

# Assessment of Options and Opportunities for Riverine Waste Collection Technologies in Southeast Asia

*Development of a Decision Support Framework (DSF)*

Klaus Sattler, World Bank

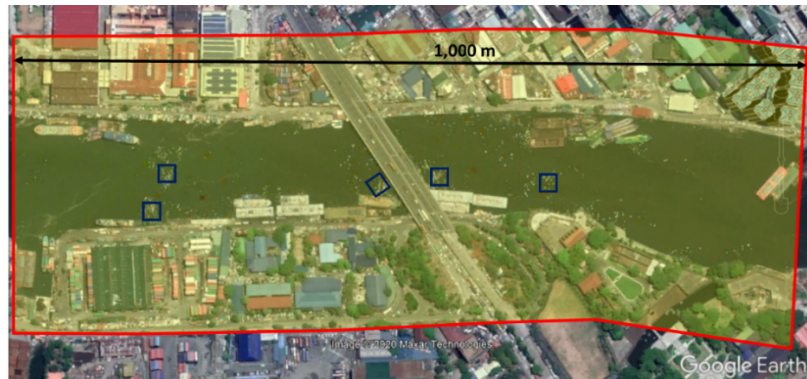
# Context of WB plastics engagement

- World Bank has a global commitment to reduce plastics pollution. More than 60 engagements in all regions. **FY21 marine plastics portfolio surpassed \$5 billion**, supporting investments and policy reforms on circular economy.
- **PROBLUE**, a multi-donor trust fund that focuses on marine plastic pollution, has committed more than US\$40 million as of March 2022.
- Key purpose of activities: **preventing land-based and marine sources of plastic pollution**
- The World Bank is **working with multiple countries in Southeast Asia** as well as with the **ASEAN secretariat** on reducing the amount of plastic waste leakage
- Analytical work on **key sources, amounts and types of plastic waste leaking into waters**
- Advisory services to **inform the development of policies and investments; the development of plastic action plans and policy options** aiming to reduce plastic waste
- Financing of **environmental and waste management projects** including activities on reducing plastics pollution

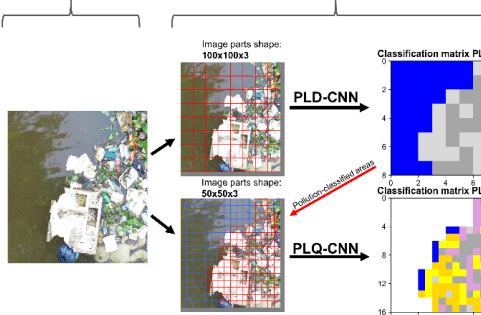
# Example: Plastics pollution diagnostics

## Identification of priority plastics and pollution hotspots

Innovative approaches based on remote sensing with automated detection and analysis of plastics (drones along riverbeds and beaches; cameras on bridges; machine-learning based automated analysis)



(a) Input image



(c) Altitude corrected counts of class areas

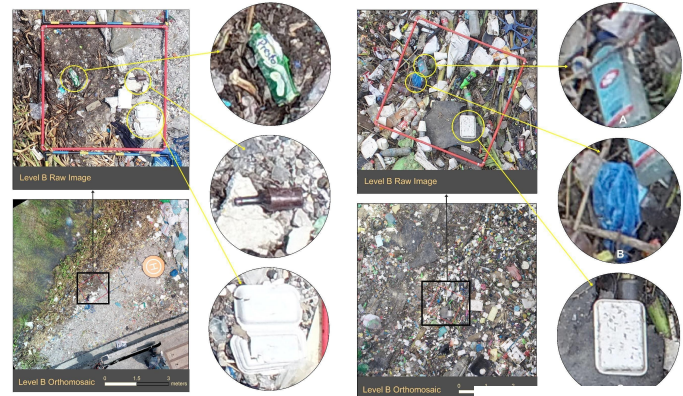
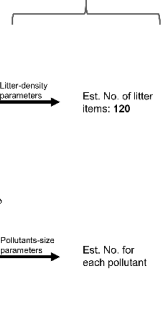
Estimated areas and pollution items; PLD-CNN

