydraulic flow.
River improvement dredging or capital dredging	Initial or sporadic dredging that modifies the bottom to create new navigation routes, increase existing depth or improve hydraulic flow. Generally involves moving large volumes of sediment.
Disposal	Final placement of dredged material at a specific location, usually due to contamination or lack of reuse potential.
Granulometry	Particle size distribution within a sediment (sand, silt, clay). Influences sediment behavior, transport, and contaminant retention.
Dredged material or sediment	A mixture of mineral particles and/or organic matter removed from the bottom of rivers, estuaries or harbors during dredging activities.
Dredged usable material	Sediment extracted during a dredging activity that, due to its physical, chemical and biological characteristics, can be used in a safe and environmentally sustainable manner in productive activities, environmental restoration, landfills, infrastructure works, or recovery of degraded areas, as long as its use complies with the technical and environmental requirements established by the competent authority.
Non-usable dredged material	Sediment extracted during a dredging activity that, after its technical characterization, does not comply with the physical, chemical or biological conditions necessary to be destined for subsequent use, either because it is considered contaminated, because of excess volume or because there is no compatibility between the dredged material and the receiving ecosystem. Consequently, it must be handled, deposited or placed in a safe disposal area, according to technical and environmental criteria that guarantee the prevention of negative impacts on ecosystems and human health.
Contaminated dredged material	Material extracted during a dredging activity that due to its chemical or biological conditions has been qualified as contaminated for a specific use.
Mineralogy	Study and characterization of minerals present in sediments.
pH	A measure of the acidity or alkalinity of sedimentary material or water. It affects the mobility and bioavailability of metals and other contaminants.

Port	Set of physical elements that include works, access channels and service facilities, which allow taking advantage of an area in front of the coast or river bank in favorable conditions to carry out loading and unloading operations of all kinds of vessels and exchange of goods between land, maritime and/or river traffic.
Regeneration	Process of recovery of the structure and function of a degraded ecosystem. It ranges from unaided natural recovery to direct human intervention (restoration).
Rehabilitation	Restoration actions aimed at bringing the degraded system to a system similar or not to the pre-disturbance system, which must be self-sustaining, preserve some species and provide some ecosystem services.
Restoration	Actions aimed at partially or totally reestablishing the composition, structure and function of biodiversity that has been altered or degraded. These actions can be: ecological restoration and ecological rehabilitation.
Ecological Restoration	Restoration actions aimed at reestablishing the degraded ecosystem to a condition similar to the pre-disturbance ecosystem with respect to its composition, structure and functioning. In addition, the resulting ecosystem must be a self-sustaining system and must guarantee the conservation of species, the ecosystem in general, as well as most of its goods and services.
Sediment	Fragmented material originating from the erosion and/or alteration of pre-existing rocks that can be transported and deposited naturally on the seabed, lake bottom and continental depressions. This sediment may contain particulate material of biological origin.
Marine sediment	Deposit of particulate components that come mainly from the fragmentation of rocks and are transported from terrestrial areas to the ocean by wind, ice and rivers. They may also come from the remains of marine organisms, underwater volcanic activity, or chemical precipitation of components from seawater.
Nature-based solutions (NbS)	Use of natural systems or processes to address societal challenges such as climate adaptation, water management and biodiversity loss.
Beneficial use (of dredged material).	Productive reuse of dredged sediments for functional or ecological purposes, such as flood defense, construction backfilling or ecosystem restoration.
Threshold values	Regulatory limits for contaminants, used to determine whether dredged material can be reused or requires disposal.
Disposal area for non-reusable dredged material.	Geographic space in water or on land destined for the disposal of non-contaminated dredged material that for force majeure, technical or legal reasons cannot be destined for the uses proposed in this decree.
Contaminated material disposal area	Geographic space in water or on land destined for the disposal of contaminated dredged material that guarantees its safe confinement so that contaminants do not migrate to adjacent areas.

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Appendices

Apéndice A Comparison of proposed thresholds with draft MinAmbiente Decree thresholds

In this appendix the thresholds for coastal zones of the most appropriate existing international guidelines (Brazil and Florida) are compared with the thresholds proposed for Colombia for ecosystemic and non-ecosystemic uses in the draft Decree being prepared by MinAmbiente.

Tabel A-1: Apéndice A Comparison of proposed thresholds with draft MinAmbiente Decree thresholds

				Nivel 1 (TEL - Usos ecosistémicos)					Nivel 2 (PEL - Usos no ecosistémicos)				
				Borrador de MinAmbiente		Florida	Ceará	S_Paulo	Borrador de MinAmbiente		Florida	Ceará	S_Paulo
Componentes orgánicos	Hidrocarburos aromáticos policíclicos - HAPs (µg/kg)	HAPs de bajo peso molecular (HAPs BPM)	Acenafteno			6,71	-	-			88,90	-	-
			Acenaftileno			5,87	-	-			128,00	-	-
			Antraceno	46,90	Buchmann (2008)	46,90	-	-	245,00	Buchmann (2008)	245,00	-	-
			Fenantreno	86,70	Buchmann (2008)	86,70	-	-	544,00	Buchmann (2008)	544,00	-	-
			Fluoreno			21,20	-	-			144,00	-	-
			2-metilnaftaleno			20,20	-	-			201,00	-	-
			Naftaleno	34,60	Buchmann (2008)	34,60	-	-	391,00	Buchmann (2008)	391,00	-	-
			Total HAPs BPM			312,00	-	-			1442,00	-	-
		HAPs de alto peso molecular (HAPs APM)	Benz(a)antraceno	74,80	Buchmann (2008)	74,80	-	-	693,00	Buchmann (2008)	693,00	-	-
			Benzo(k)flouranteno	70,00	Buchmann (2008)	-	-	-	537,00	Buchmann (2008)	-	-	-
			Benzo(a)pireno	88,00	Buchmann (2008)	88,80	-	-	763,00	Buchmann (2008)	763,00	-	-
			Criseno	108,00	Buchmann (2008)	108,00	-	-	846,00	Buchmann (2008)	846,00	-	-
			Dibenzo(a,h)antraceno			6,22	-	-			135,00	-	-
			Fluoranteno	113,00	Buchmann (2008)	113,00	-	-	1494,00	Buchmann (2008)	1494,00	-	-
			Indeno(1,2,3-cd) pireno	68,00	Buchmann (2008)	-	-	-	488,00	Buchmann (2008)	-	-	-
			Pireno			153,00	-	-			1398,00	-	-
			Total HAPs APM			655,00	-	-			6676,00	-	-
						1733,00					15188,90		
		Total HAPs	Total HAPs	1684,00	Buchmann (2008)	1684,00	925,70	182,60	16770,00	Buchmann (2008)	16770,00	1957,00	1138,00
	Hidrocarburos clorados (µg/kg)	Bifenilos policlorados (PCBs)	PCB 28	1,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 52	1,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 101	4,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 118	4,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 138	4,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 153	4,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			PCB 180	4,00	NL Ministry of Infras	-	-	-	4,00	NL Ministry of Infra	-	-	-
			Total PCBs	21,60	Canadá; Buchmann	21,60	-	-	189,00	Canadá; Buchman	189,00	-	-
		Clorobencenos	Pentachlorobenceno	1,00	NL Ministry of Infras	-	-	-	100,00	NL Ministry of Infra	-	-	-
			Hexachlorobenceno	0,05	NL Ministry of Infras	-	-	-	5,00	NL Ministry of Infra	-	-	-
	Plaguicidas (µg/kg)	Organoclorados	Aldrin			-	-	-			-	-	-
			Clordano			2,26	-	-			4,79	-	-
			p,p'-DDD			1,22	-	-			7,81	-	-
			p,p'-DDE			2,07	-	-			374,00	-	-
			p,p'-DDT			1,19	-	-			4,77	-	-
			Dieldrin			0,72	-	-			4,30	-	-
			Endrin			-	-	-			-	-	-
			α-endosulfán			-	-	-			-	-	-
			Epóxido de heptacloro			-	-	-			-	-	-
			Heptacloro			-	-	-			-	-	-
			Lindano (γ-HCH)	0,05	NL Ministry of Infras	0,32	-	-	230,00	NL Ministry of Infra	0,99	-	-
		Organonitrogenados	Atrazina			-	-	-			-	-	-
		Organosulfuros	Disulfotón			-	-	-			-	-	-
	Otras sustancias orgánicas		Grasas y aceites			-	-	-			-	-	-
Componentes organometálicos (µg/kg)			Tributilestaño (TBT)	0.02 (0.007)	NL Ministry of Infras	-	-	-	10 (0.7)	NL Ministry of Infra	-	189,60	-
Componentes minerales	Metales (mg/kg)		Bario (Ba)	130,10	Buchmann (2008)	-	-	-	48,00	Buchmann (2008)	-	-	-
			Cadmio (Cd)	0,68	EEUU	0,68	-	0,40	4,20	EEUU	4,21	1,10	0,80
			Cobalto (Co)			-	-	-			-	-	-
			Cobre (Cu)	18,70	EEUU - Canadá	18,70	15,60	9,40	108,00	EEUU - Canadá	108,00	19,40	17,60
			Cromo (Cr)	52,30	EEUU - Canadá	52,30	44,50	24,90	160,00	EEUU - Canadá	160,00	59,00	31,50
			Estroncio (Sr)		No hay referencias	-	-	-		No hay referencias	-	-	-
			Hierro (Fe)			-	-	-			-	-	-
			Mercurio (Hg)	0,13	EEUU - Canadá	0,13	0,04	0,20	0,70	EEUU - Canadá	0,70	0,70	-
			Molibdeno (Mo)			-	-	-			-	-	-
			Níquel (Ni)	15,90	EEUU	15,90	20,20	10,80	42,80	EEUU	42,80	24,10	14,60
			Plata (Ag)	0,73	Buchmann (2008)	0,73	-	-	1,77	Buchmann (2008)	177,00	-	-
			Plomo (Pb)	30,20	EEUU - Canadá	30,20	24,00	6,70	112,00	EEUU - Canadá	112,00	47,30	16,60
			Selenio (Se)			-	-	-	1000,00		-	-	-
			Vanadio (V)			-	-	-			-	-	-
			Zinc (Zn)	124,00	EEUU - Canadá	124,00	543,00	52,60	271,00	EEUU - Canadá	271,00	603,00	190,20
	Metaloides (mg/kg)		Antimonio (Sb)			-	-	-			-	-	-
			Arsénico (As)	7,24	EEUU - Canadá	7,24	-	8,10	41,60	EEUU - Canadá	41,60	-	-

