CONCEPT

Alternative sediment handling Ghana

Report step 2 – Program of requirements and stakeholder analysis

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Alternative Sediment Handling in Ghana
STEP 2

Title:	Alternative sediment handling Ghana
Project number:	NP.2020.250
Your ref. number:	202004007
Date:	June 12, 2020

SCOPE OF WORK

Step 1	Desk research
Step 2	Program of requirements and stakeholder analysis
Step 3	Technical feasibility
Step 4	Financial feasibility
Step 5	Economic feasibility
Step 6	Financial overview

Alternative Sediment Handling in Ghana
STEP 2

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PROGRAM OF REQUIREMENTS AND STAKEHOLDER ANAYSIS

Based on the information from the desk research, NETICS has drafted a program of requirements and boundary conditions. This is done in the form of a system analysis. A system analysis is a method used to analytically analyse a complex system and to select the useful data for further investigation. The system analysis sets the basis for the feasibility study hereafter.

In addition, a stakeholder analysis is made which will also include the various contacts from NETICS in Accra, Ghana (from the SBIR Phase I project). This analysis also identifies potential business partners / companies to set up the supply chain to process, sell, buy use and transport the building elements as well as a list of potential off-takers. Meetings with RVO, HKV and IMDC are held to select the companies / parties / organisations which are interesting for this study and which we can engage to obtain the answers to the questions as described for the technical, financial and economic feasibility.

Step 2 – Program of requirements & stakeholders
CONTENT

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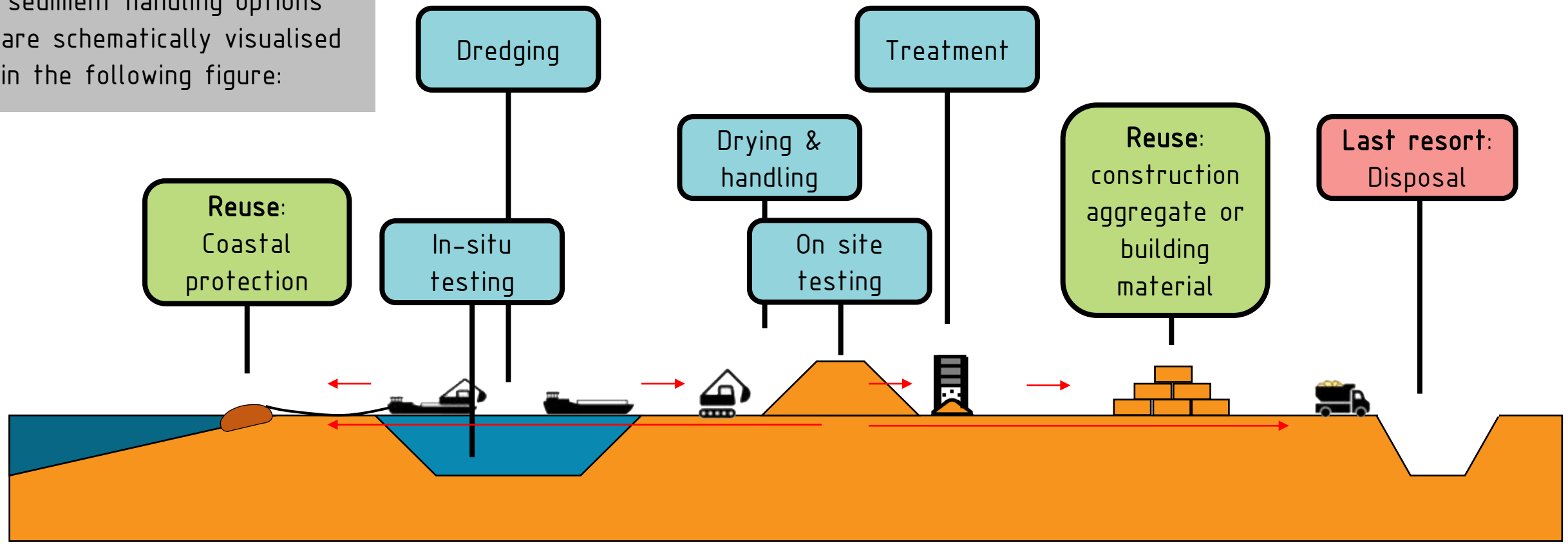
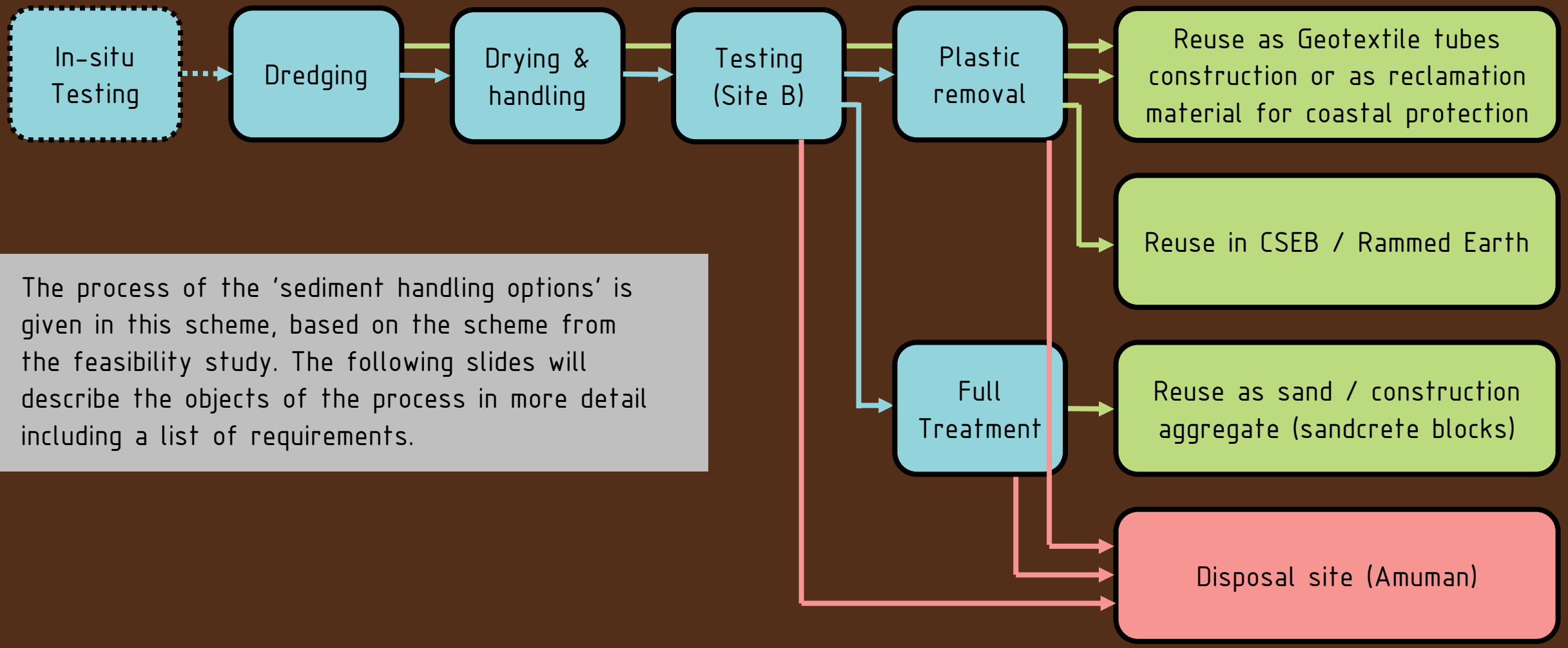
STEP 2 – PROGRAM OF REQUIREMENTS AND STAKEHOLDER ANAYSIS

2.1. Program of requirements
SYSTEM ANALYSIS

The objects of the system 'sediment handling options' are schematically visualised in the following figure:

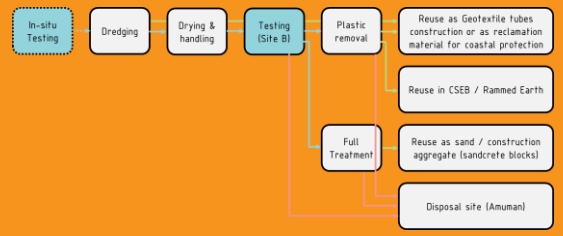


2.1. Program of requirements
SYSTEM ANALYSIS



The process of the 'sediment handling options' is given in this scheme, based on the scheme from the feasibility study. The following slides will describe the objects of the process in more detail including a list of requirements.