Water	462
Vegetation	3
Sand	0
Litter - high	21
Litter - low	33
Other	0

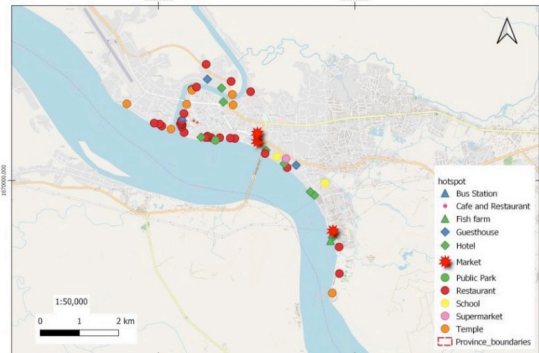
Estimated item areas for specific classes; PLQ-CNN

Carton	0
Plastic bag - large	1
Plastic bag - small	60
Plastic bottles	99
Plastic bowls	0
Plastic cups	0
Plastic plates	45
Polystyrene packaging	37
Styrofoam	0
Styrod and cord	0
Styrofoam	45
Yoghurt	12
Vegetation	3
Sand	0
Other	0

(d) Assessment of class-object counts



Hotspot map of Parkse City, Champasak Province, Lao PDR



# Context of Decision Support Framework on Riverine Plastic Collection Technologies

- To overcome the problem of marine plastic pollution, an **integrated approach is required**, aiming at the reduction of (single-use) plastics; the improvement of plastic waste collection; the increase of re-use and recycling; and others.
- **Investments throughout the whole plastic value** chain are needed. The **ASEAN Regional Action Plan for Combating Marine Debris**, includes (i) Reduce inputs in the system; (ii) Enhance collection and minimize leakage; (iii) Create value for waste reuse
- Current estimations show **over 2 tons of plastic waste are leaking into the oceans every minute, requiring quick actions**. Land-based sources account for approximately 80% of marine plastic debris.
- **Technologies for collection of plastics from waterways** can play a key role in significantly reducing the amount of marine plastics within a very short time.
- This **Decision Support Framework (DSF)** has been developed to support governments in identifying effective riverine waste collection technologies based on location specific characteristics and conditions
- The technologies in the DSF's database are selected based on conditions in Southeast Asian countries. **As such the DSF assists users in taking informed action and investments on plastic waste collection** for their most polluted rivers.