Apéndice B Diagnosis of port areas with respect to expected volumes of material to be dredged in access channels and potential beneficial uses.

Colombia has nine (9) port zones in which different foreign trade activities are carried out, in each of these there are different port concessions that are used for loading and unloading or cargo handling. A port concession contract allows the temporary and exclusive occupation and use of the beaches, shores, low tide lands and accessory areas for construction and operation, in exchange for an economic consideration in favor of the Nation and the municipalities where they operate.

During the last three decades the Colombian port system has been modernized in terms of its development and expansion, advancing in the physical and technological infrastructure of the country, as a result of the incorporation of private capital. Under Colombian regulations governing port and environmental matters, port areas must have a concession contract or permit to operate.

A figure showing the location of the country's port zones is shown atIllustration B -1 :

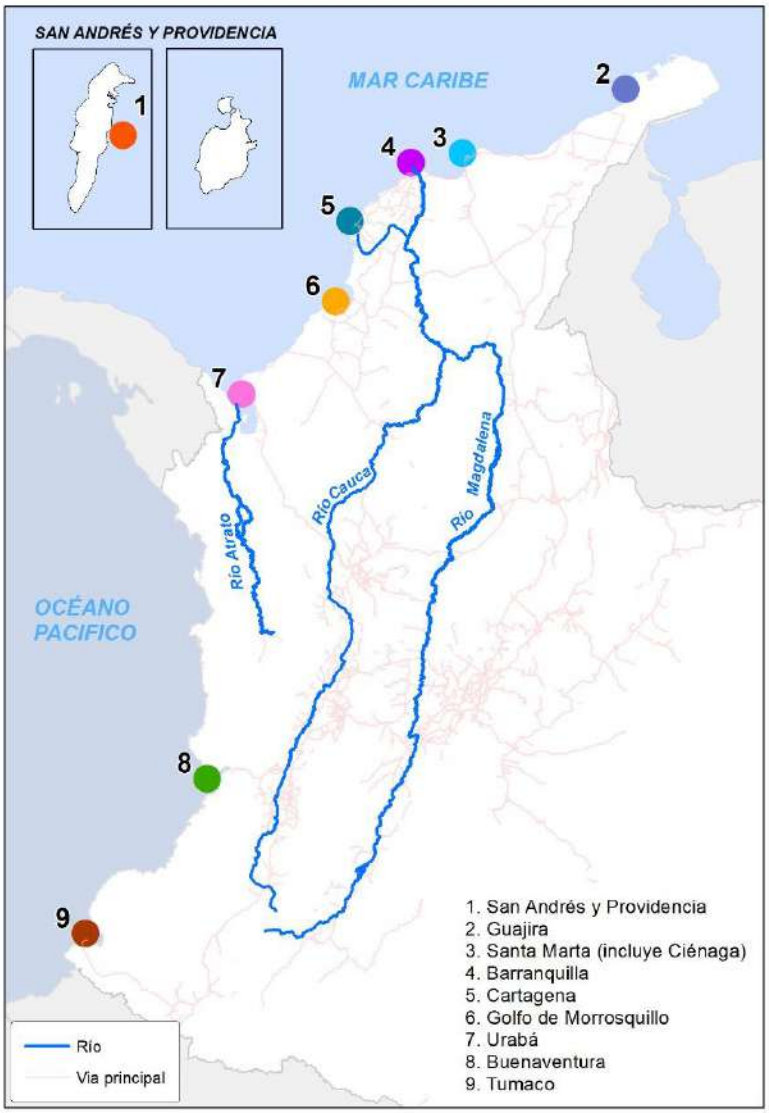


Illustration B -1 Location of Colombia's port zones.

At present, there are three (3) state entities in charge of granting these concessions, the Government of San Andres and Providencia in its jurisdiction, the Regional Autonomous Corporation of the Rio Grande de la Magdalena

(Cormagdalena) for the banks of the Magdalena River sector and the National Infrastructure Agency (ANI) for the rest of the country. According to the POFPA 2024 (Plan de Ordenamiento Físico Portuario y Ambiental) the port sector in Colombia has grown significantly, between 1991 and 2024, while in 1991 there were seven (7) concession contracts in force, in 2024 this figure rose to 97 granted in total. Of the 97 port concessions existing in 2024, it can be identified that 70% (68 concession contracts) are in charge of ANI; 29%, equivalent to 43 concession contracts, are in charge of Cormagdalena; and one (1) contract concessioned by the Government of San Andres, which represents 1%. The following table shows the amount by port zone:

Tabel B-1: Amount of concession contracts per Port Zone

Port Zone		Concession contracts
1	San Andres and Providencia	2
2	Guajira	3
3	Santa Marta and Ciénaga	6
4	Barranquilla	28
5	Cartagena	31
6	Morrosquillo	5
7	Urabá	5
8	Buenaventura	12
9	Tumaco	5
	TOTAL	97

Source: Physical, Port and Environmental Management Plan - POFPA 2024.

In the POFPA 2024 document, it was identified that out of the 97 concession contracts, 12 concession contracts in different port areas are not in force to date; 1 in Santa Marta, 2 in Buenaventura, 1 in Tumaco and 8 in Barranquilla.

According to the operating characteristics, some port areas are identified as specialized coal and hydrocarbon cargo terminals and other terminals are called multipurpose terminals, which include the above and general containerized cargo.

	PORT ZONE
Specialized hydrocarbon terminals	Morrosquillo Gulf
Specialized coal terminals	Guajira, Ciénaga (Santa Marta)
Multipurpose terminals Caribbean	San Andres, Santa Marta, Barranquilla, Cartagena, Turbo,
Pacific multipurpose terminals	Tumaco and Buenaventura

In the **Gulf of Morrosquillo**, the loading of hydrocarbons to a tanker is done by means of a Monobuoy, which is a floating structure in deep waters that is connected with underwater hoses to the land area; therefore, this area and the vessels that operate it do not require the infrastructure of an access channel and dredging activities are not necessary.

The specialized coal terminals, located in **Guajira and Ciénaga** (Santa Marta), are in areas where each of the port concessions has a unique access channel to its dock, and each of the concessions is particularly responsible for performing the maintenance dredging or capital dredging (river improvement dredging) required for the loading activities of its vessels (ships). The location of these port terminals in the Caribbean region does not have the presence of large river mouths that could contribute sediments and affect the depths of the access channel periodically. In the 2017

National Dredging Plan (PND) it was estimated that each of these areas would dredge an average of 300,000 m3 annually.

