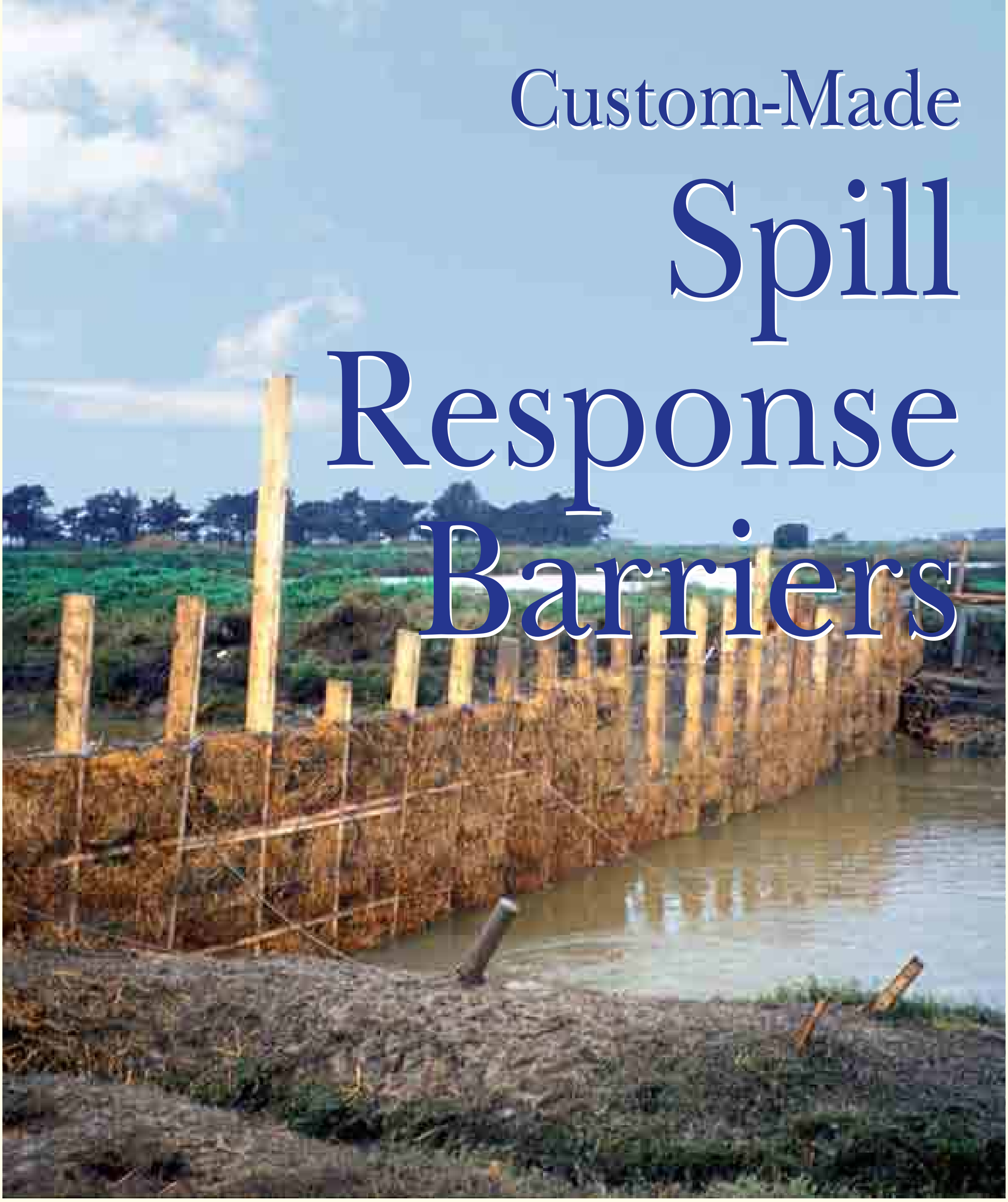

Custom-Made Spill Response Barriers

OPERATIONAL GUIDE

Cedre

Custom-Made Spill Response Barriers

OPERATIONAL GUIDE

Information
Decision-making
Response

Guide produced by *Cedre* with financial support from TOTAL SA and the French Ministry of Ecology.

Author: Arnaud Guéna

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*Cover photo:
Filter barrier on Croisic sea inlet, at water intakes for the Guérande salt marshes during the Erika spill. © Cedre*

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Purpose and structure of this guide

The dissemination of *Cedre*'s knowledge in the form of operational guides constitutes an important component of our organisation's activities, as emphasised by our strategic committee. This publication on "custom-made barriers", also referred to as "makeshift barriers", is part of this effort to share our know-how in this field.