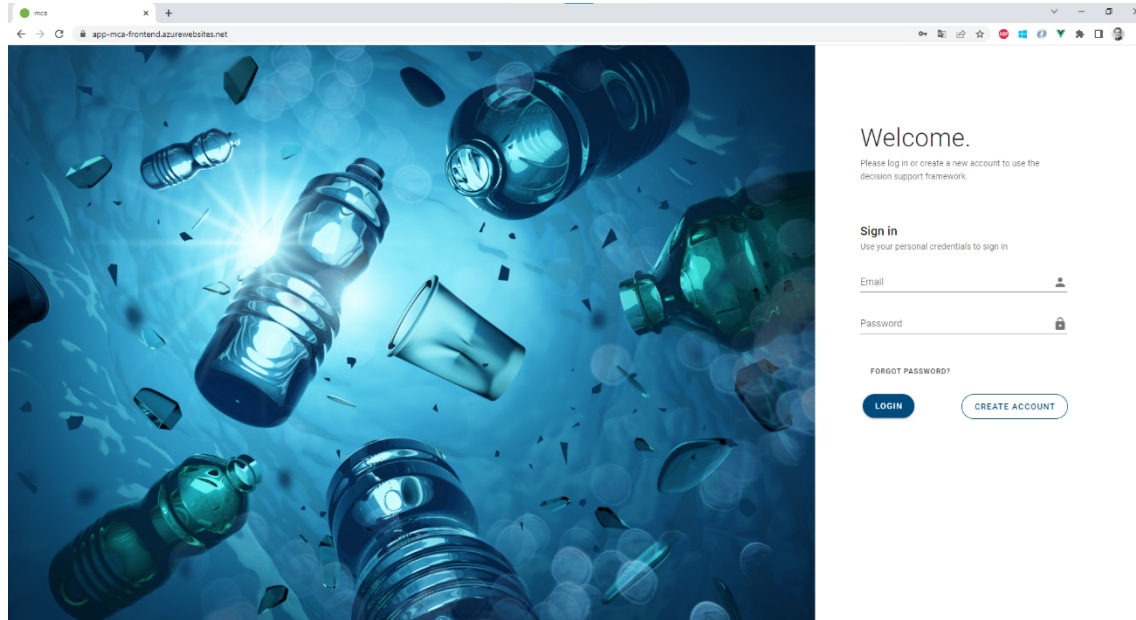
# Purpose of the DSF

- Based on results from plastic diagnostics on plastic pollution and hotspots
- The DSF aims to assist government agencies to identify potentially suitable riverine waste collection systems for their specific river location.
- The DSF is a web-based information tool that hosts a database with the details of ~90 riverine waste collection technologies that can be filtered on specific selection criteria
- Information on the suitable technologies are made available through a user friendly user interface.
- Report with detailed information and user manual available on webs



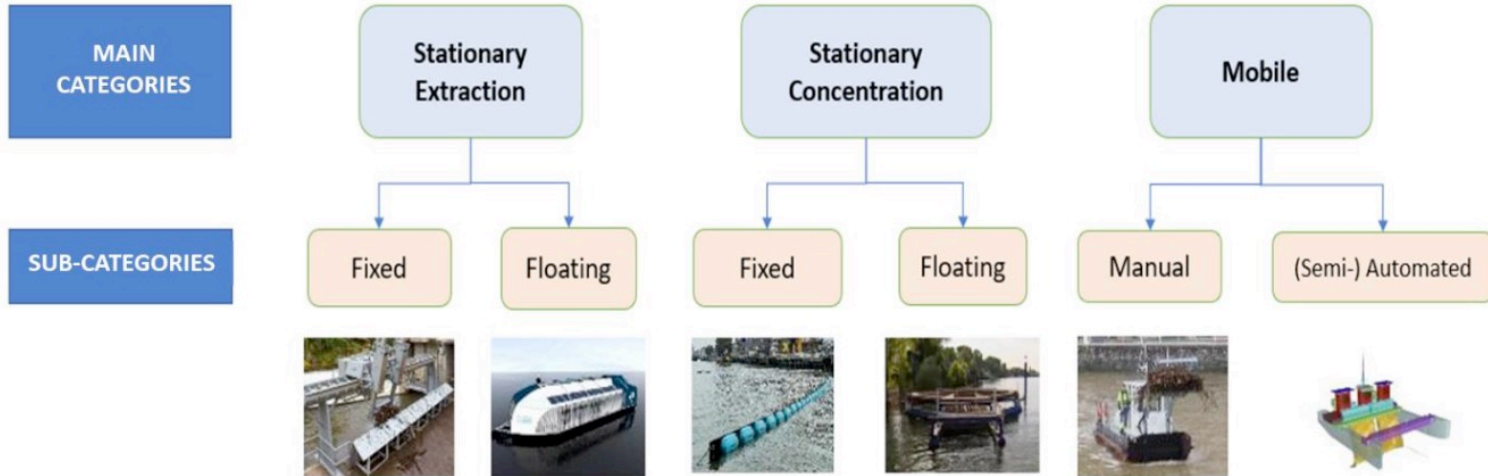
# Access to the Decision Support Framework