The Multipurpose Terminals of the Caribbean region, **San Andres and Providencia** the PND determined that maintenance dredging activities of 18,500 m3 and 7,500 m3 per year are required respectively. The **Santa Marta** Port Zone has sufficient natural depth and no dredging activities are carried out. In the **Cartagena** Port Zone, between 2014 and 2015 dredging was carried out to deepen and widen the access channel in Bocachica (entrance to the Bay of Cartagena) and in Manzanillo (entrance to the inner Bay), this is the most recent dredging carried out and to date has not required maintenance dredging.

The other multipurpose terminals in the Caribbean region; **Barranquilla** Port Zone is located at the mouth of the Magdalena River with a large amount of sediments in the access channel with maintenance dredging of 3,600,000 m3, average of the last 6 years, necessary to maintain adequate depths. The **Turbo** Port Zone is located near the mouth of the Atrato River, but the only port under construction, called Puerto Antioquia, is not yet in operation.

In the Pacific region, there are the **Tumaco and Buenaventura** Port Zones. It was identified that for the Tumaco access channel an annual maintenance dredging of 160,000 m3 is required, while for Buenaventura an annual volume of 2,180,000 m3 was estimated.

The following is a description of the relevant aspects of the dredging executed in the port zones, compiling the most recent information on the characteristics of the dredged material, volumes **(Supply)**, future dredging projects (maintenance or deepening) that will allow identifying the different opportunities **(Demand)** for the beneficial uses of the dredged materials in the Colombian context.

San Andres and Providencia Port Zone

The San Andres access channel has an approximate length of four kilometers, between the sea buoy located at coordinates 12° 32.337'N - 81°41'28.06 "W and the port basin located at coordinates 12° 34.452'N - 81° 42.174'W (approximately), this channel connects the port facilities of the island of San Andres with the open sea, as shown inIllustration B-2 in red line and by a yellow rectangle the disposal area of the dredged material at 2km. The access channel to the port of San Andres has a base channel dimension of less than 60 meters with a depth of 8.3 meters.

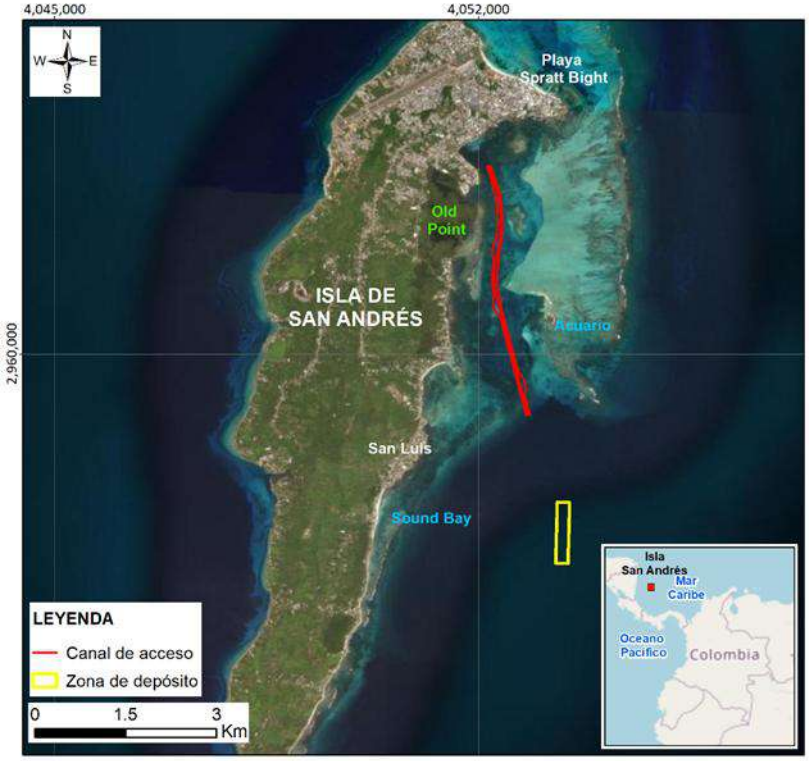
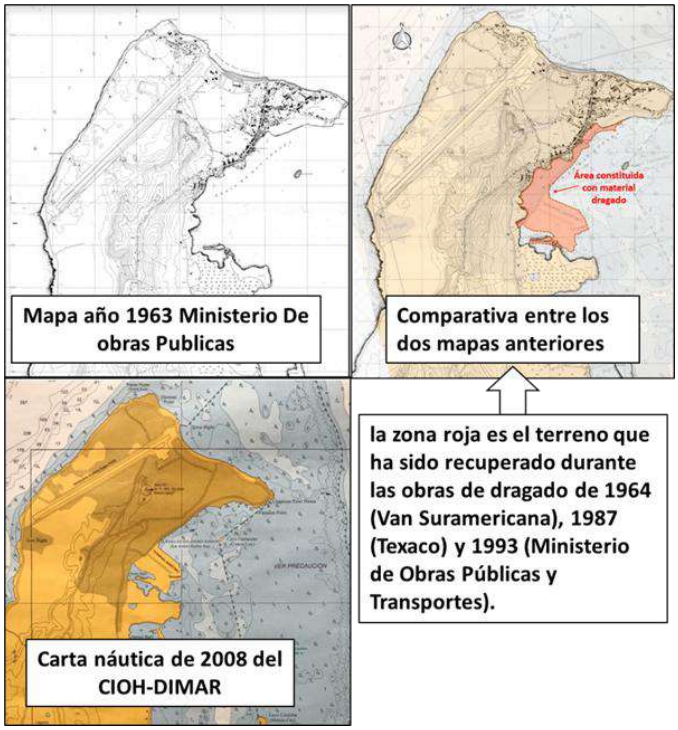


Illustration B-2 San Andres access channel and dredged material deposit.



According to the research carried out, the current area where the chamber of commerce offices, the administrative facilities of the Governor's Office and the Port of San Andres are located was created by using dredged material. InIllustration B-3 shows the map of the northern zone of the island, indicating information from maps of 1964 and 1987. According to officials from INVIAS-Instituto Nacional de Vías, the Van Suramericana company dredged the access channel to the port to build the Texaco dock wall, which resulted in a large land reclamation project that added approximately 500,000 m2 (50 ha) of dry area for San Andres. Part of this area is today the Port of San Andres and to the north the area was reclaimed to build part of the road around the island.

The exact technique used for the dredging and feeding activities and the impact it caused on the environment during that period is unknown. However, previous studies and reports show no severe impacts or changes to the environment during this period.

Illustration B-3 Comparison of maps from 1963 and 2008 to identify areas with land reclamation by dredged material. (Source: adjusted from information from the Ministry of Public Works and CIOH: Oceanographic and Hydrographic Research Center and DIMAR: General Maritime and Port Directorate.

The Port Zone of San Andres is the least active port area, in the last 18 years no dredging has been performed; and despite the fact that dredging for deepening the access channel was contracted by the Governor's Office of the Archipelago (Contract 821 of 2016), at the expiration of its term (Dec. 31, 2016) nothing was executed.

Future dredging volume (Bid)

In 2017, another contract was made for the deepening dredging of the San Andres channel (Process LIC-005-2017) and was not executed because there was an error in the calculation of the volume to be dredged and administratively the contract did not allow budget expansion. Between 2017 and 2020 different environmental studies have been carried out to obtain the environmental license that allows the execution of the dredging and to date there is no authorization by the environmental entity in charge.

According to the above, the San Andres Port Zone has had no maintenance dredging activities since 2007 (**Supply**) and no future maintenance dredging or deepening of the access channel is known to date that would allow establishing a supply of dredged material.

Beneficial uses of dredged material (Demand)

According to the study by Arcadis c.s. (2022), regenerating the beaches by extracting sand from the access channel to the port, from the area to the west of Johny Cay, or from the banks around the island is a possibility that must take into account that the source of sediments cannot affect the composition or the aesthetic aspect of the beaches. The feasibility of using this sand stock for the Spratt Bight beaches should be analyzed. Invemar field work indicated that there are no hazardous or toxic concentrations and its suitability for nourishment and grain size is adequate.

Barranquilla Port Zone

In the port area and the access channel of the last 22 km of the Magdalena River, channeling works have been carried out since 1930 and docks have been built for the development of the city's port. These works have gradually fixed the river banks, partially controlling the natural development of the riverbed.

The Barranquilla access channel is the only Port Zone (ZP) in the country that is in charge of Cormagdalena; dredging activities in the other ZPs are in charge of INVIAS.

The access to the port area of Barranquilla comprises a Maritime Channel or Enfilación Channel that is governed by the existing maritime guidelines in the Eastern Tajamar of the Magdalena River and is indicated in green on the figure below, and a Fluvial access Channel indicated in red. InIllustration B-4 a yellow circle is indicated with the location of the deposit zone, located 3 km from Bocas de Ceniza's Western Tajamar.