2.1. Program of requirements
(IN SITU) TESTING



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In-situ Testing → Dredging → Drying & handling → Testing (Site B) → Plastic removal → Reuse as Geotextile tubes construction or as reclamation material for coastal protection

Plastic removal → Reuse in CSEB / Rammed Earth

Testing (Site B) → Full Treatment → Reuse as sand / construction aggregate (sandcrete blocks)

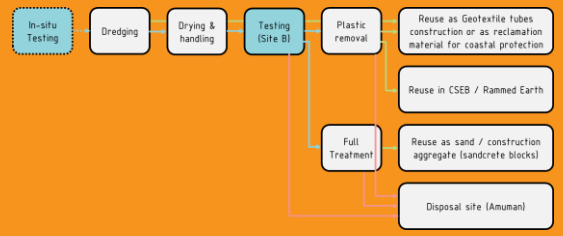
Testing (Site B) → Disposal site (Amuman)

Full Treatment → Disposal site (Amuman)

Plastic removal → Disposal site (Amuman)

Requirements and background information about in-situ testing and testing at Site B (handling site)

2.1. Program of requirements
(IN SITU) TESTING



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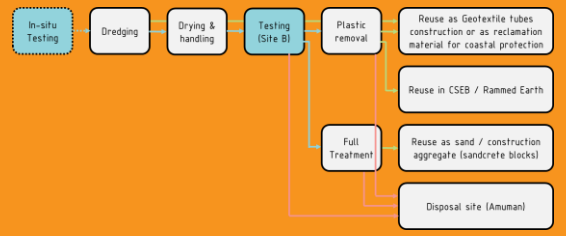
The Odaw sediment has been tested by RHDHV & SAL according to the Dutch Standards for reuse on land. For a complete overview the sediment is also tested with the Dutch Standards for reuse in waterbodies and with another (in Accra well known) international sediment quality guideline: the Australian Sediment Quality Guideline.

2.1. Program of requirements
(IN SITU) TESTING



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Sediment quality guideline values

- Dutch Standard 'Besluit Bodemkwaliteit' (source: https://wetten.overheid.nl)
- Australian Standard 'ANZECC/ARMCANZ' (source: https://www.waterquality.gov.au)

VALUES FOR REUSE **ON LAND**	Dutch Standard	NL All use	NL Housing	NL Industrial use	NL Not suitable for direct reuse
	Australian Standard	AUS No effects	AUS Effects possible	AUS Effects expected	
VALUES FOR REUSE **IN WATER**	Dutch Standard	NL All use	NL Class A	NL Class B	NL Not s...
	Australian Standard	AUS No effects	AUS Effects possible	AUS Effects expected	

Weighed average of five metals: Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb) and Zink (Zn).

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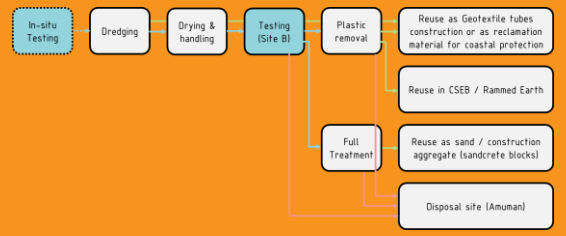

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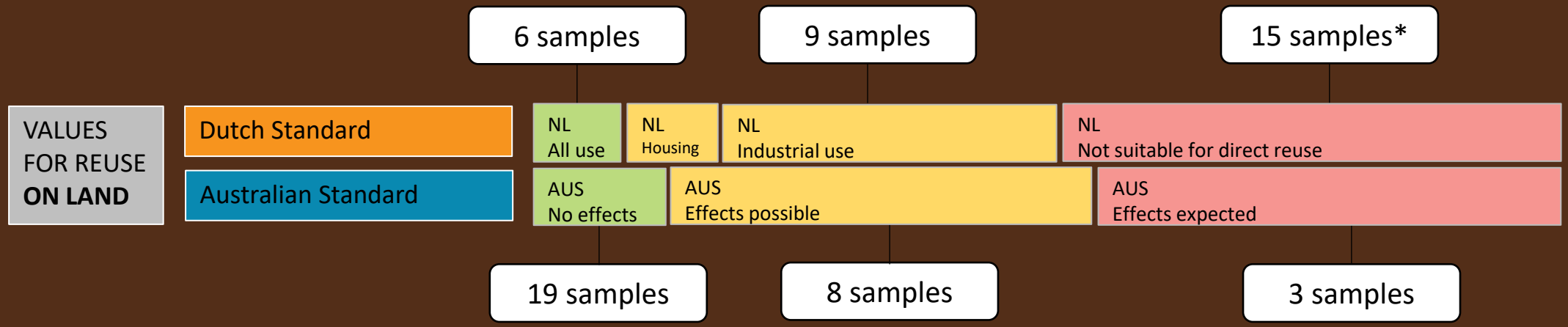
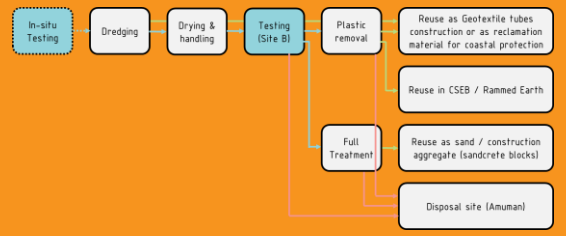
Categorisation of the 30 Odaw samples taken by RHDHV / SAL in relation to the Dutch and Australian standard for reuse on land



*In most cases, the sample is not suitable for direct reuse based on Mineral Oil concentrations (MO) or metals. However, when the sediments are put aside for some time and turned regularly to get air to the soil, but keeping it wet, the mineral oil with disintegrated. Looking at the relatively low concentrations (compared to the Dutch intervention level), after this treatment industrial reuse must be possible.

2.1. Program of requirements (IN SITU) TESTING



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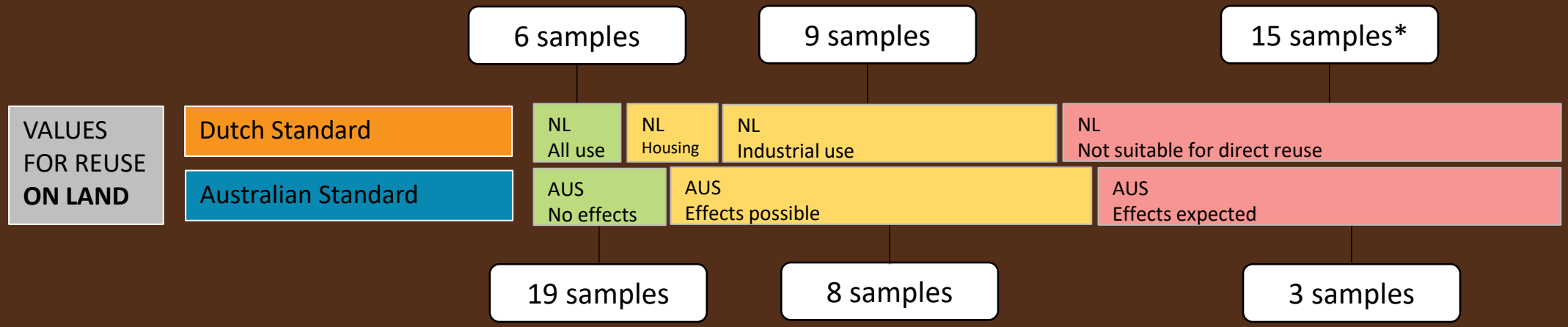
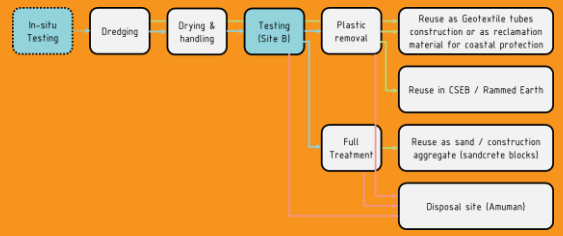


- According to the Dutch standard, some sediment samples are already clean enough for direct reuse (only plastics have to be removed then). Even if this is 20%, you still have a large volume for direct reuse.
- By introducing more testing capacity in the process you can increase your reuse volume significantly.
- According to the Australian standards, even more samples fall within the lower contamination segments.