- The system is World Bank-funded, free to use and publicly accessible for everyone through: <https://riverine-plastic-waste-collection-technology.com/>

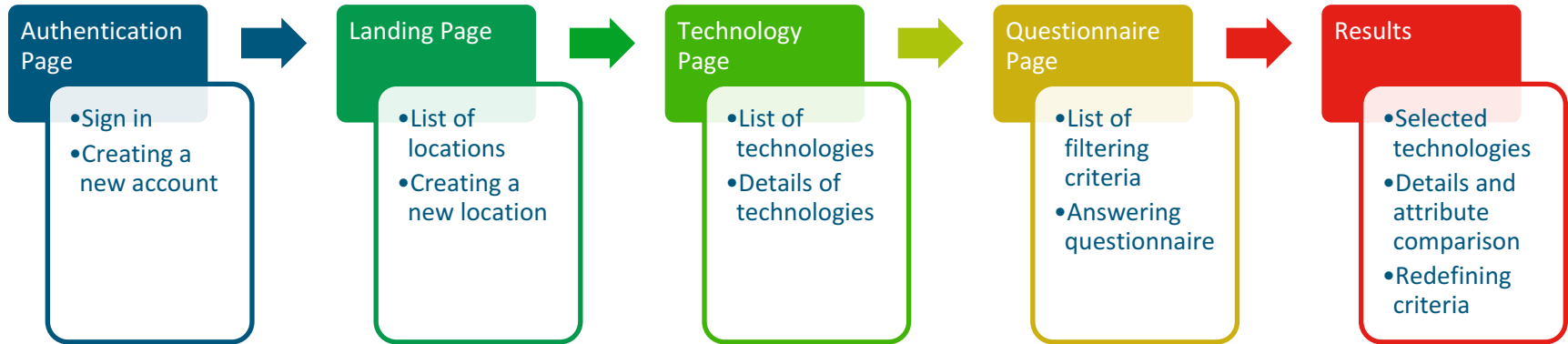


# Categories of collection systems

- ~90 technologies are currently included in the supplier database
- These technologies passed a Technological Readiness Level (TRL) equal or above 7, and are relevant for riverine river systems in Southeast Asia.