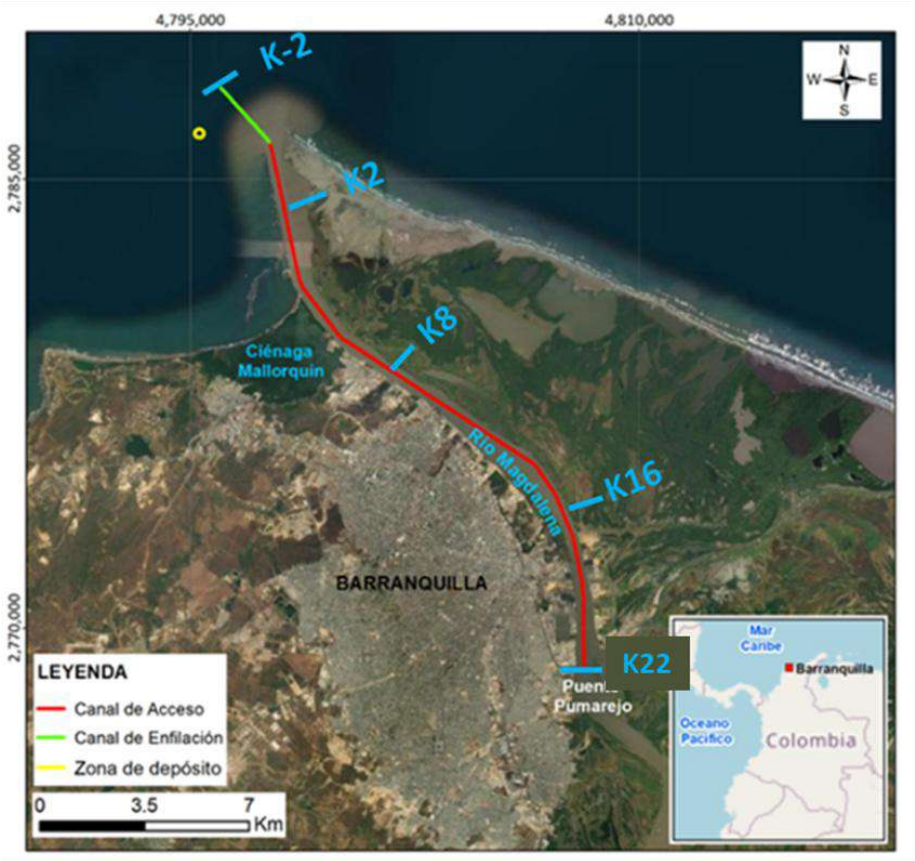


Illustration B-4 Location of access channel and dredged material deposit in the Barranquilla Port Zone.

The access channel has a non-constant depth of 40 feet (12 m), base less than 150 m. The material to be dredged is silty sand. The material to be dredged is fine to coarse silty sand. The area of greatest sedimentation is located in the first two kilometers of the entrance to the access channel in the Bocas de Ceniza sector. The image shows the abscissa of the access channel and the following is a description of the 4 sectors that divide the Barranquilla access channel:

Tabel B-2: Description of the 4 sectors that divide de Barranquilla access channel.

Sector	Km Interval	Maximum channel depth (m)	Channel width (m)	Description
I	-K2-800 to K02+000	13.7	Begins with 315 m at K2-800 and ends with 200 m at K0+000.	Sector with strong winds and waves that influence hydrodynamics. Some bars are located as a result of subtidal low growth in the east.
II	K02+000 to K8+000	12.0	200	Sector with hydrodynamics determined by the interaction between the Caribbean Sea and the Magdalena River. Normally in the area there are some bars that reduce the depth of the access channel. These bars are recurrent and require immediate intervention as soon as they occur.
III	K08+000 to K16+000		150	Imminently fluvial zone with incidence of some affections generated by waves. Due to the saline wedge that enters during low flows and other special conditions, there is a dynamic that requires dredging.
IV	K16+000 to K21+750			Fluvial zone that requires constant monitoring.

According to information from the last dredging, there is a record that the place with the highest volume of dredging corresponds to sector I in the channel at the entrance of the channel. Maintenance dredging volumes are shown below atIllustration B-5 .

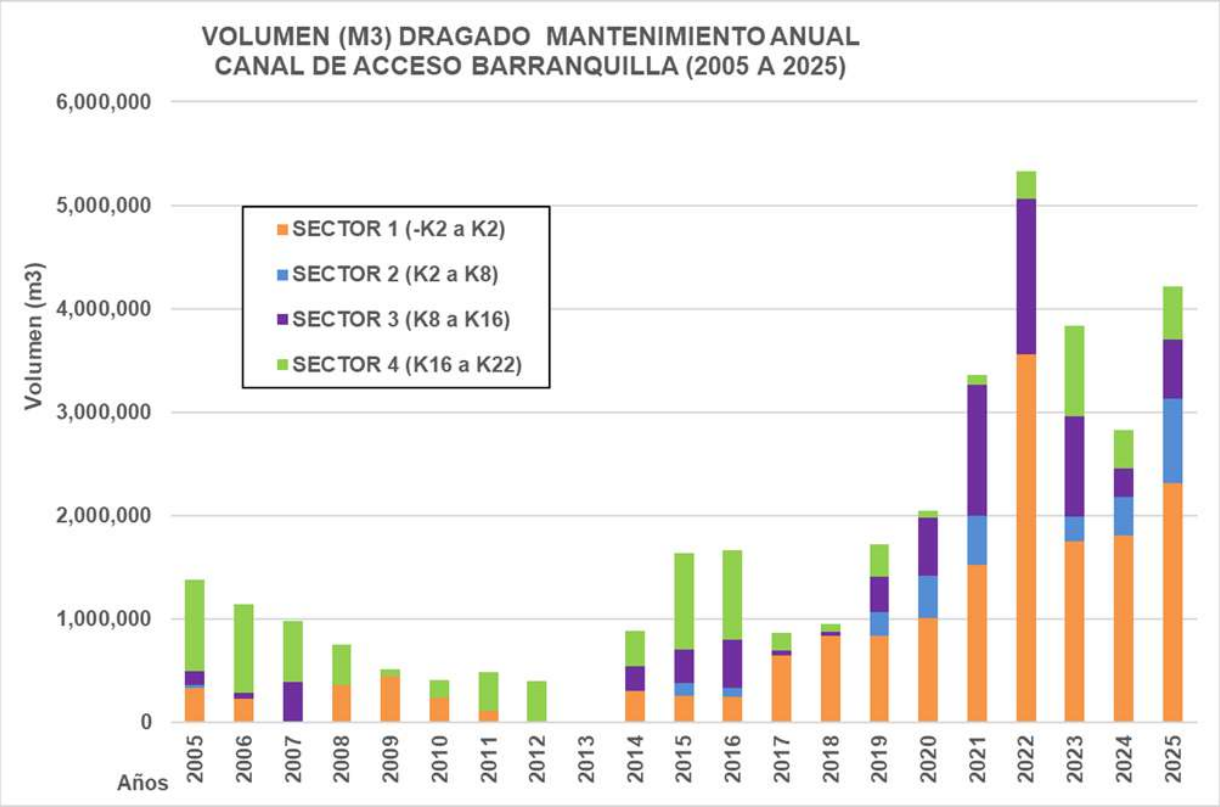


Illustration B-5 Maintenance dredging volumes for the access channel (Data source: Cormagdalena).

The information of the volumes (m3) of dredging represents a regime jump from 2019/2020: the total volumes increase on average from one (1) million m³/year to four (4) million m³/year. The largest amount of dredging is concentrated in Sector 1, which corresponds to the seaward channel and where critical bars are formed that require recurrent dredging. Sectors 2 and 3 act as modulators of the effort when there are extreme hydrological conditions, increasing the total volume dredged. Sector 4 ceased to be the major structural contributor it was between 2005 and 2016; currently the amount of volume dredged is not episodic. A detailed analysis in each sector is presented below:

- **Sector 1** (-K2 to K2) is the most critical sector and the one that dominates the dredging effort today. Since about 2019/2020, a structural increase in the required volume is observed. This confirms that the sea-river transition zone at the mouth has become the permanent bottleneck of the access channel. During the years 2005 to 2018, the average volume of dredged material was 325,000 m3/year, from 2020 to 2025, the average volume increased to 2,000,000 m3/year.

- For **Sector 2** (K2 to K8) presents moderate increases after 2015 and behaves as a complement to Sector 1. When the Magdalena enters loaded and there is more intense interaction with waves and closure events, this sector is activated. But it is not the main driver: its relative weight rises, but it does not define the peak years by itself.