During the response to many oil spills in coastal or inland waters, the use of manufactured booms (cf. *Cedre* operational guide on this subject) has often been supplemented by the use of devices put together by response teams in emergency situations. In many cases, due to the site characteristics, the pollutant's behaviour or insufficient or even a complete lack of specific response means, responders build makeshift devices with locally available resources to contain, deflect or trap the pollutant or to protect sensitive areas. The efficiency of these custom-made barriers is highly variable according to the materials and techniques employed.

The use of custom-made barriers may therefore be considered, however these barriers should not be improvised in an emergency but rather should have been designed, tried and tested, as part of a response planning and preparedness effort.

The second section of this guide comprises practical datasheets for various custom-made barriers. These datasheets present the deployment conditions, equipment required, benefits and limitations observed in the field for each type of barrier. This is in no way an exhaustive inventory of what could be imagined. On the basis of the information presented and the many illustrations provided, readers will be able to determine the most appropriate equipment for the situation in hand, and then to assess the chosen solution during exercises.

....

This guide is mainly intended for public and private personnel in charge of spill response preparedness, but also for response teams, who will find practical advice on building devices that can then be adapted to the given situation.

A number of the other guides published by *Cedre* also address the theme of booms and barriers:

- the "**Manufactured Spill Response Booms**" guide attempts to provide an overview of the main spill containment equipment available on the market
- the "**Use of Sorbents for Spill Response**" guide deals with the use of sorbents, including sorbent booms.

"Sorbents" guide

"Manufactured Spill Response Booms" guide

Contents

Preparedness - Response plan

A

Filter barrier made of straw, sorbent and geotextile installed on a stream polluted with crude oil, Ambès 2007

What is a custom-made barrier?

A1

In opposition to the term "manufactured boom" referring to floating booms commercially available through manufacturers or distributors, the term "custom-made barrier" refers to a device designed and manufactured on site using locally available, generally inexpensive, materials.

In many cases, custom-made barriers are used where manufactured booms are unavailable, insufficient or ineffective.

According to their design, custom-made booms can be used on the shore, in ports, in inland waters, at the surface of a water body, in the water column or on the bottom.

They can be used to:
- **Contain** the spill
- **Deflect** the spill
- **Protect** a sensitive area
- **Trap** the spill for subsequent recovery
- **Filter** the water column.

Other terms sometimes used: makeshift barrier, improvised barrier, emergency barrier.

Deflecting the pollutant towards a recovery site, Romania 2007

Protecting a sensitive site, Moliets 2003

Containing diesel using a straw barrier, Herbignac 2005

Containing effluent during clean-up operations, Ambès 2007

Why use custom-made barriers?

A2

The use of custom-made barriers can be considered in the following situations:

- **Unsuitable environmental conditions for the deployment of manufactured booms**: discontinuous presence of water or insufficient draught, excessive current speed, excessive surface agitation, inaccessible to responders or the necessary deployment equipment, presence of structures or substrates liable to deteriorate a floating boom. Building a custom-made barrier suited to the given situation is a way of taking action rather than doing nothing, or even of saving time rather than waiting until the conditions become suitable for the deployment of manufactured booms.

- **Pollutant behaviour incompatible with the use of manufactured boom**: a pollutant that is sinking, fragmented, dispersed throughout the water column or dissolved can escape under a manufactured boom. Only a custom-made barrier designed according to the substance's behaviour can overcome this difficulty.

- **Insufficient human resources and equipment** to urgently deploy a complete containment and recovery chain:
  - many types of custom-made barriers require less personnel and specialised equipment for their deployment than manufactured booms
  - in the case of too limited a stock of manufactured booms, building custom-made barriers can be a useful way of supplementing existing lengths of boom
  - where recovery equipment is in short supply or completely lacking, a custom-made boom can be designed not only to contain or deflect the pollution but also to trap it
  - in certain cases, a custom-made boom can be used in addition to manufactured or sorbent booms, in particular to make the system more efficient and more resistant to sea and weather conditions (wind, current, waves), hydrological conditions or the presence of floating debris.