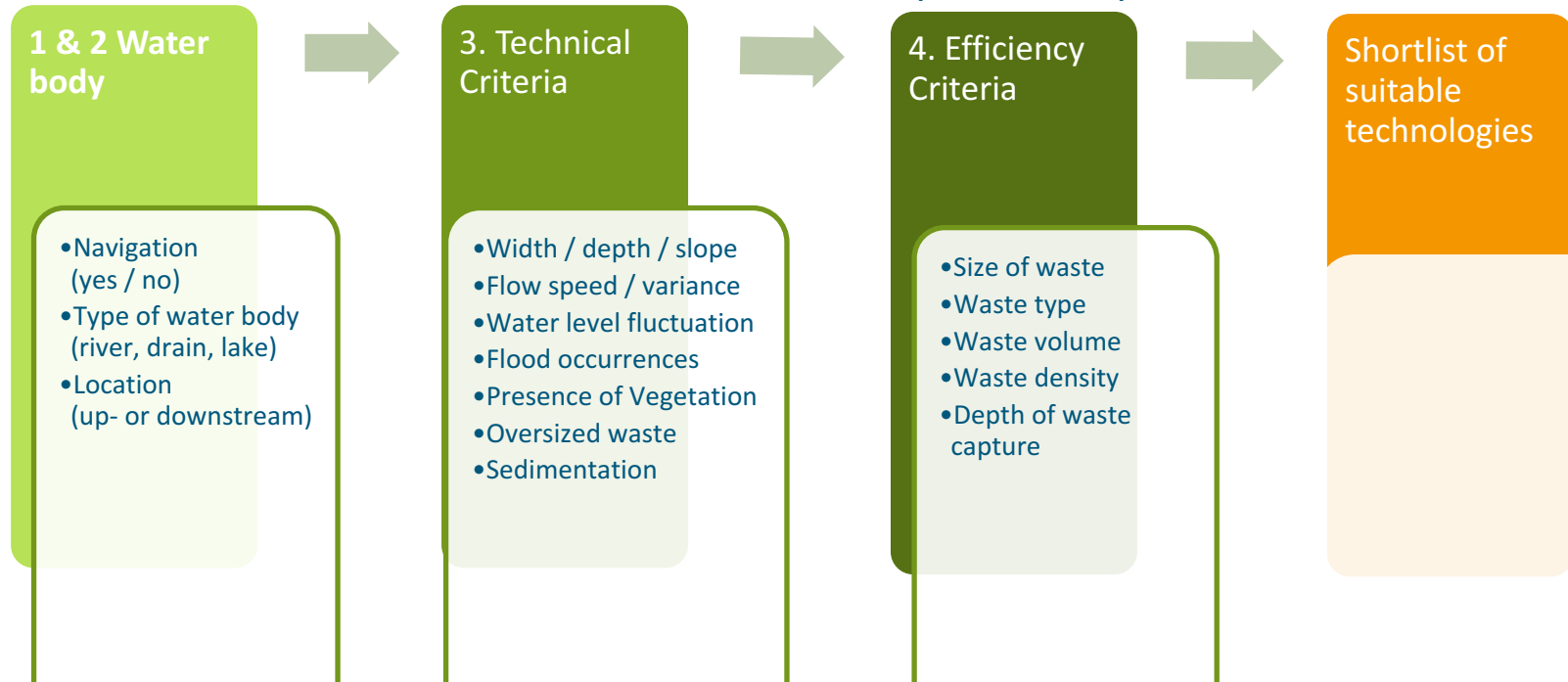
# Demo Flowchart





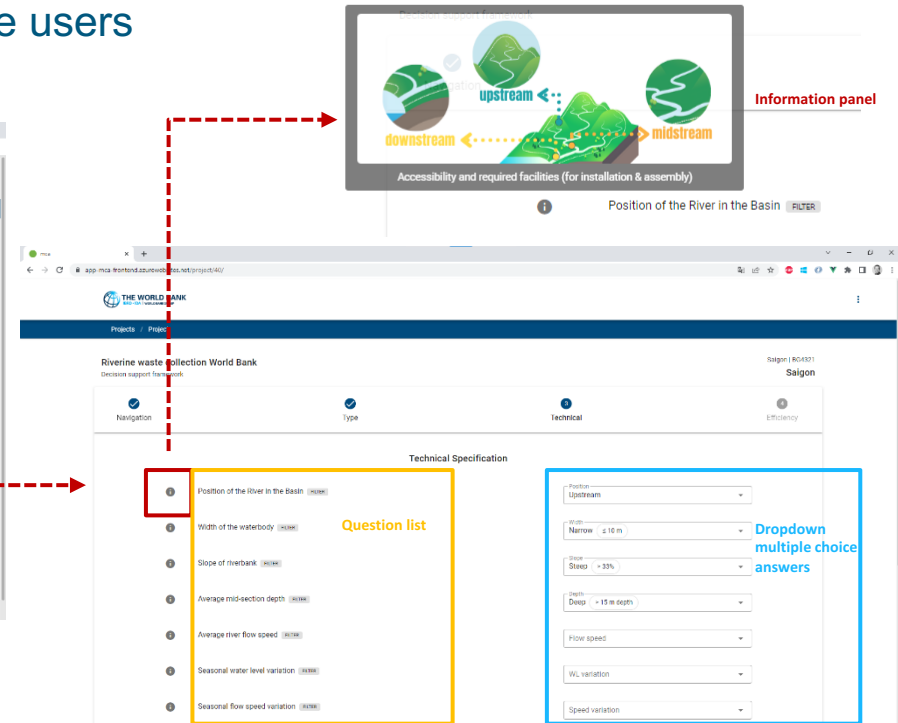
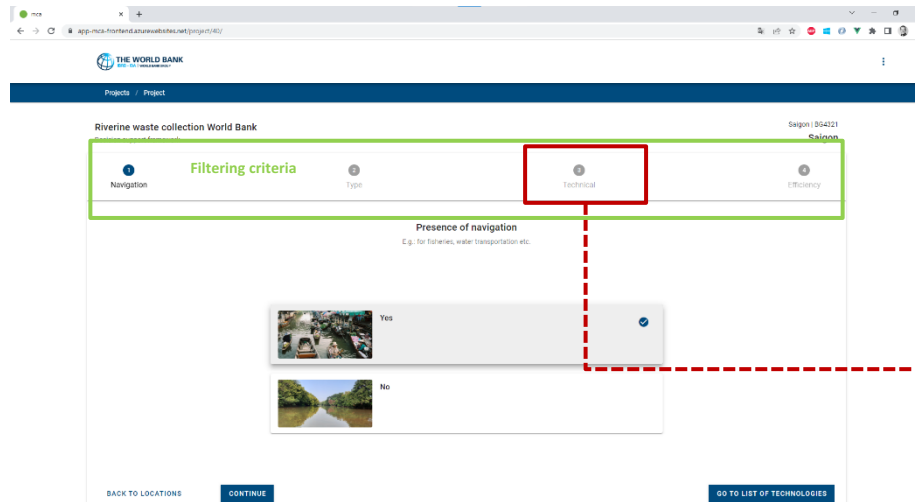
# Selection of Technologies