- In **Sector 3** (K8 to K16) this sector is reactivated by dredging when there are episodes of salt wedge advance and low flows. Between 2021 and 2023 a strong contribution is seen in high years → bottom fluvial dynamics plus marine intrusion make this section function as a "buffer" where sediment is deposited when hydrological extremes push sediment along the channel.

- **Sector 4** (K16 to K22) during the first years (2005-2008) was proportionally more relevant. It then loses relative importance over the years. However, when there are hydrologically extreme years, it reappears (2022-2024) showing that the upper riverine part also suffers under special conditions, but it is not the area that permanently requires dredging like Sectors 1 and 3.

Future dredging volume (Bid)

The most recent maintenance dredging contract is for the year 2024 with an expected duration until December 2025. The navigable channel has been kept in dredging activity with the geometric conditions indicated and with the expected depths ranging between 12 and 13.7 meters according to the design that applies for each section, corresponding to standard slopes of 1V:5H. As of October 31, 2025, the contract has executed 89% of the contracted volume, as follows is a table with the quantities executed in the 4 sectors of the access channel

Tabel B-3: *Total volume of material dredged in each sector of the access channel, between Nov/2024-Mar/2025, and volume pending dredging during the remainder of the contract 2024-25 (Source: Prepared based on data from the dredging contractor).*

Sector	Km interval	Volume (m^3)	Fraction of total
I	K-2-800 to K2+000	2.315.567	49 %
II	K2+000 to K8+000	813.550	17 %
III	K8+000 to K16+000	574.434	12 %
IV	K16+000 to K21+750	512.778	11 %
Total, dredged between Nov/2024 and Oct/2025		4'216.329	89 %
Volume pending dredging for the remainder of the contract		497.622	11 %

Since 2015, the disposal area recommended by DIMAR by means of official letter No. 13201500926: "Due to the above, the Regional Port Captaincy of the General Maritime Directorate - DIMAR, recommends the sediment discharge area to be carried out in an area of 150 meters radius around the point with the following geographical coordinates: Latitude 11°06.70N, longitude 74°52.50W. (see figure with the location of the dump site).

Beneficial uses of the dredged material (Demand)

Considering that the Barranquilla access channel is located in an area that mixes maritime and fluvial conditions with nearby urban areas, it is considered that the beneficial use of dredged material should be evaluated and the physical, chemical and biological characteristics should be determined for beach reclamation in the Caribbean region or hydraulic landfills for port expansion / logistics or construction / reinforcement of dikes on riverbanks or restoration of wetlands / ecosystems. These issues in the Barranquilla port area will be developed in detail and analyzed in Deliverable 5.

Cartagena Port Zone

The Cartagena Access Channel is limited in physical conditions by the width in two sectors called BOCACHICA and MANZANILLO. The first sector has a depth of 20.5 meters, with a base of less than 140 meters. The second sector has a depth of 17.5 meters and a base of 140 meters.

Sediments in the bay come basically from fluvial contributions, including those from the Canal del Dique and local erosion. The predominant sediments in the bay are muds, fine sands and coarse sands, coral debris and siliceous gravels. The location of the area where the dredged material is deposited and authorized is approximately 9 miles from the Bocachica sea buoy and occupies an area of 4.5 km2 with depths greater than 100m. It can be identified in the yellow rectangle atIllustration B-6

Illustration B-6 Cartagena Port Zone. Location of access channel and dredged material deposit.

The Deepening and Widening of the Cartagena Access Channel - Bocachica and Manzanillo Sectors, executed between 2014 and 2015, was carried out with the objective of obtaining in the Bocachica sector a depth of 20.5 m at mean low tide of sicily, and a channel base width of 140 m, and in the Manzanillo sector a depth of 17.5 m, with a width of 140 m at the base.

For the development of the Project, called PROCANAL, the Ministry of Transportation and INVIAS determined that the ideal entity for the Administration and integral Management of the project to facilitate the channeling of public and private resources was the Financiera de Desarrollo Nacional - FDN. On the other hand, the National Infrastructure Agency - ANI-, authorized the request for the advance payment of port considerations in charge of the concessionaires: CONTECAR, Sociedad Portuaria Puerto Bahía S.A, Sociedad Portuaria Regional Cartagena - SPRC, to finance with such resources the costs of the project.

This deepening and widening of the access channel in Bocachica (entrance to the Bay of Cartagena) and in Manzanillo (entrance to the inner Bay), is the most recent dredging carried out and to date has not required maintenance dredging.

Future dredging volume (Supply)

The access channel to the Cartagena Port Zone has the capacity to receive New Panamax class vessels by available depth and therefore does NOT require future deepening dredging, but it DOES require a strategy for the expansion of its width to double lane, to increase maritime traffic capacity, as there is already evidence of congestion and waiting times for vessels to enter and leave the port.

With respect to the maneuvering areas and private docks of the Cartagena Port Zone, approximately 30 port concessions, the National Maritime Dredging Plan identified an annual dredging volume of 250,000 cubic meters.

Beneficial uses of dredged material (Demand)

Particularly, the concessions that carry out dredging activities in their maneuvering areas or docking docks, through the environmental license for port operation, request authorization for the volume of dredged material to be used as hydraulic fill with the purpose of obtaining an adequate ground level for the expansion of port yard areas. Therefore, for the Cartagena Port Zone there is no opportunity to make beneficial use of the dredged material other than the particular use and need of each concessionaire.

Buenaventura Port Zone

The Port of Buenaventura is located on the Pacific Coast in the southwest of the country. The access channel has a length of 34 kilometers and is divided into two sectors; Internal Bay and External Bay, seeIllustration B-7 . The depth of the channel is 12.5 m in the inner bay (K0 - K15) and 13.5 m in the outer bay (K15 - K34+000), the channel maintains a width of 160 m in the inner bay and 200 m in the outer bay.

The last maintenance dredging performed in the access channel in 2023, an amount of 1,200,000 cubic meters was dredged to maintain the depths of 12.5 meters and 13.5 meters.

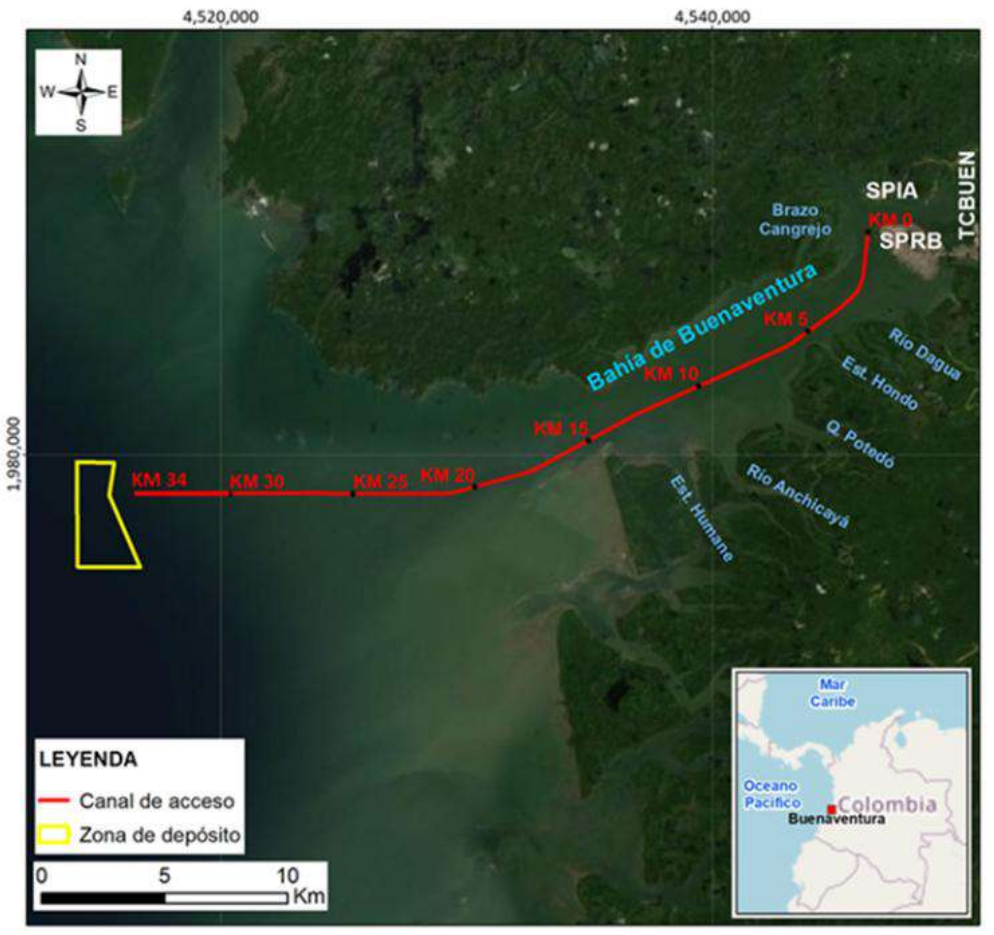


Illustration B-7 Zona Portuaria de Buenaventura. Location of access channel and dredged material deposit.