2.1. Program of requirements
(IN SITU) TESTING



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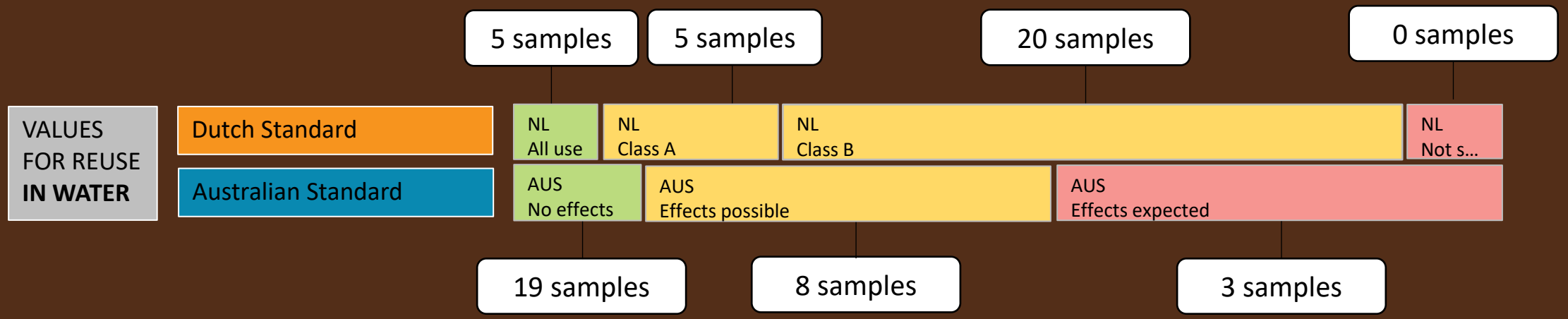
Categorisation of the 30 Odaw samples taken by RHDHV / SAL in relation to the Dutch and Australian standard for reuse in waterbodies



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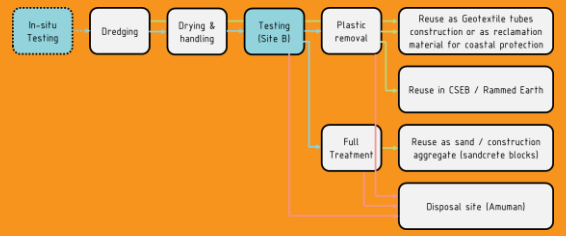
(IN SITU) TESTING



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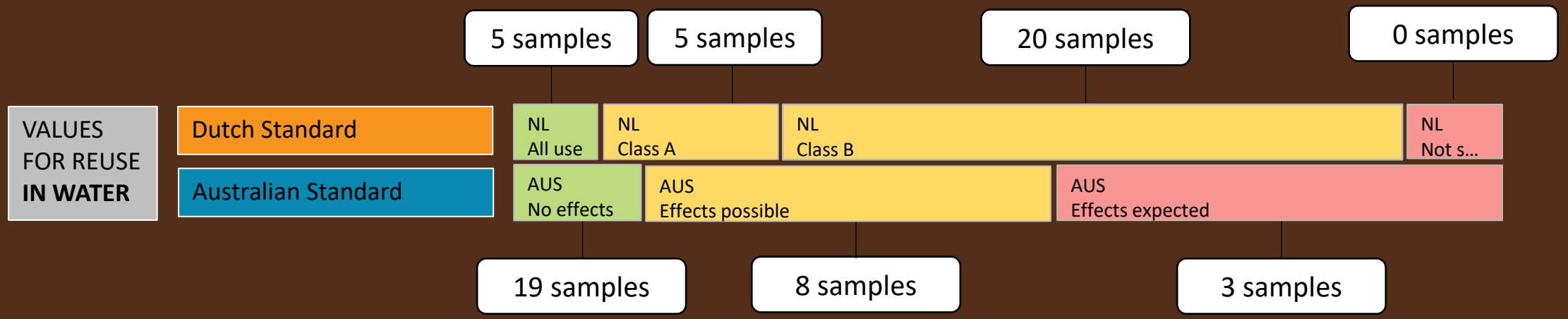
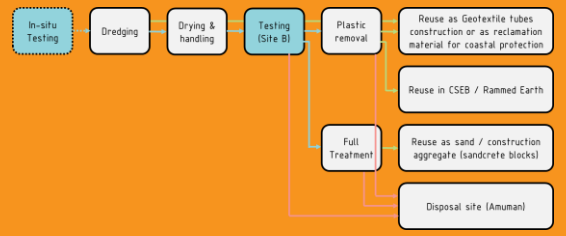


- According to the Dutch Standards, reusing in waterbodies can be possible for all dredged sediments, only **if the dredged sediment is cleaner or of the same class than the receiving soil.**
- Extra testing of the receiving soil should also be included in the reuse process.
- The Australian standards for reuse in waterbodies is similar to reuse on land.

2.1. Program of requirements
(IN SITU) TESTING



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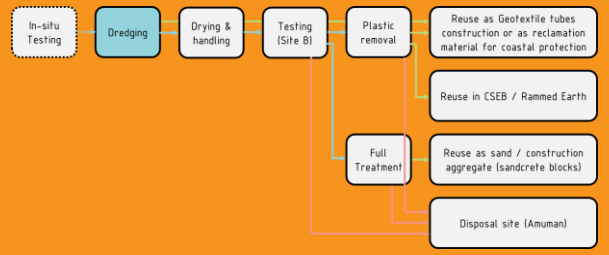
Sediment quality and composition

In-situ testing (prior to the dredging process) can be interesting if you want to use the sediment directly after dredging. For example for filling geotextile tubes for coastal protection. In-situ testing is also interesting for optimizing the throughput at handling site B since there is limited space for sediment treatment and stockpiling.

Testing large quantities of sediment

Testing on land at site B after dredging will increase the reuse capacity. Common practice in the Netherlands for testing at a handling site is testing of several 'lots'. These lots cannot exceed 10,000 tons (around 6000m3). Based on the tests, a lot will receive a certain classification. The requirements further specified in the Dutch Besluit Bodemkwaliteit: *https://wetten.overheid.nl*

2.1. Program of requirements
DREDGING



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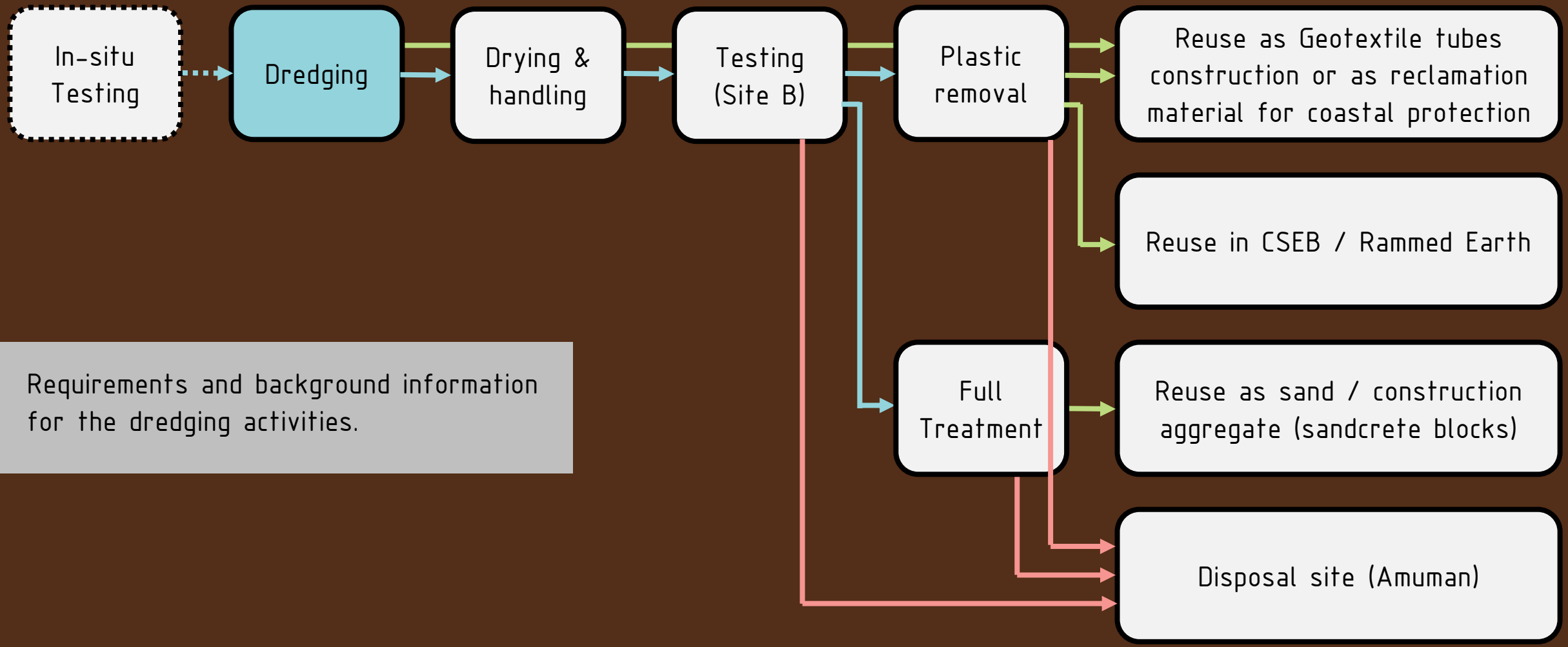
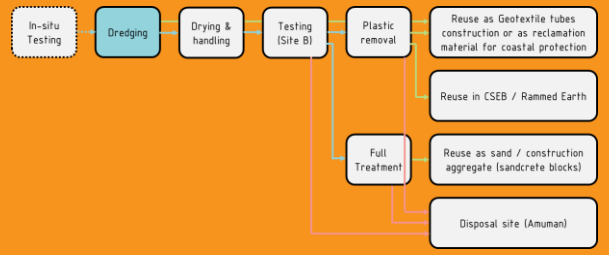


Requirements and background information for the dredging activities.