- Riverine waste collection technologies are filtered based on selection criteria that are grouped under 1. water body, 2. technical and 3. efficiency criteria.
- The criteria were selected based on a) a literature review, b) the outcome of the country surveys in Southeast Asia and c) the consultant's previous experience.



# Questionnaire Page

- When selecting a location, the users will be directed to the questionnaire
- There the filtering criteria can be filled by answering the questions
- Information buttons are available to guide the users



# List of technologies

- The full list of technologies is being displayed and sorted based on their suitability for the user's selections.
- The user selections are visible in the side bar and can be changed to quickly re-filter the full list

The screenshot shows a 'Results questionnaire' sidebar with various filter options. A red box highlights the 'Results questionnaire' header and a 'RE-ENTER QUESTIONNAIRE' button. A red arrow points to a 'Back to questionnaire page' link. A green box highlights the 'Flow speed' filter, which is currently set to 'Shallow < 1.0 m depth'. A yellow box highlights the 'Sedimentation' filter, which is currently set to 'Low'. The sidebar also includes filters for 'Presence of navigation', 'Type of waterbodies', 'Technical specification', 'Flooding', 'Rough weather', and 'Vegetation'.

User requirements panel

The screenshot shows a list of technologies with a navigation bar at the top. The navigation bar includes a search icon, a page indicator (1, 2, 3, ..., 16, 17, 18), and a refresh icon. A blue banner at the top of the list states: 'There are 89 technologies of which 4 are suitable for your defined conditions. Please scroll to view the other options.' The list includes the following technologies:

- Debris Removal Screen** (FIES / Floating extraction system): Navigation, Type, Position, Width. Suitable for Canal/Drain, River/Stream, Midstream, Downstream, Intermediate, Wide.
- TrashWheel** (FIES / Floating extraction system): Navigation, Type, Position, Width. Suitable for Canal/Drain, River/Stream, Midstream, Downstream, Intermediate, Wide.
- RISE A/S** (FIES / Floating extraction system): Navigation, Type, Position, Width. Suitable for Canal/Drain, River/Stream, Midstream, Downstream, Intermediate, Wide.
- Interceptor** (FIES / Floating extraction system): Navigation, Type, Position, Width. Suitable for Canal/Drain, River/Stream, Midstream, Downstream, Intermediate, Wide.


A yellow banner at the bottom of the list states: 'The variants below this line are not suitable for the defined criteria.'