In accordance with contract No. 5026 of 2023, in February 2024 activities began for the preparation of the Environmental Impact Assessment (EIA), license management, review, updating and/or supplementation of the studies and designs for the deepening dredging of the access channel to the port of Buenaventura-Valle del Cauca. The objective of the deepening dredging of the access channel is to increase the available depth by 4 meters, that is to say that the channel sill reaches depths of 16.5 meters and 17.5 meters in the inner and outer bay, respectively, to allow the entry of the New Panamax vessel.

This process includes the development of prior consultation where 7 prior consultations were held with the community councils of black communities i) Mayor de Anchicayá, ii) Punta Soldado, iii) Gamboa, iv) San Joaquín and Agua Dulce, v) Bazán Bocana, vi) Chucheros Ensenada del Tigre and vii) Juanchaco. Currently, the beginning of the biotic environment characterization activities is being socialized.

Through mechanical soundings, the characteristics of the material that makes up the port access channel are classified as (i) gray silty clay, (ii) silty clays with presence of sand, (iii) very fine sandy silts, (iv) siltstones with very fine sand veins, (v) greenish gray siltstones with fine-grained sandy parts of hard consistency, and (vi) silty sand followed by fairly plastic gray clay of soft consistency.

It is expected that the EIA can be finalized next year and the respective environmental license obtained the following year to consider future deepening dredging.

Future dredging volume (Supply)

Since the first week of October 2025, INVIAS is in the process of contracting the maintenance dredging at depths of 12.5 and 13.5 of the Buenaventura access channel with the following activities.

- Mobilization and demobilization of the dredge to Colombia to the port of Buenaventura,
- Perform maintenance dredging of the access channel, prepare and execute the PAGA,
- Carry out pre, post and control bathymetries of the dredging,
- Develop the social management plan, process and manage the permits before DIMAR and environmental entities.

The material to be dredged corresponds to sand and is divided into the following quantities:

- Inner Bay Volume: 107,048 m3
- Volume External Bay: 2,073,829 m3

The estimated volume for this year is higher than the maintenance dredging carried out in 2023, which was 1.2 million cubic meters and 1.8 million cubic meters in 2020.

Regarding the disposal of the dredged material, the terms of reference of the contract indicate that the authorized dump must be used, located at a distance of approximately 4 km from buoy No. 1 at the entrance to the channel, to the west of the 20-meter deep embankment.

It can only be used to dispose of dredged sediments, following the stipulations of RESOLUTION NUMBER (0042-2023) MD-DIMAR-CP01-ALITMA of SEPTEMBER 11, 2023, which quotes textually, in section "g" of chapter 2 of recommendations, the following:

"(g) The unloading of maintenance dredging material should be carried out homogeneously in the authorized dumping area, in the deepest areas, in order to avoid the accumulation of sediment in a single point; it is recommended to deposit the sediment in the veriles of more than 30 meters deep."

Beneficial uses of dredged material (Demand).

The different opportunities for beneficial uses of dredged material have been identified and analyzed, with the main objective of building with nature and it was found that the dredged material in the Buenaventura access channel can be used in the creation of a hard point to stabilize a number of islands created with the filled material and subsequently establish mangrove planting to consolidate the islands. The initial location is planned in the outer bay of Buenaventura, starting from the sector known as Punta Soldado and continuing in the direction of the access channel out to sea. The above proposal consolidates the sediments that, according to coastal drift, are affecting the depths of the access channel in the outer bay.

With respect to the dredged material from the inner Bay, one option is on land reclamation; an area of approximately 10 hectares was identified in Phase 2 of Stage 1 of the construction of the La Cruz Bay Seawall (Cascajal Island), in which the use of the dredged material in the inner Bay and in the access channel to the Estero San Antonio sector can be implemented as a source of dredged material of approximately 1 million cubic meters per year of fill to recover the land and increase the space for possible housing construction projects or recreational parks. Subsequently, the same idea can be structured for Phase 2 and 3 of the Malecon project.

Tumaco Port Zone

The port of Tumaco is located in the southern part of the Colombian Pacific coast. It is located in an internal geographical position between islands and is the second most important port on the Colombian Pacific coast. Tumaco Island is exposed to be affected by a tsunami.

The access channel to the port of Tumaco is approximately 8.3 kilometers long, with a channel depth of 7.30 meters at mean low tide, width at the base of the channel of 60 meters, and side slopes 1V:6H. SeeIllustration B-9

The last deepening dredging was carried out in 2008 with a volume of approximately 1 million m3 , all the material was disposed of in the offshore area. Since the deepening of the access channel to 7.30 meters, maintenance dredging of the access channel to the port of Tumaco has been carried out in 2010, 2016, 2018 and 2019. The disposal area of the dredged material is to Mar a fuera, 1.7 km north of the sea buoy. In 25m and 30m veriles. This zone was determined by

Resolution Number 0220 of August 29, 2003 issued by the Regional Autonomous Corporation of Nariño, CORPONARIÑO, delimited by the vertices indicated in the yellow box in the figure below:

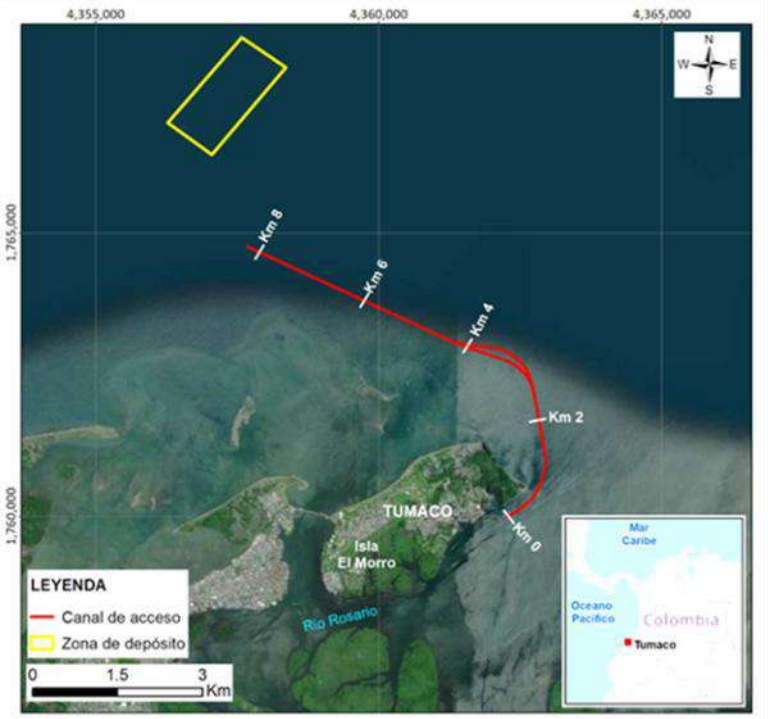


Illustration B-8 Tumaco. Location of access channel and material deposit

Future dredging volume (Supply)

With the objective of deepening the access channel to Tumaco to a depth of 11.5, Resolution No. 196 of 2023 of Corponariño grants the Environmental License to the National Roads Institute (INVIAS) for the dredging project of deepening and realignment of the access channel. The project is divided into two phases and is considered technically feasible after evaluation of the Environmental Impact Assessment (EIA). A total capital dredging volume (river improvement dredging) of $3,445,558 m3 of material was authorized, composed mainly of sands (98.3%) and rocks (1.7%). The dredged material will be disposed of entirely within the authorized marine polygon, as the granulometric analysis determined that it is not suitable for the regeneration of Morro Beach. The license includes environmental management conditions and programs, with special attention to nickel management in certain deep stations and coordination with ethnic communities impacted by temporary fishing restrictions.

The environmental license described the considerations for the use of the dredged material as follows:

- Primary and Authorized Use: The INVIAS plan, which was approved, is the total disposal of the dredged material in the authorized offshore disposal zone (marine dump). This area is the same area that has been used for maintenance activities in the access channel.
- Material Not Suitable for Beach Regeneration: The dredged material, with an average mean diameter (D50) of 0.18 mm, is not suitable for beach regeneration at El Morro. This is because the native beach material has an average D50 of 0.24 mm, and the technical recommendation is to use a material with the same or higher granulometry to ensure stability.
- Nickel Sediment Management: For deep stations (S03M2-3 and S03M4) where nickel exceeds Action Level B of the Spanish guideline, INVIAS should guarantee the underwater confinement of this material in the marine dump, covering it with material of Action Level A or lower. In the event that future monitoring shows that the material exceeds the contamination thresholds of the Spanish guideline, treatment must be carried out on land by an authorized third party.