2.1. Program of requirements
DREDGING



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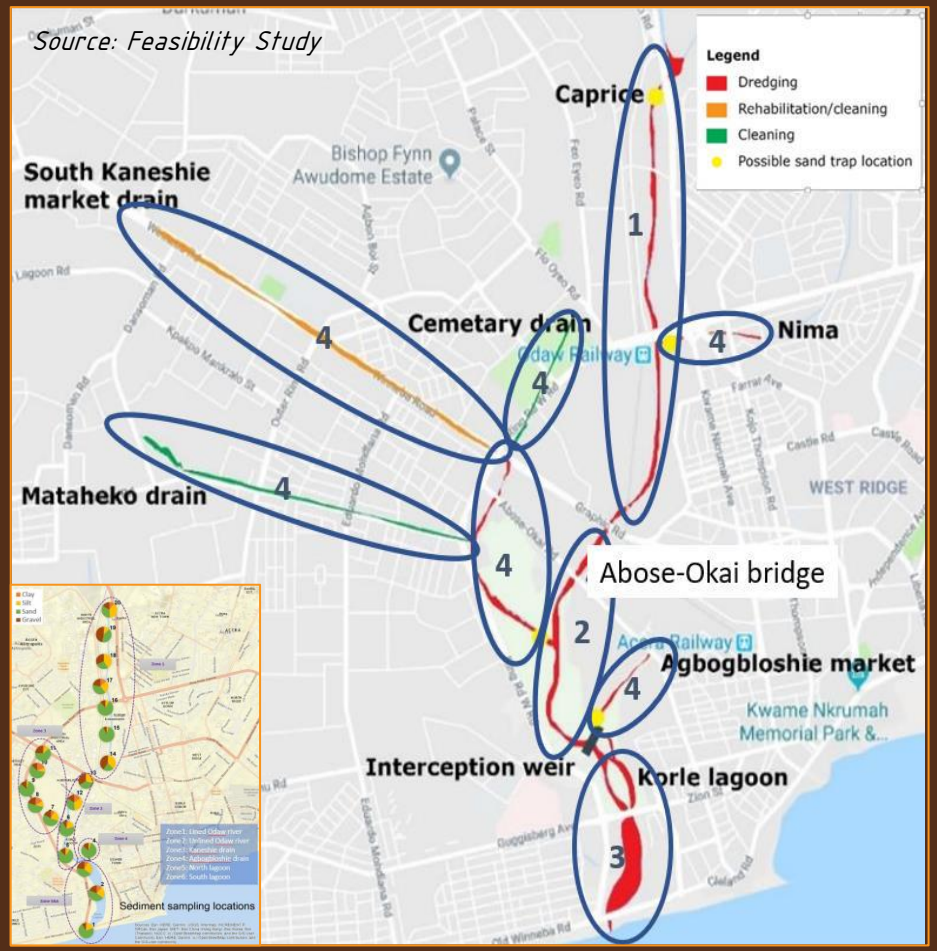
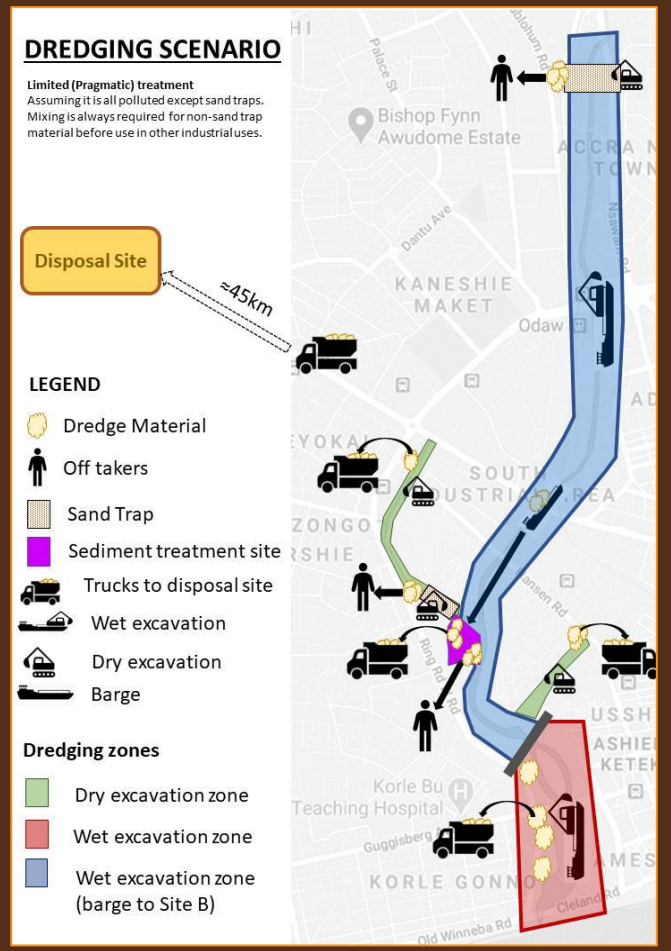


Dredging locations



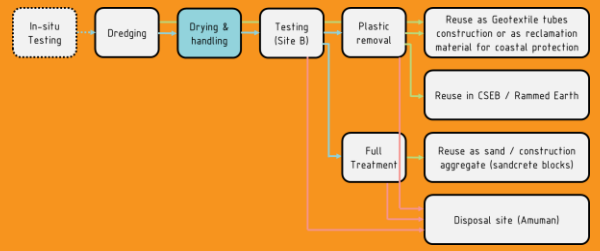
Dredging scenario

The requirements for the dredging activities are given in the feasibility study. Dredging is divided in several locations, in maintenance dredging and deffered dredging and in dry excavation and wet excavation.

General sediment composition

- 20% gravel
- 55% sand
- 25% silt and clay

2.1. Program of requirements
DRYING & HANDLING



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Plastic removal → Reuse in CSEB / Rammed Earth

Testing (Site B) → Full Treatment → Reuse as sand / construction aggregate (sandcrete blocks)

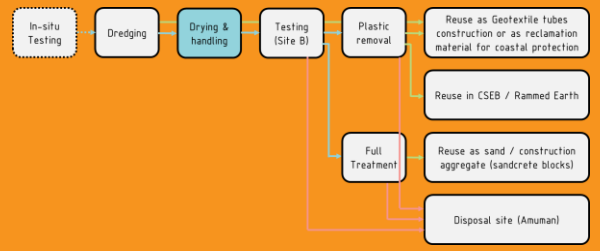
Testing (Site B) → Disposal site (Amuman)

Plastic removal → Disposal site (Amuman)

Full Treatment → Disposal site (Amuman)

Requirements and background information for drying & handling of the sediment at Site B (handling site)