# Technology page

- List of available riverine waste extraction technologies in the database
- Details of technologies, including: name, picture, type, description, technology attributes, and supplier contact.

< 1 2 3 ... 16 17 18 >


There are 89 technologies of which 89 are suitable for your defined conditions. Please scroll to view the other options.



**Trash Skimmer HD (variants 40, 60, 100, 150)**  
 MAC / Mobile (semi) auto collection system

Presence of navigation  
 Navigation  Yes  No


Type of waterbodies  
 Type  Canal / Drain  River / Stream  Open Water



**Kvichak/MARCO Filterbelt Boat**  
 MMC / Mobile manual collection system

Presence of navigation  
 Navigation  Yes  No


Type of waterbodies  
 Type  Canal / Drain  River / Stream  Open Water



**Walker**  
 FxCS / Fixed concentration system

Presence of navigation  
 Navigation  No

Type of waterbodies  
 Type  Canal / Drain  River / Stream




**Barrages Flottants**  
 FICS / Floating concentration system

Presence of navigation  
 Navigation  Yes  No

Type of waterbodies  
 Type  Canal / Drain  River / Stream  Open Water

**Barrages Flottants**  
 FICS / Floating concentration system

**Name, type, and image**



**Supplier contact**

SIAP  
 01 4775 4475  
<https://www.siap.fr/>

**Description**  
 Basic: waste collection basket, all floating extraction by docking boat with conveyor belt. To capture the waste that drifts along the water, consisting of two superimposed grids, they are laid out in such a way as to hide the waste.

**Description**

**Technology attributes**

Criterion	Selections technologies	Selections user
Presence of navigation	<input type="radio"/> Yes <input type="radio"/> No	
Type of waterbodies	<input type="radio"/> Canal / Drain <input type="radio"/> River / Stream <input type="radio"/> Open Water	
Technical Specification	<input type="radio"/> Upstream <input type="radio"/> Midstream <input type="radio"/> Downstream <input type="radio"/> Intermediate <input type="radio"/> None <input type="radio"/> Gentle <input type="radio"/> S&D <input type="radio"/> Shallow <input type="radio"/> Intermediate <input type="radio"/> Deep <input type="radio"/> Low <input type="radio"/> Intermediate <input type="radio"/> Low <input type="radio"/> Low <input type="radio"/> Low <input type="radio"/> Low <input type="radio"/> High <input type="radio"/> Low <input type="radio"/> Low <input type="radio"/> Yes <input type="radio"/> No	
Equipment	<input type="radio"/> Supporting Equipment	

# Results: filtered technologies

- The list of filtered technologies is being displayed and sorted based on their suitability for the user selections.
- The user selections are visible in the side bar and can be changed to quickly re-filter the full list
- The suitability of the technologies can be noticed from the colours of the chips for each criteria in the variant

Criterion		
Presence of navigation	Navigation	null
Type of waterbodies	Type	null
Technical Specification		
Position	Position of the River in the Basin	
Width	Width of the waterbody	
Slope	Slope of riverbank	
Depth	Average mid-section depth	
Flow speed	Average river flow speed	
WL variation	Seasonal water level variation	
Speed variation	Seasonal flow speed variation	
Flooding	Major flooding occurrence	
Rough weather	Rough weather occurrence	
Vegetation	Existence of floating vegetation	
Sedimentation	Level of sedimentation	
Over-sized waste	Presence of oversized waste size (> 2 m length)	