Beneficial Uses of Dredged Material (Demand)

On December 31, 1906, a tsunami wiped out almost the entire population of Tumaco and on December 12, 1979, this natural phenomenon was repeated, with catastrophic consequences not only for this municipality but for the entire South Pacific. The destructive capacity of the previous Tsunami (1979) was reduced by El Guano Island and as a consequence the Island was eliminated. A future objective may be to create similar protection with dredged material.

Illustration B-9 Inundation map of Tumaco by eventual Tsunami. Source: Map of Dimar - CIOH "Evaluation of the impact of the Tsunami on the coastal zone of Tumaco by means of Mathematical Modeling". CCCP 2000. Lines indicated in red color indicated in INVIAS presentation, Webinar use of dredged material. 2020

Apéndice C Detailed recommendations on the Environmental Guide (Invias, 2022).

Volume 1 Conceptual, legal and regulatory framework of the guidelines.

Recommendation 1:

In the *2008 Guidance for Strategic Environmental Assessment (SEA),* within the operational environmental objectives of the port policy, the promotion of eco-efficiency in the use of natural resources through the use and reuse of rainwater and sanitation, as well as the recovery and valorization of waste is included.

This objective should include the use of dredged material, which has been erroneously considered a waste, when in fact it constitutes a resource with multiple environmental, social and economic uses and benefits.

Recommendation 2:

The rights of communities, noted in the following two paragraphs, should be fully taken into account in the development of dredging projects, including the beneficial use of sediments and the implementation of nature-based solutions (NbS).

The Constitutional Court also ruled against appropriate forms of socialization and specifically against artisanal or small-scale fishermen's groups and associations, highlighting the document of the World Conference of Small-Scale Fishers held at the FAO Fisheries and Agriculture Department in Bangkok in 2008, which recognizes the human rights of artisanal fishing communities and states the following: "What is important about the content of the declaration - which is also based on the concept of food sovereignty - is that it recognizes a set of rights, among which is that of guaranteeing these communities' access to their traditional marine fishing areas and their participation in decisions affecting the coasts where they exercise their activity, participation that must be prior, informed and with their consent."

"For these reasons, the users of this guide are urged to take into account each of the guidelines indicated herein and to carry out adequate censuses that allow the identification of the communities affected by their projects, which will entail an effective socialization of the same, in which the right to participation is fully guaranteed, and in which compensation measures are also designed jointly with the affected community, without these necessarily having to be of an economic nature, and which are in line with their culture and subsistence customs."

Recommendation 3:

Within the framework of legal and regulatory standards for the biotic environment, the decree currently being drafted by the Ministry of Environment and Sustainable Development on the use of sediments should be incorporated. The incorporation of this decree will update the legal and regulatory framework regarding the use of dredged materials, providing clear and official guidelines to guide maritime and river infrastructure projects. In addition, it will strengthen legal certainty and regulatory consistency, incentivizing the valorization of sediments as a resource and not as waste, in accordance with the principles of circular economy, environmental sustainability and the generation of social and economic benefits for local communities.

Recommendation 4:

In the legal and regulatory standards of the socioeconomic environment, regarding productive projects, the use of dredged material should be incorporated, so that this resource can generate direct economic benefits for the communities.

Volume 2 Infrastructure classification: maritime and river modes.

Recommendation 1:

In "Table 3 Areas of Special Environmental Interest (AEIAs)", in the complementary conservation and sustainable development strategies, Other Effective Area-based Conservation Measures (OMEC) are missing, which were defined in Decision 14/8 of 2018 of the Convention on Biological Diversity as "A geographically defined area distinct from a protected area, which is effectively governed and managed in a manner that achieves long-term positive and sustainable outcomes for the in situ conservation of biodiversity, associated ecosystem functions and services; and locally relevant cultural, spiritual, socio-economic and other values, where appropriate".

Volume 3. Baseline and impacts by project type.

Recommendation 1:

In the methodological aspects for the definition of the area of influence, during the field stage, it is recommended to conduct the reconnaissance of the area with the accompaniment of local leaders, in order to ensure a more accurate and contextualized characterization of the intervention area.

Recommendation 2:

In the methodological aspects for the definition of the area of influence, field stage "Table 4: Information to be collected from the UTMe in the field", it is established that, for all types of projects, the user communities of the intervention areas must be included within the area of influence, even if they are itinerant, associated or non-associated fishermen. It is essential to ensure the participation of the user communities of the intervention areas, as well as the sedentary communities in these areas, as they are the main affected or beneficiaries of the implementation of the projects and, therefore, should actively participate in the decisions that concern them.

Recommendation 3:

In the methodological aspects for the definition of the area of influence, field stage, paragraph: "In this field phase, the contractor shall develop and facilitate informative and participatory spaces with leaders, grassroots organizations, non-associated fishing communities, fishermen associations and authorities of the area of influence, to present the characteristics of the project, respond to concerns and record assessments, impacts and perceptions about the project as input for the formulation of management measures." It is essential to ensure broad, representative and inclusive participation in the projects. To this end, it is recommended to actively involve community action boards and grassroots social organizations, such as ethnic, women's, victims of the conflict, peasant, and transportation organizations, among others. The participation of these actors is key, given that they represent diverse interests and realities of the territory, which enriches decision-making, strengthens governance, prevents socio-environmental conflicts and guarantees that the benefits derived from the projects reach local communities in an equitable manner. Likewise, their inclusion contributes to generating trust and legitimacy in the process, essential aspects for the social and environmental sustainability of interventions.

Recommendation 4:

On the basis of the socioeconomic environment, for the characterization of the demographic aspects of the smallest territorial units, it is recommended to consult the statistics available in the SISBEN, given that this source offers updated and disaggregated information on the population, which facilitates a more accurate approximation of the socioeconomic conditions of the territory.

Recommendation 5:

In Table 12 "Suggested baseline information due to the complexity of the project for the demographic component", the identification and characterization of the ethnic groups present in the area of influence is missing, both for the larger and smaller territorial units, in order to recognize their social, cultural and territorial particularities.

Recommendation 6:

In the spatial component, within the social mapping, the areas of provision of plant material used by the communities for the elaboration of handicrafts should be incorporated, in order to recognize and make visible these spaces as part of their cultural and productive practices.

Recommendation 7:

In the economic sphere, within green enterprises, the collective use of sediments can be considered a sustainable business idea. This alternative not only allows giving a productive use to a material that is generally considered waste, but also generates economic opportunities for local communities, promotes the circular economy and contributes to environmental conservation.

Recommendation 8:

In Table 14, "Suggested baseline information according to project complexity for the economic component," it is recommended that the productive projects of ethnic minorities be incorporated, as well as the livelihoods linked to the water bodies subject to dredging and the natural resources they provide to the population. This inclusion will provide a more complete view of the economic and social dynamics associated with the territories, strengthening the impact analysis and management measures.

Recommendation 9:

In Table 16, "Suggested basic information according to the complexity of the project for the Cultural Component". it is recommended to include the cultural use of water bodies and their relationship with the cultural identity of the communities. This incorporation will allow recognition of the symbolic, spiritual and traditional value that these spaces have for human groups, as well as their role in the transmission of knowledge, ancestral practices and ways of life.

Recommendation 10:

In the following paragraph of the political, organizational and institutional component: "In addition, various community and organizational processes are present in the territory, fundamental for understanding the interrelationships and relationships with existing organizational expressions. Thus, processes such as active associations of fishermen, both ancestral and non-ancestral, beneficiaries and projects, hunting and fishing areas, peasant/agricultural and/or livestock organizations, collectives and/or associations of actors in the road, river and maritime sectors, and any other type of organizational expression related to the territory where the infrastructure projects will be framed should be distinguished." Likewise, community action boards, transportation companies, organizations of artisans, women, victims, ethnic groups, and youth, among others, should be included. The inclusion of these actors is key to guarantee an integral characterization of the territory, given that they play a decisive role in the social, economic, cultural and governance dynamics. In addition, their participation in the planning and decision-making processes of the projects allows for the promotion of representativeness, equity and the construction of legitimate and sustainable agreements.