2.1. Program of requirements
DRYING & HANDLING



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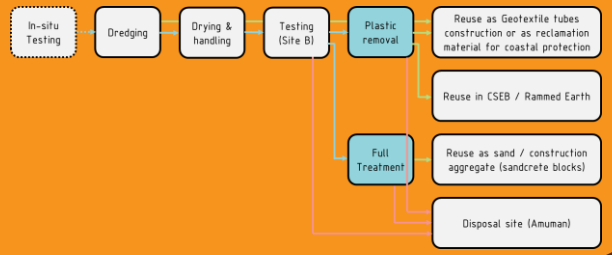
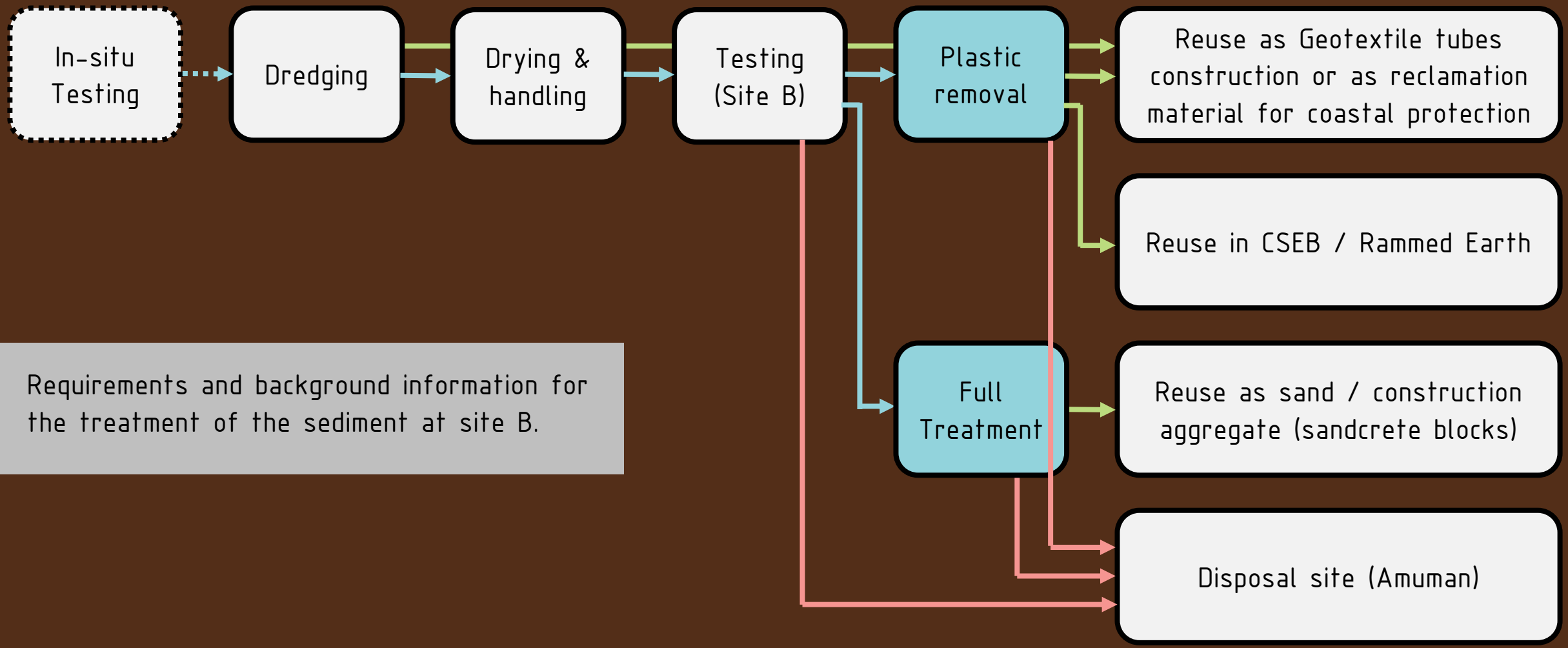
Source: Feasibility Study

Drying and handling will be carried out at **Site B.** Site B is a sediment handling site situated on the western bank of the Odaw and managed by the contractor. According to the feasibility study is recommended to clear all of Site B to allow more room for sediment handling and more flexibility. The area is currently around 14 hectares (140,000 m2). Based on the site visit it is assumed that 50% of this site is currently occupied by DML, and that the material is stacked 5 m high. Furthermore, the remaining 50% is assumed to be capped. This results in an available storage volume of **350,000m^3 + 105,000m^3**. Source: Feasibility study.

2.1. Program of requirements
TREATMENT

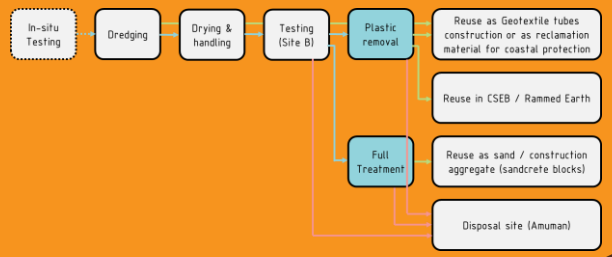


THE SEDIMENT ENGINEERS



Requirements and background information for the treatment of the sediment at site B.

2.1. Program of requirements
TREATMENT



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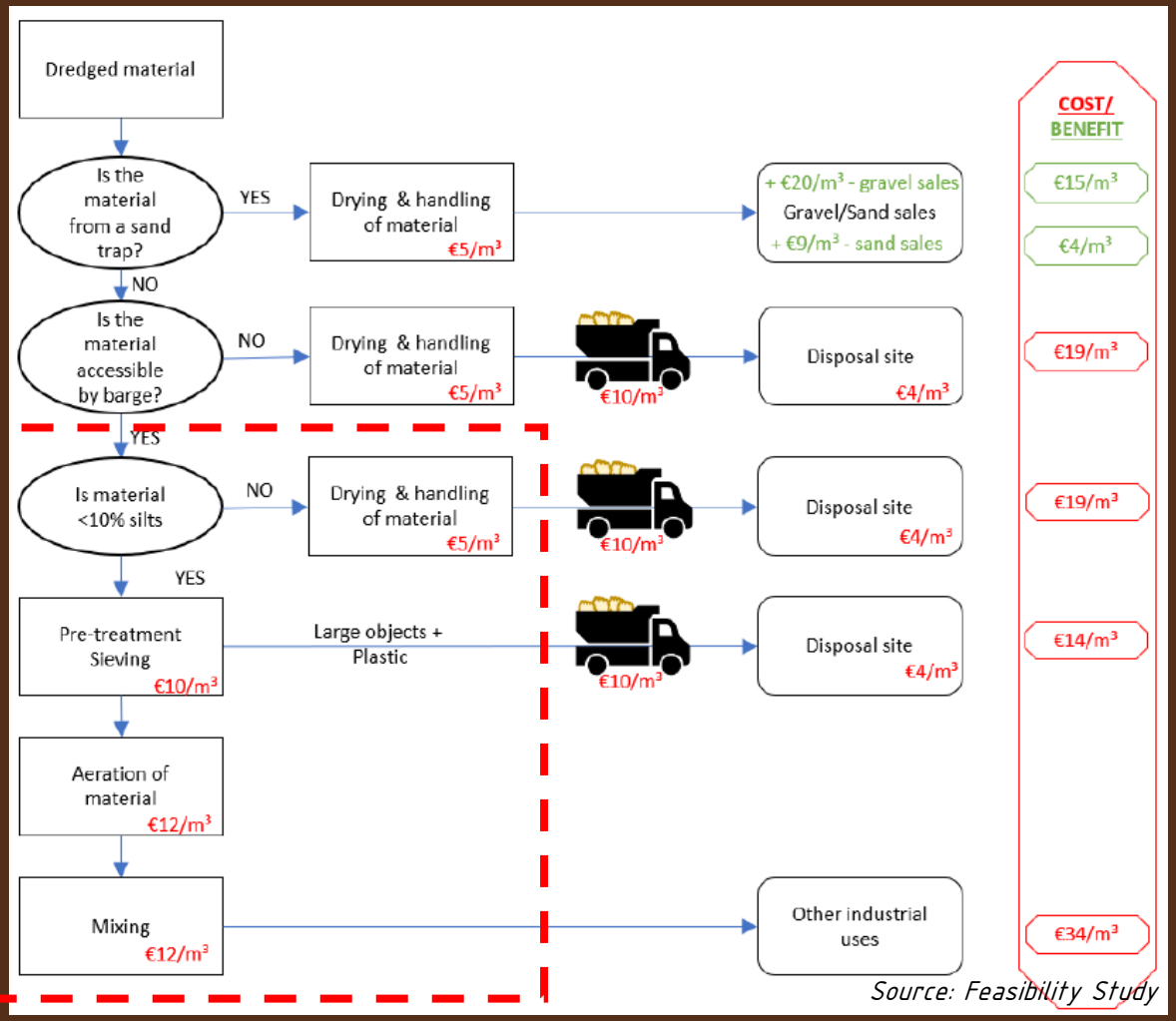
The required treatment steps to clean the sediment for reuse are described in the feasibility study including the costs per step. Two treatment process are described: The full reuse treatment option and the limited (pragmatic) treatment option. In this study the treatment options are assessed by NETICS and Royal IHC in more detail, also in collaboration with IMDC.

Treatment steps and costs according to the feasibility study:

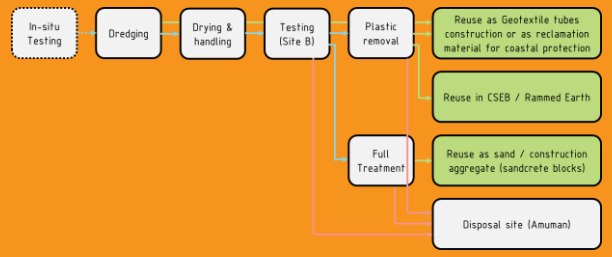
Drying (€5/m³.)
Spreading and aeration (€12/m³.)
Removal of plastics (€10/m³.)
Mixing (€12/m³.)
Gr. Separation (€25/m³.)
Disposal fee (€4/m³.)