Example of a spill in the Loire River in August 1999

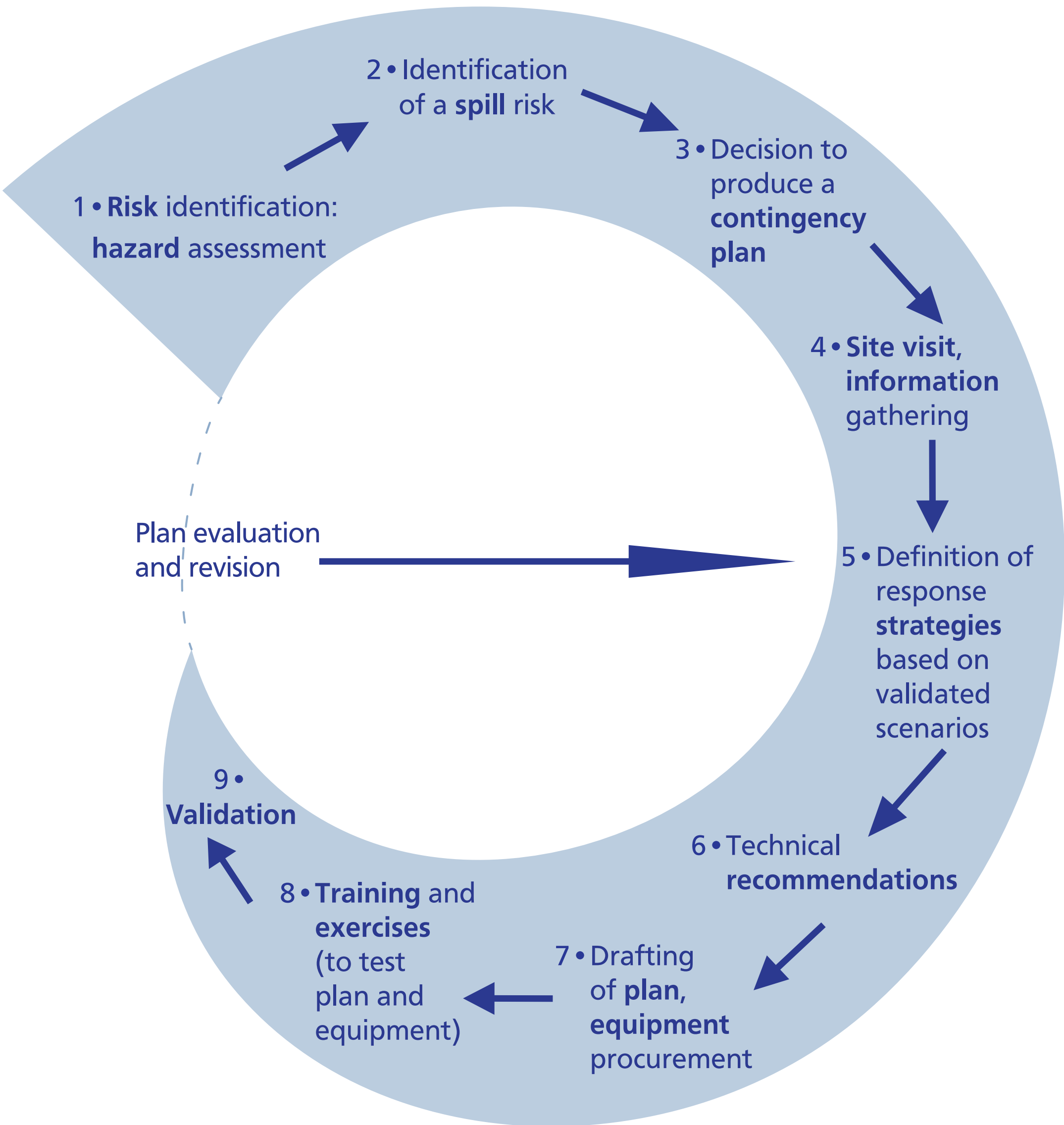
Shallow waters cause the boom to plane; furthermore, the pollutant is distributed throughout the water column

Straw filter barrier required to overcome the limitations of the boom already deployed