Recommendation 11:

In the following paragraph of the section on the identification of environmental socioeconomic impacts: "The identification and establishment of socioeconomic impacts are derived from the adequate characterization of the baseline, where all the components included in the areas of influence are collected, with the respective activities that may be affected by the development of transportation infrastructure projects." It is necessary to add, within the activities, the identification of the socioeconomic and cultural dynamics that may be affected. The inclusion of this activity makes it possible to anticipate possible impacts on the lifestyles, cultural practices and social relations of local communities. It also favors the implementation of more comprehensive and participatory management measures that guarantee the social and cultural sustainability of projects.

Recommendation 12:

In Table 26 "Identification of impacts on the socioeconomic environment", it is recommended that the impact "Generation or exacerbation of conflicts" be incorporated into the demographic component, considering that projects may intensify pre-existing tensions or generate new disputes between communities, institutions and economic agents over access, use and distribution of resources.

Volume 4 Management measures by project type

Recommendation 1:

In subprogram 2: training and sensitization of field staff, within the social training topics, it is suggested that local socioeconomic and cultural dynamics be included, so that field staff understand the social context in which projects are developed, identify relevant community practices and values, and adopt a respectful and constructive relationship with the communities in the area of influence.

Recommendation 2:

In subprogram 3: Environmental management of dredging activities for river maintenance and improvement, it is proposed to incorporate the impact on ichthyofauna and alteration of their mobility as impacts to be managed. Dredging can generate direct and indirect effects on ichthyofauna due to sediment resuspension, changes in water quality, loss of habitat and alteration of the species' breeding and feeding areas. Likewise, dredging works may cause temporary or permanent restrictions to the mobility of riparian communities and users of water bodies (fishermen, transporters, river tourism, among others), which should be prevented and properly managed to minimize social and economic conflicts.

Recommendation 3:

The following action of subprogram 3: Environmental management of maintenance dredging activities and river improvement, "Analysis of the results of sediment characterization, in order to determine whether, based on the quality of sediments evaluated according to international standards or the regulations of the Ministry of Environment and Sustainable Development, and the needs of the intervention area, a beneficial use of the dredged material is possible", includes the decree currently being prepared by the Ministry of Environment and Sustainable Development on the use of sediments. The incorporation of this decree will update the legal and regulatory framework regarding the beneficial use of dredged materials, providing clear and formal guidelines to guide maritime and river infrastructure projects. In addition, it will strengthen legal certainty and regulatory consistency, incentivizing the valorization of sediments as a resource and not as waste, in accordance with the principles of the circular economy, environmental sustainability and the generation of social and economic benefits for local communities.

Recommendation 4:

In Subprogram 1: Hired labor with a focus on gender, rights and differentiation, in the information section, it is proposed to incorporate the Public Employment Service as an articulating entity. The inclusion of the Public Employment Service will guarantee greater transparency, equity and traceability in the hiring processes, ensuring that the hiring of local labor respects gender, differentiation and rights approaches. It also facilitates labor formalization and promotes the participation of vulnerable populations in the projects, contributing to the socioeconomic development of the communities in the area of influence.

Recommendation 5:

In the following action of Subprogram 3: Support for productive capacity and green enterprises, it is proposed: "Within the framework of this subprogram, support will be provided to strengthen associative and teamwork processes around productive projects, productive training or green enterprises, seeking sustainable development of the community by strengthening their productive capacities and opportunities." Likewise, in the "Use and valorization of waste" sector of the "Industrial Ecoproducts" category of Green Businesses, it is proposed to incorporate the use of dredged material as a Green Business, so that its sustainable use generates direct economic benefits for local communities. Dredged material, far from being considered waste, can be transformed into a useful resource for various productive and environmental activities (soil improvement, ecosystem recovery, infrastructure inputs, among others). Its inclusion in the category of Green Businesses allows recognition of its economic and environmental potential, promoting income generation, community ownership and sustainable development in the territories where dredging projects are carried out.

Recommendation 6:

In Subprogram 1: Attention to the community, in the point referring to the installation and adequacy of a citizen attention office, it is recommended to indicate that said office should be located in a place accessible to the communities, thus

facilitating their attendance and participation in the process, avoiding physical, transportation or distance barriers that may limit access to information and services.

Recommendation 7:

In the following action for the formation of the community participation committee for Subprogram 3: Maritime and River Culture and Community Participation, it is indicated that "in the initial meeting, the contractor shall make known the functions of the committee and register the persons who wish to participate in this process, indicating their name, address or road sector where they reside or develop their economic activity, telephone, among other data." It is recommended that the community representatives be elected directly by the communities through a democratic process that guarantees the representativeness of the different social groups present in the territory. Said representatives should not be selected at the initial meeting; on the contrary, it is necessary to grant the communities a reasonable period of time to organize and carry out this electoral process in an autonomous and participatory manner.

Recommendation 8:

In Subprogram 4: Social Inclusion from a Gender Perspective and Mainstreaming, within the topics of training and prevention of violence against women, national and international legislation that protects their rights should be incorporated. This will make it possible to develop training processes with a solid normative approach and to ensure that workers and communities are aware of the legal frameworks that support the guarantee of women's rights. Similarly, the participation of women should be promoted with a leading role in the use and transformation of dredged material, by linking them to productive chains. Likewise, it is recommended that their capacities be strengthened through training processes in environmental monitoring, community participation, productive chains and leadership, among others, in order to contribute to their empowerment and the sustainability of the initiatives.

Recommendation 9:

In Subprogram 5: Governance, organizations of people who are victims of the armed conflict should be explicitly incorporated, recognizing their fundamental role in the processes of reconstruction of the social fabric, citizen participation and community strengthening. Their inclusion guarantees that this historically affected population group has representation and a voice in project planning and management.

Volume 5 Follow-up, control and monitoring program.

Recommendation 1:

In subprogram 6.1: follow-up and monitoring of contracted labor with a gender, rights and equity approach, it is proposed to incorporate the Public Employment Service as the articulating entity. The inclusion of the Public Employment Service will guarantee greater transparency, equity and traceability in hiring processes, ensuring that the hiring of local labor respects gender, equity and rights approaches. It also facilitates labor formalization and promotes the participation of vulnerable populations in the projects, contributing to the socioeconomic development of the communities in the area of influence.

Note: Although dredging processes do not involve land ownership, projects for the use of dredged material may involve aspects related to land ownership. Therefore, it is recommended that this issue be incorporated into the Guidelines, establishing guidelines for the management of legal title to land generated from sediments, which should be accompanied by a specific protocol.

Apéndice D Traffic light type eligibility tool for the use of dredged material with a focus on community benefit.

Conventions

Green: High viability - priority use
Yellow: Conditional feasibility - requires adjustments, additional studies or permits
Red: Low feasibility - not recommended without substantial modifications

Tabel D-1: Traffic light decision matrix for the eligibility tool for the use of dredged material with a focus on community benefit.

Traffic light decision matrix						
Use option	**Community benefit**	**Technical feasibility**	**Environmental risk**	**Permits / licensing**	**Logistics and costs**	**Institutional decision**
Geobags (flood control)						
Construction materials						
Compost / soil improvement						
Agricultural land reclamation						
Ecosystem restoration (mangrove)						
Coastal/river erosion control						
Adequacy of rural roads						

Institutional use guidelines

Green (Prioritize): Uses with high community benefit, low environmental risk and manageable technical requirements. Can be incorporated directly into projects, subject to compliance with standard requirements.

Yellow (Conditional): Viable uses that require specific studies, detailed designs, community consultation or additional environmental permits. Their implementation should be conditioned to the mitigation of identified risks.

Red (Restrict): Uses that imply a high level of permits, possible significant environmental impacts or technical uncertainty. They should only be considered if there are robust environmental instruments and express approval from the competent authority.

Quick decision rules

- If two or more criteria are in red → Do not prioritize.
- If green predominates with one or two yellow → Suitable with conditions.
- If green predominates without red → Suitable and prioritized.

Colophon

POLICY AND TECHNICAL ADVICE ON BENEFICIAL USES OF DREDGED MARINE SEDIMENTS IN COLOMBIA, INCLUDING NATURE-BASED SOLUTIONS.
FORMULATE PROCEDURAL GUIDELINES TO DETERMINE FEASIBLE AND SUITABLE USES OF DREDGED MARINE SEDIMENTS IN COLOMBIA, INCLUDING NATURE-BASED SOLUTIONS.

The project “Policy and Technical Advice on the Beneficial Uses of Marine Dredged Sediments in Colombia, including Nature-Based Solutions” is part of the collaboration between the Government of the Netherlands, through the Partners for Water program, and the Colombian Ministry of Environment, the National Planning Department (DNP) and the Ministry of Transport. The project was carried out by a consortium consisting of Arcadis, Fundación Herencia Ambiental Caribe, JESyCA, and Netics, together with government entities from both Colombia and the Netherlands.

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