Source: Feasibility Study

Sequence of activities of the pragmatic treatment methodology

2.1. Program of requirements
REUSE OPTIONS



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In-situ Testing

Dredging

Drying & handling

Testing (Site B)

Plastic removal

Reuse as Geotextile tubes construction or as reclamation material for coastal protection

Reuse in CSEB / Rammed Earth

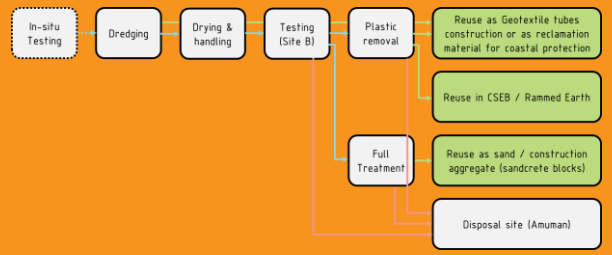
Full Treatment

Reuse as sand / construction aggregate (sandcrete blocks)

Disposal site (Amuman)

Requirements and background information for the reuse options of the sediment after treatment.

2.1. Program of requirements
REUSE OPTIONS



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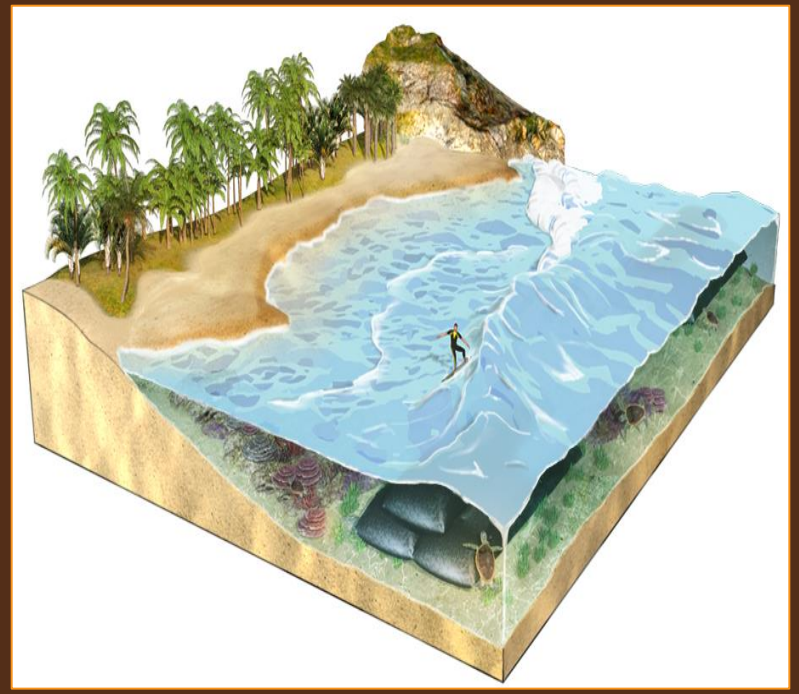
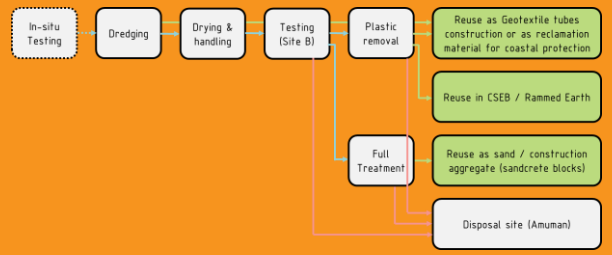
As **sand / construction aggregate** (for example for sandcrete blocks)

In **geotextile tubes** or as **reclamation material** for coastal protection



In **compressed stabilized earth blocks** (CSEB) or **rammed earth**

2.1. Program of requirements
REUSE OPTIONS



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As **sand / construction aggregate** (for example for sandcrete blocks)

Requirements for sand / construction aggregate

Building materials will have to conform to the Ghana Standards Authority (GSA) specifications. The Civil Department of the GSA could test the sediment before it is used to manufacture construction materials if needed.

The Ghana Standard for building materials are:

- Sandcrete blocks: GS 189:2000 (old)
- Sandcrete blocks: **GS 297-1:2010 (new)**
- Concrete Pipe Culverts: BS 5911-3:2010
- Concrete kerb units: BS EN 1340:2003

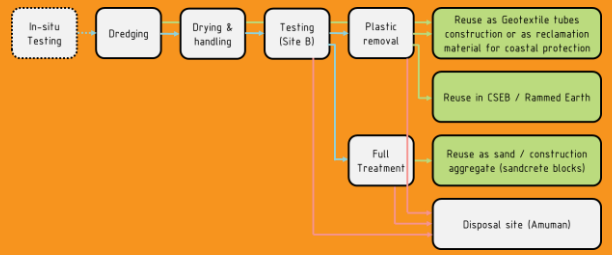
Physical requirements
Fines < 10% (<150µm)
Fine sand < 30% (<300 µm)
Gravel < 10% (>5mm)

Physical requirements for the use in concrete:

"Effect of Silt Fines on the Durability Properties of Concrete", S. Cho (2013)
Fines < 5% (<63µm = silt & clay)

If the construction materials are used for road construction, then the materials have to be tested further at the Ghana Highway Authority Lab.

2.1. Program of requirements
REUSE OPTIONS



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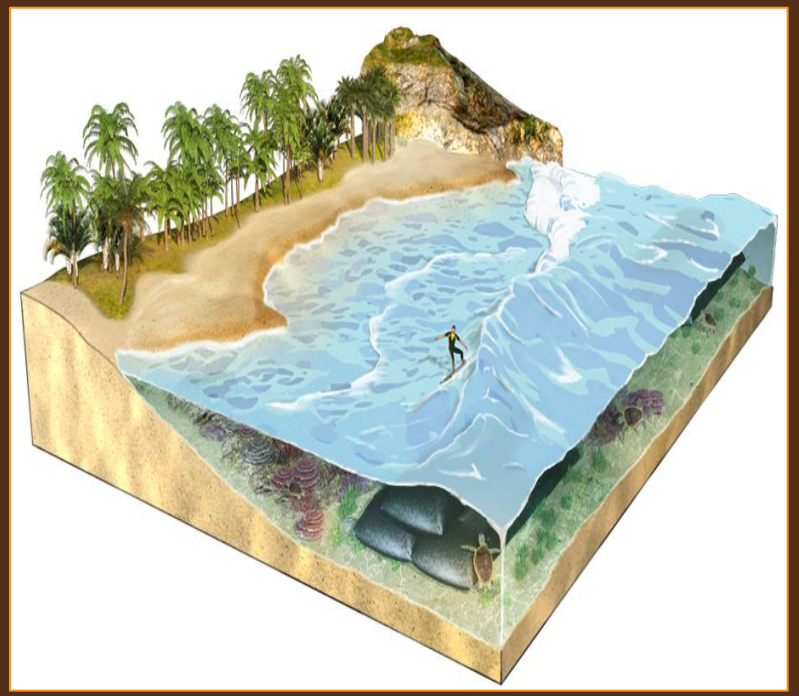
In **geotextile tubes** or as **reclamation material** for coastal protection



Physical requirements

Mechanical dredging: no gravel (> 20mm)

Hydraulical dredging: no gravel (> 20mm) & no fines (<63µm = silt & clay)

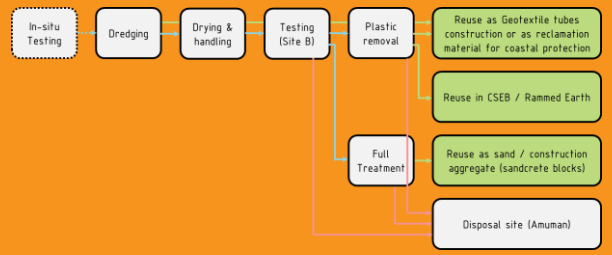
Hydraulical dredging with flocculants: no gravel (> 20mm)

Chemical requirements:

Dredged sediment should be cleaner or of the same class as the receiving soil.

According to the Dutch standards maximum industrial class sediment.

2.1. Program of requirements
REUSE OPTIONS



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In **compressed stabilized earth blocks** (CSEB) or **rammed earth**

Physical requirements

ARS174: No gravel > 20mm

"Modern earth building codes, standards and normative development", H. Schroeder (2012).