Preparing for an efficient response

A3

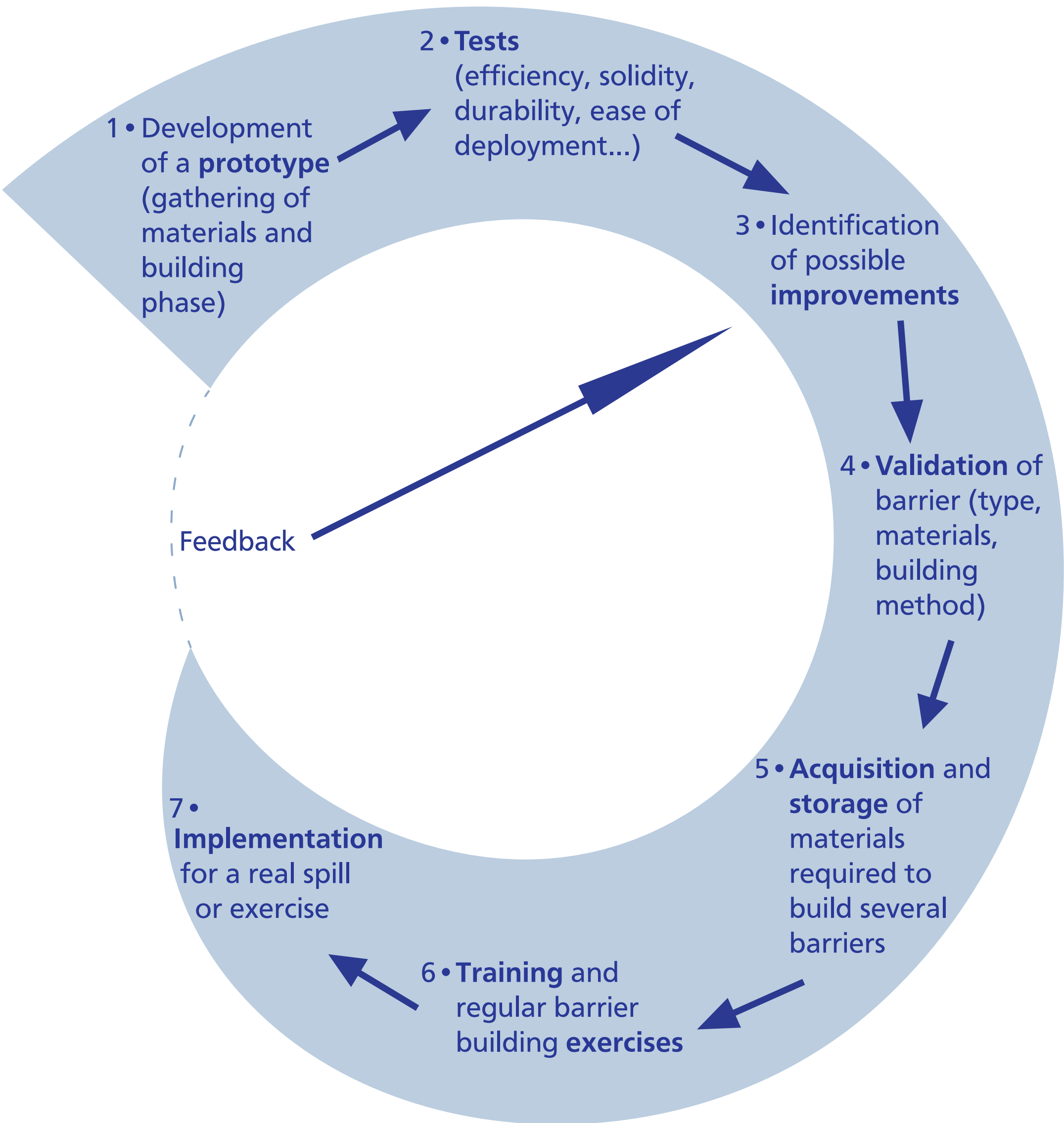
Although the term "makeshift barrier" is often used as a synonym for "custom-made barrier", recourse to such response means in emergency conditions, without prior preparation, will not always meet with success. To be effective, a custom-made barrier needs to be designed and tested in advance. This is an integral part of the following planning procedure:



General response strategy

If the technical recommendations (step 6 on the left-hand page) include the use of custom-made barriers, this option should be integrated within the following stages of resource acquisition, training, exercises and continuous improvement.

The procedure will be as follows:



Procedure for including the "custom-made barrier" technique in a contingency plan

Acquiring and managing stockpiles

A4

See section C3 *Replenishing stockpiles* for an inventory of the items to be stored.

To avoid being restricted by the quantities of materials that should be rapidly available, sufficient stockpiles should preferably be built up in advance; pre-built custom-made barriers can even be stored and can then simply be deployed.

This preparation is all the more important as certain materials used for custom-made barriers are only available at certain times of the year. This is the case for plant fibres (coir, sisal, straw, reeds...). Stocks of such materials should be built up during the harvesting season of these materials (harvest season for cereals, pruning season of banks for reeds...).

Other materials are only available for purchase in limited quantities or from specialised suppliers. Once again, they should be acquired in advance, particularly when they are not particularly sensitive to weathering: sorbents, mesh, nets, stakes...

Many of the materials used to build custom-made barriers are flammable. They should therefore be stored away from all sources of ignition or heat and in compliance with the safety regulations that apply at your facilities.