Selections technologies	Selections user
Navigation: No	Navigation: No
Type of waterbodies: Canal / Drain / River / Stream	Type of waterbodies: Canal / Drain
Position: Upstream / <b>Midstream</b> / Downstream	Position: Midstream
Width: Narrow / Intermediate	Width: Intermediate
Slope: <b>Shallow</b> / Steep	Slope: Gentle
Depth: Shallow / Intermediate / Deep	Depth: Deep
Flow speed: <b>Intermediate</b> / High	Flow speed: High
WL variation: Low / High	WL variation: Low
Speed variation: Low / High	Speed variation: Low
Flooding: Low / High	Flooding: Low
Rough weather: Low / High	Rough weather: Low
Vegetation: Low	Vegetation: Not applied
Sedimentation: Low	Sedimentation: Not applied
Over-sized waste: No	Over-sized waste: Not applied

Attributes vs criteria comparison

Riverine waste collection World Bank  
Decision support framework

Changes to the results can be made in the side bar

Results questionnaire

BACK TO QUESTIONNAIRE

**Side bar input panel**

Presence of navigation: Navigation No

Type of waterbodies: Type Canal / Drain

Technical Specification

- Position: Midstream
- Width: Intermediate
- Slope: Gentle
- Depth: Deep
- Flow speed: High
- WL variation: Low
- Speed variation: Not applied
- Flooding: Not applied
- Rough weather: Low
- Vegetation: Not applied
- Sedimentation: Not applied
- Over-sized waste: Not applied

Equipment: Equipment Not applied

There are 89 technologies of which 3 are suitable for your defined conditions. Please scroll to view the other options.

**Suitable technologies**

**Interceptor**  
PIES / Floating extraction system

Presence of navigation: Navigation Yes

Type of waterbodies: Type Canal / Drain / River / Stream

**Debris Removal Screen**  
PIES / Floating extraction system

Presence of navigation: Navigation Yes

Type of waterbodies: Type Canal / Drain / River / Stream

**TrashWheel**  
PIES / Floating extraction system

Presence of navigation: Navigation Yes

Type of waterbodies: Type Canal / Drain / River / Stream

The technologies below this line are not suitable for the defined criteria.

**Less suitable technologies**

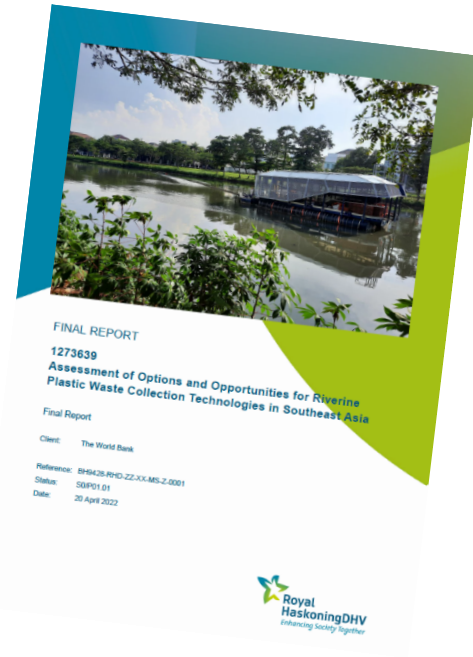
**RISE A/S**  
PIES / Floating extraction system

Presence of navigation: Navigation Yes

Type of waterbodies: Type Canal / Drain / River / Stream

# Considerations and pre-conditions

- In parallel to applying technical and efficiency criteria, an assessment of the enabling environment is recommended for details assessment and feasibility study. Key elements include:
  - Financing arrangements particularly for operations and maintenance (including upstream/downstream beneficiaries)
  - Institutional and operational arrangements with integration of river-based and land-based collection systems and service providers
  - Environmental and social impacts
  - Permits and regulations
  - Treatment and disposal in line with national waste management regulations
  - Support infrastructure for transport, treatment/recovery and disposal
  - ...



# Q&A

- Any feedback is appreciated, especially related to:
  - User-friendliness of the DSF
  - Applicability of the filtering criteria
  - Any missing technologies or information on the technologies
  
- The DSF will be maintained and updated based on your user-feedback. User-feedback can be submitted through: [ksattler@worldbank.org](mailto:ksattler@worldbank.org)
  
- Development of DSF supported by Royal HaskoningDHV