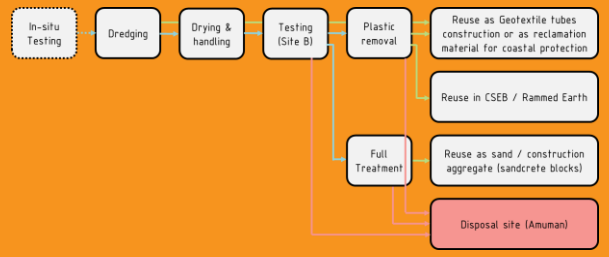
Clay 5-20%

Sand + fine gravel 50-90%

Chemical requirements:

N/A

2.1. Program of requirements
DISPOSAL



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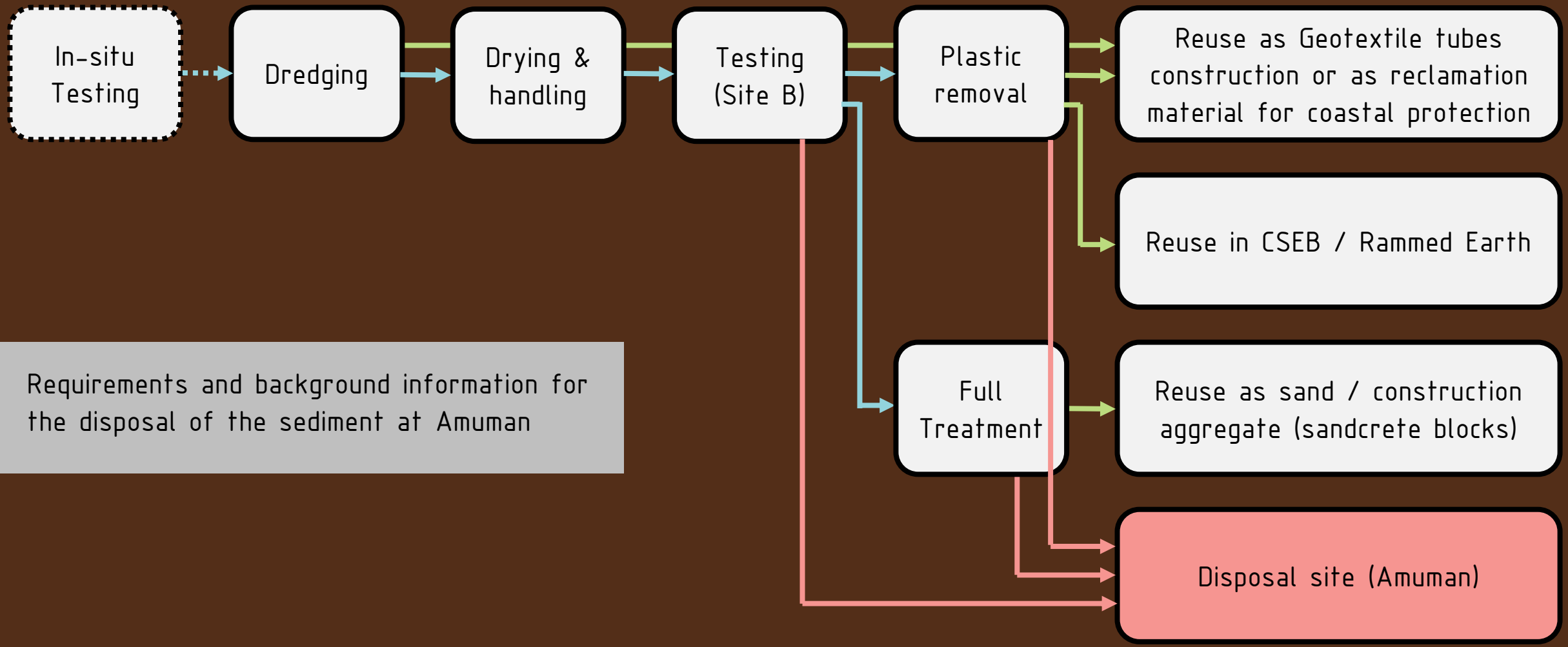
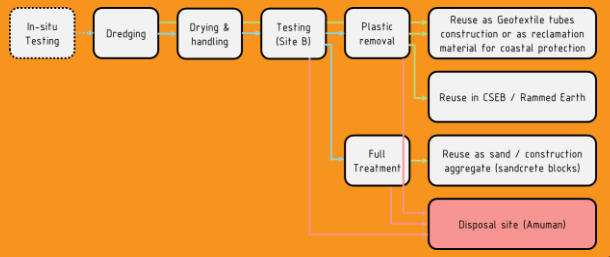


Requirements and background information for the disposal of the sediment at Amuman

2.1. Program of requirements
DISPOSAL



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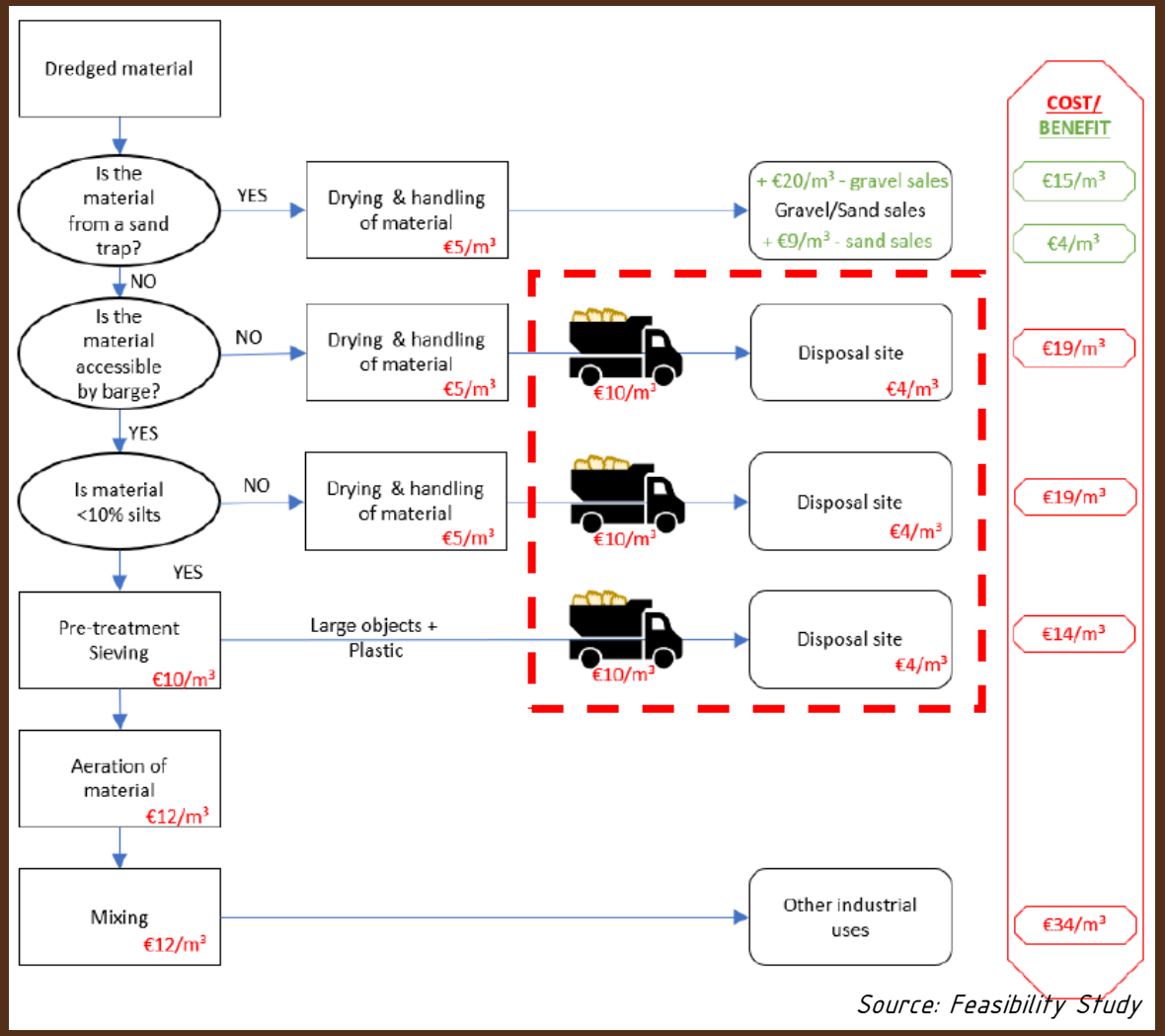
The material which cannot be reused has to be brought (as a last resort) to the disposal site called 'Amuman'. Amuman is managed by the ministry. It is located around 45 km away from the Odaw basin and has a capacity of 4 M m^3 which is enough for around 20 years of dredging.