Stockpile of materials to build barriers, Romania 2007

Materials required to build barriers loaded into a vehicle, Ambès 2007

In terms of storage, the following rules must be followed:

- Store equipment in good conditions making sure that they are protected, according to their type, against:
  - **Dampness** which reduces sorbents' hydrophobic character and accelerates the rotting of plant matter, wooden stakes and planks, fabrics...
  - **Sunlight** which can damage fabrics, nets and plastic sheeting
  - **Rodents** which attack fabrics, plant matter and sorbents
  - **Flames and hot spots** liable to cause fires to set off quickly in equipment stockpiles, particularly in the case of flammable materials such as straw and wood.
- Store all plant matter in a well ventilated place sheltered from rain and sun.
- Store sorbents in plastic bags, or even crates if rodents are present.
- Shelter other materials (wood, nets, mesh) from precipitation.
- In addition to the materials required as part of custom-made barriers, gather together all the equipment required for their assembly (tools, fastenings...), mooring (stakes, ropes...) and installation.
- Periodically check that the items placed in the emergency stockpiles are properly preserved.
- Provide information on the use of the stored equipment to prevent these means from being taken for other purposes, resulting in a lack of equipment when the spill occurs.

Storage in crates of elements required to build custom-made barriers

Stockpile of straw, plant fibre fence (brushwood) and wood for building custom-made barriers

Straw barrier angled to hold strong in the flow of the river, Gironde 2001

Situation assessment

Sorbent booms and custom-made barriers at a river mouth at low tide, Manche 2009

Suitable conditions for using custom-made barriers

B1

Safety

Before responding to a spill, it is essential to ensure that all the safety conditions are met. In particular, it is important to ensure that:

- each member of the response team has the necessary **personal protective equipment (PPE)** to effectively protect them against the hazards presented by the substance spilt, the spill site and the equipment used to build and install the barrier
- the site's **safety rules** are followed throughout the building, installation and dismantling of the custom-made barrier
- the **materials** used are **compatible** with the **site's** safety requirements (beware of highly flammable materials such as bundles of vegetation).

Response strategy

All the types of custom-made barriers identified in the second part of this manual are designed for use as part of a site protection or containment and recovery strategy.

Prior planning is required in order to ensure that this strategy is the most suitable to deal with the given spill. In particular, the opportunity to respond to the spill should be assessed by considering its potential effects on the environment and the efficiency of another strategy. Consider a strategy that does not consist in responding to the pollutant itself but rather limiting its effects (dilution, protection measures...), in particular in watercourses where the dilution potential is often high and the conditions for the installation of custom-made barriers are often less suitable than in calm waters.

Barrier made of net, straw and sorbent fibres, 2011

Barrier made of mesh and straw, Loire 1999

Choice of barrier type

Once it has been deemed necessary to protect a sensitive site or contain and recover the pollutant, and this can be done in complete safety, the next step is to check whether manufactured equipment suited to the situation is available. This of course includes manufactured booms and sorbents, without forgetting their limits of use, but also devices such as flood protection barriers or filter cartridges that can be suitable for certain situations.