Requirements

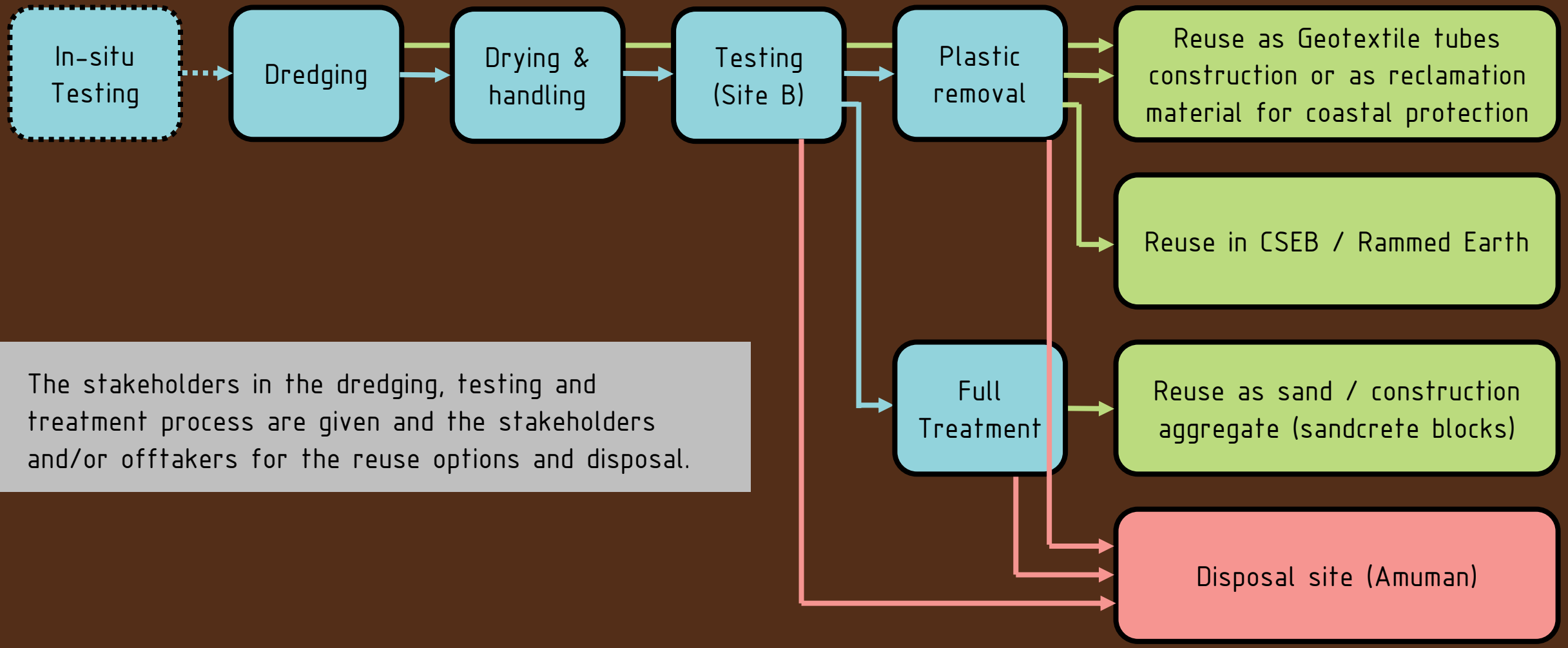
Disposal of the sediments and the effluents have to be in agreement with the guidelines of the Environmental Protection Agency (EPA) as described in the ESIA. Such as:

- Hazardous and Electronic Waste control and Management Act
- Environmental Protection Agency Act
- National Effluent Quality Guidelines



Source: Feasibility Study

2.2. Stakeholder analysis
STAKEHOLDERS IN THE PROCESS



The stakeholders in the dredging, testing and treatment process are given and the stakeholders and/or offtakers for the reuse options and disposal.

2.2. Stakeholder analysis
STAKEHOLDERS IN THE PROCESS

Stakeholders in the dredging, testing and treatment process

	In-situ Testing	Dredging	Drying & handling	Testing (Site B)	Treatment
Contractor	x	x	x	x	x
Local consultant / laboratory	x			x	
Environmental Protection Agency	x	x	x	x	x
Other Govermental intstitutions	x	x	x	x	x
Landowner			x		
Entrepreneurs or subcontractors					x

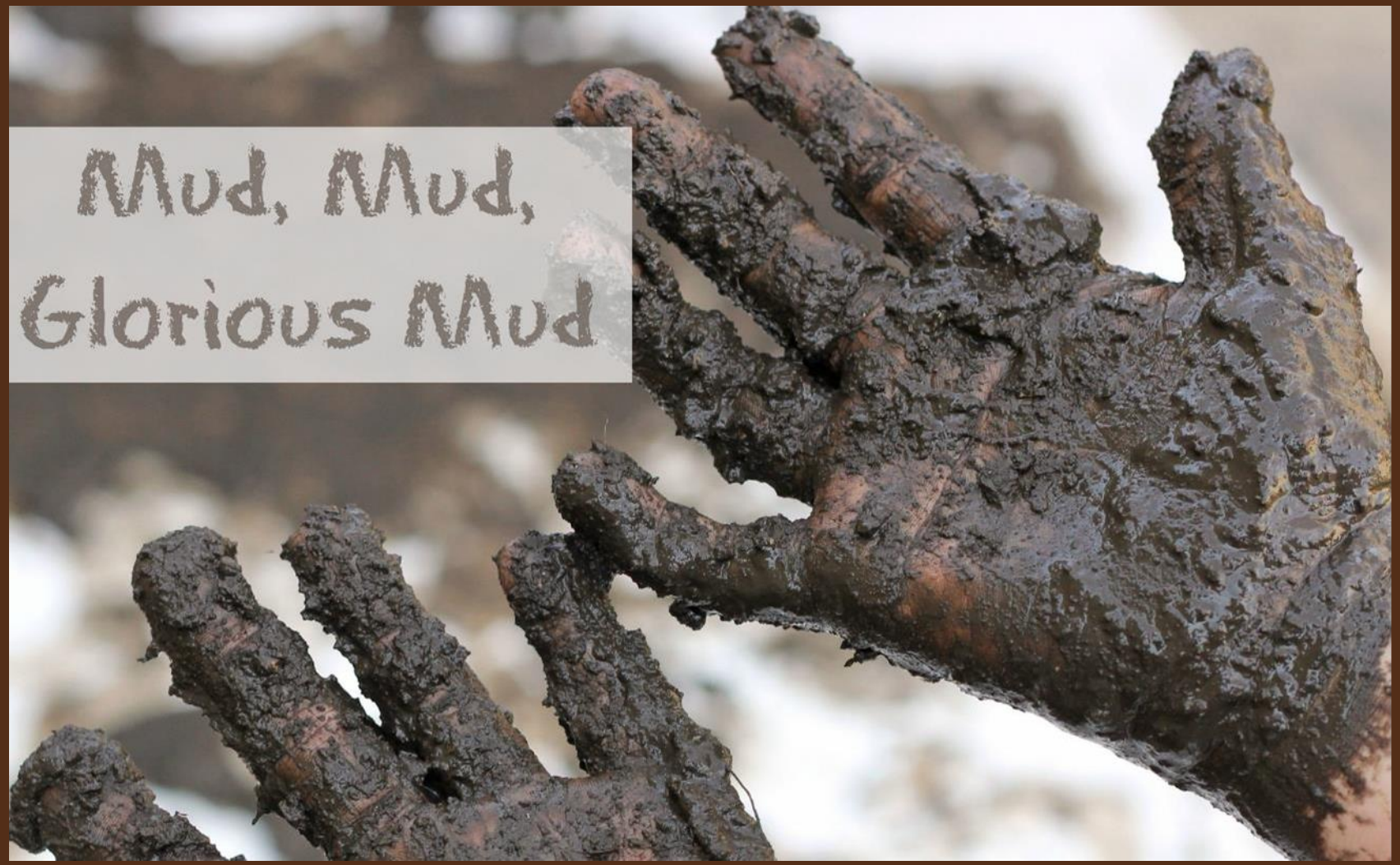
x = stakeholder

2.2. Stakeholder analysis
STAKEHOLDERS IN THE PROCESS

Stakeholders and/or off-takers for the reuse options and disposal.

	Coastal protection	CSEB / Rammed Earth	Sand / aggregate	Disposal
Contractor	x	x	x	x
Engineering company	x			
Construction companies		x / o	x / o	
Local consultant / laboratory	x			
Environmental Protection Agency	x	x	x	x
Ghana Standard Authority		x	x	
Ministry of Works and Housing	x / o			x
World Bank	x / o			
Private owners	x / o			

x = stakeholder o = off-taker



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