Retaining a spill at a discharge outlet using a filter cartridge

Containing floating pollution using a flood protection barrier and sorbent boom

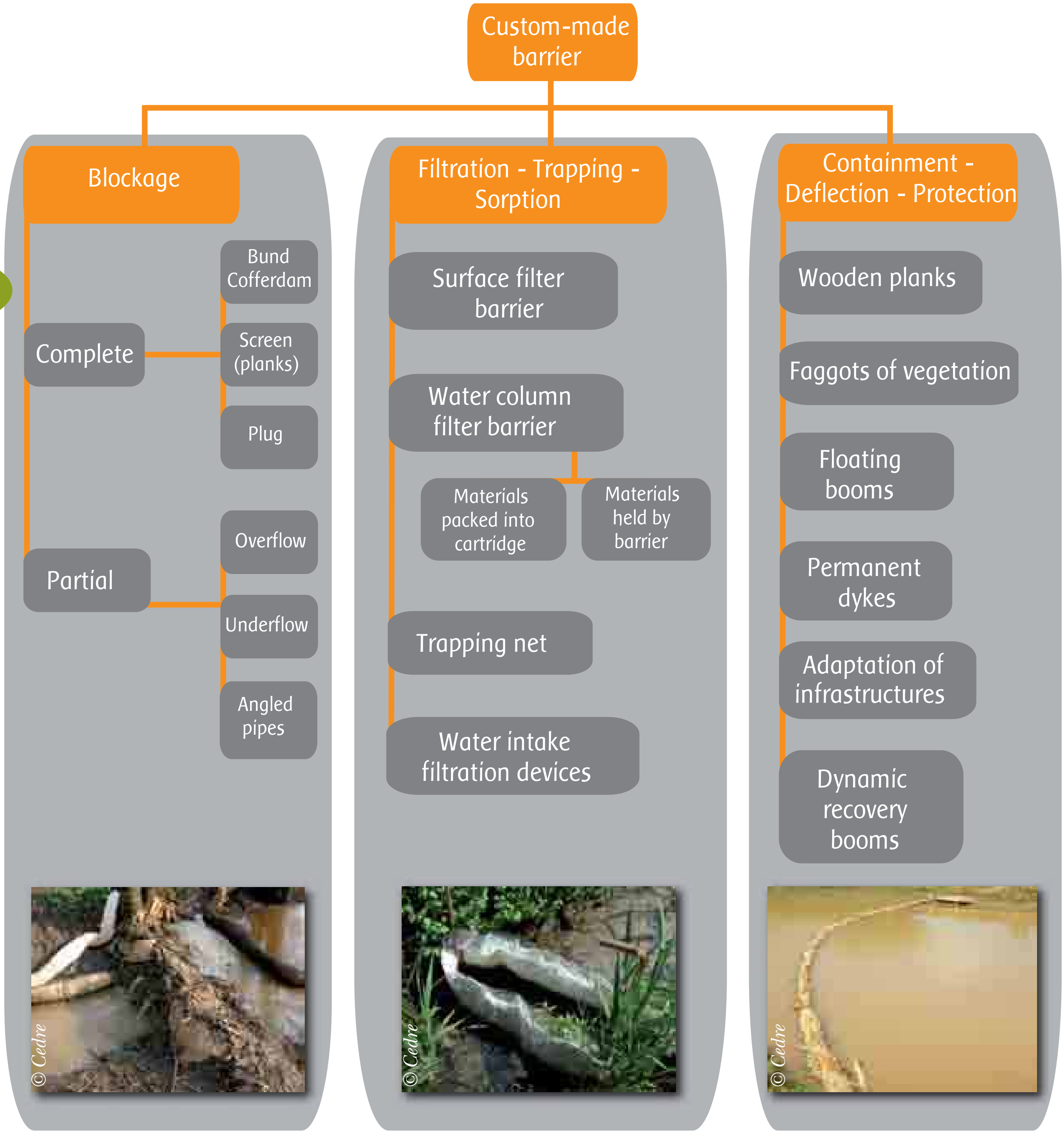
Waste management

The local possibilities for waste treatment should also be taken into consideration in the choice of the type of custom-made barrier. In regions where waste treatment capacities are low, natural materials should be prioritised (vegetation, wood) while in regions with suitable waste treatment facilities (in particular an incineration plant), a wider variety of materials can be used.

The possible methods for dealing with used custom-made barriers are specified at the bottom of each sheet in the "After use" section.

For further information on the booms referred to in this chapter, refer to *Cedre's* guide on Manufactured Spill Response Booms.

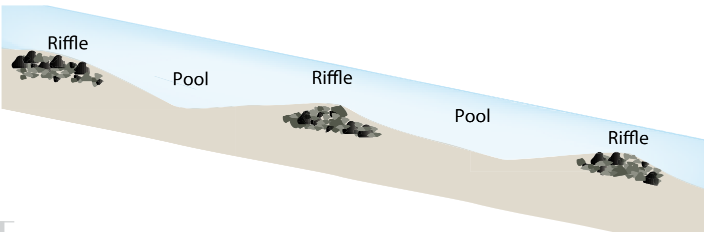
Different types of custom-made barriers



Positioning a custom-made barrier

Prioritise areas with the lowest current
In a river, the narrowest sections are often those where the flow rate is highest. To set up a custom-made barrier, a wide area with low current (pool) should be chosen over a narrower area with a higher current speed (riffle).

Prioritise areas where the surface is least agitated
Do not install the barrier on a riffle but rather on the downstream side of a pool as the current is lower, the water calmer and the bottom softer.



Pool-riffle sequence

Prioritise areas where the barrier will form the best seal
To ensure that the custom-made barrier is as efficient as possible, it should be positioned in an area where the bank is regular and bottom smooth (sand or mud). Sometimes the presence of a structure (bridge, duct...) can be used to advantage.

Prioritise areas where safety conditions are best (easy access, limited current, stable banks, harmless vegetation...)

The main environmental limits of use for custom-made barriers are:

- the width of the river: beyond 25 m they are difficult to set up in the centre of the river. On the shore, there are no limits if the entire length is accessible.
- the current speed, although less restrictive if the barrier is moored to piles (which implies limited depths).
- the water depth: a factor that complicates the installation of all barriers designed for purposes other than surface containment (filtration of water column, containment on the bottom...).
- presence of floating waste and debris (trunks, branches...) which can damage barriers.

Choice matrix for custom-made barriers

B4

		Pollutant characteristics					Aquatic environment characteristics					
		Behaviour			Viscosity		Current		Width		Water depth	
		Floating	Dispersed	Sinking	High	Low	Yes	No	Wide	Narrow	Deep	Shallow
COMPLETE BLOCKAGE	BUND	Moderately suitable	Suitable	Suitable	Suitable	Suitable	Unsuitable	Suitable	Unsuitable	Suitable	Moderately suitable	Suitable
	SCREEN	Moderately suitable	Suitable	Suitable	Suitable	Suitable	Unsuitable	Suitable	Unsuitable	Suitable	Moderately suitable	Suitable
	PLUG	Moderately suitable	Suitable	Suitable	Suitable	Suitable	Unsuitable	Suitable	Unsuitable	Suitable	Unsuitable	Suitable
PARTIAL BLOCKAGE	OVERFLOW	Unsuitable	Unsuitable	Suitable	Suitable	Suitable	Suitable	Moderately suitable	Unsuitable	Suitable	Moderately suitable	Suitable
	UNDERFLOW	Suitable	Unsuitable	Unsuitable	Suitable	Suitable	Suitable	Moderately suitable	Moderately suitable	Suitable	Unsuitable	Suitable
	ANGLED PIPES	Suitable	Unsuitable	Unsuitable	Suitable	Suitable	Suitable	Moderately suitable	Unsuitable	Suitable	Moderately suitable	Suitable
FILTRATION - TRAPPING - SORPTION	SURFACE FILTRATION	Suitable	Unsuitable	Unsuitable	Suitable	Moderately suitable	Moderately suitable	Suitable	Moderately suitable	Suitable	Suitable	Suitable
	WATER COLUMN FILTRATION	Suitable	Suitable	Suitable	Suitable	Moderately suitable	Suitable	Moderately suitable	Moderately suitable	Suitable	Moderately suitable	Suitable
	TRAPPING NETS	Suitable	Suitable	Moderately suitable	Suitable	Unsuitable	Suitable	Moderately suitable	Moderately suitable	Suitable	Moderately suitable	Suitable
	WATER INTAKE FILTRATION	Suitable	Suitable	Suitable	Suitable	Moderately suitable	Suitable	Suitable	Suitable	Suitable	Moderately suitable	Suitable
CONTAINMENT - DEFLECTION - PROTECTION	WOODEN PLANKS	Suitable	Unsuitable	Unsuitable	Suitable	Suitable	Moderately suitable	Suitable	Moderately suitable	Suitable	Suitable	Suitable
	FAGGOTS OF VEGETATION	Suitable	Unsuitable	Unsuitable	Suitable	Moderately suitable	Moderately suitable	Suitable	Moderately suitable	Suitable	Suitable	Suitable
	CUSTOM-MADE FLOATING BOOMS	Suitable	Unsuitable	Unsuitable	Suitable	Suitable	Moderately suitable	Suitable	Moderately suitable	Suitable	Suitable	Moderately suitable
	FIXED WALL	Suitable	Suitable	Moderately suitable	Suitable	Suitable	Suitable	Suitable	Moderately suitable	Suitable	Moderately suitable	Suitable
	DYNAMIC RECOVERY	Suitable	Unsuitable	Unsuitable	Suitable	Moderately suitable	Unsuitable	Suitable	Suitable	Unsuitable	Suitable	Moderately suitable

Unsuitable *Moderately suitable* *Suitable*

Logistical requirements

If a custom-made barrier is built as part of an effort to respond with limited human and material resources ("makeshift barrier" concept) or as part of an emergency response without any prior preparation ("improvised barrier" concept), the barrier will be of simple design, will only use locally available materials and will not, or as little as possible, require transport, deployment, mooring, monitoring or maintenance equipment. The device's efficiency will be relative. If the use of a barrier is considered as part of an anticipatory approach, aiming to be as efficient as possible on the day it is required, more elaborate barriers can be designed and installed on more difficult sites, if all the necessary logistics for an appropriate response have been included in the organisation. The following will be required:

- a **storage** means for barrier materials
- a **transfer** means for transporting these materials to the site (trailer, four-wheel drive...)
- the necessary **assembly** equipment (toolbox, fastenings, ropes...)
- **anchoring** or **mooring** means (anchors, sinkers, stakes, sledgehammers, ropes, cables) whose size and resistance are in proportion with the size of the boom and the current force (wooden stakes driven in using a sledgehammer/wide stakes driven in using machinery)
- barrier **deployment** means (by hand if conditions are suitable or using machinery or boats)
- **monitoring** means to supervise the barrier's efficiency and hold (boat, vehicle)
- barrier **replacement** or **reinforcement** materials in case required (replacement of saturated vegetation, reinforcement of moorings...) (see section C1 *Maintaining barriers*)
- **dismantling** and repacking means (caution, booms composed of non-hydrophobic materials will be far heavier at the end of operations than the beginning and will require greater deployment efforts)
- **storage** means for **polluted** barriers, until they can be evacuated and treated.

The response will be all the more efficient where all these materials and equipment have been tested prior to deployment and response personnel have been familiarised with them through training courses and regular exercises.

Material samples

Vehicle for transporting materials

Monitoring, maintenance and dismantling

Maintaining barriers in use

It is difficult to build a sufficiently efficient and durable device at the first attempt. Following set-up, all custom-made barriers should be observed for several hours. This enables operators to improve and finalise them.

Time can be saved if tested have been conducted as part of response preparedness. A lack of pollutant does not prevent barriers from being tested, in particular their resistance and efficiency in their deflective role, as the pollutant can be simulated using different floating substances or objects: rice hull, peat, sawdust, small vegetation, oranges...

C1

In the case of filter devices, it is also important to check that head loss remains limited and that the pressure on the barrier or rise in water level does not require filter elements to be altered.

Furthermore, experience has shown that even when tested in advance, barriers must constantly be tweaked during a spill to continually adapt them to changes in environmental conditions (change in water level, variation in current) or in the pollutant (increased viscosity, tendency to sink, adhesion to floating debris).

Among the points to be carefully supervised we of course find anchoring and mooring systems, as well as all connections between the barrier's different elements and the links and fastenings used (nails, screws, rope, wire...) in order to ensure that the barrier retains its optimal position. Do not hesitate to reinforce these elements, or even change the materials of which they are composed (for instance, the number and size of mooring stakes and piles can be increased).

Any alterations to the device will require additional anchoring or mooring systems, as those that have already been used may not necessarily be easily and rapidly recovered and repositioned.

Example of alterations to a filter barrier to deal with increased current: replacement of piles with railway sleepers

In the case of barriers designed to absorb the pollutant, the material used (straw or other suitable vegetation) should be renewed as soon as it becomes saturated. If this material is encased, for instance using mesh, the fastening system of this mesh should enable the material to be easily replaced. It could therefore be practical, wind and current conditions permitting, to place loose vegetation in front of the barrier to act as sorbents, as they will be easier to recover and replace than encased vegetation. In this case, storage capacities for recovered polluted materials should be available on the banks.

Furthermore, certain types of vegetation can become water-logged over time; barriers should therefore be regularly supervised to replace this vegetation before it sinks (remember that its weight will have increased due to water absorption). However, if no pollutant is present, its biodegradability will limit the risks of harm to the environment, if these materials were to sink.

Generally speaking, to guarantee continuous protection over time, several successive barriers are required in order to plan maintenance phases as well as to build replacement barrier elements (outer casing for vegetation, filter cartridges), or even new barriers, in advance.

Channel filter barrier built in advance, Ambès 2007

Delivery of straw and sorbent fibres to replace filtration materials, Camargue 2011

Dismantling and managing used barriers

In addition to recovering contained pollutant, for which storage and elimination facilities must be provided, the barriers themselves will need to be processed or disposed of after use.

These **processing operations** will comprise several phases:

1. Setting up **temporary storage** and sorting capacities on the bank or shore for recovered pollutant, sorbents and various barrier materials. (Provide oil-tight skips for polluted filler materials).
2. Recovering, sorting and storing all **pollutant still free** on the water and any sorbents deployed in front of the barriers.
3. **Unmooring and retrieving** barriers from the water.
4. **Dismantling**, sorting and storing the various barrier components.
5. **Retrieving** all **anchoring** and **mooring** systems (anchors, piles, sinkers...).
6. Possibly, **cleaning** components recovered (structural elements, anchors...) on site or at a specific cleaning facility.
7. **Evacuating** waste to suitable treatment facilities.
8. **Returning** reusable elements to the storage facility to be cleaned, repaired and repacked.

Good segregation of the various materials and components will greatly improve their selective processing. Even if specialised waste treatment facilities are used wherever they exist, **several treatment techniques** can be considered according to the conditions (pollutant type, waste volume, national regulations, locally available facilities...) :

- **Composting** and **enrichment** for putrescible materials: unpolluted vegetation, wood residues...
- **Biodegradation** at a separate site for polluted putrescible materials: filler vegetation
- **Burning** of unpolluted vegetation and wood: filler vegetation, wooden planks and piles...
- **Landfill** for all unoiled materials: nets, wood, mesh...
- **Quicklime** treatment for polluted vegetation.
- Incineration at a **household waste incineration plant** for unpolluted combustible materials: vegetation, wood, geotextile, plastic...
- Incineration at an **incineration plant** for **special waste** for all polluted materials: sorbents, geotextile, wood, vegetation.

Locally available treatment solutions should be examined in advance in order to determine the type of materials to be prioritised to build and moor custom-made barriers.

For further reading on the question of oil spill waste processing and disposal, please refer to *Cedre*'s guide on "Oil Spill Waste Management", available from *Cedre*'s website (www.cedre.fr)

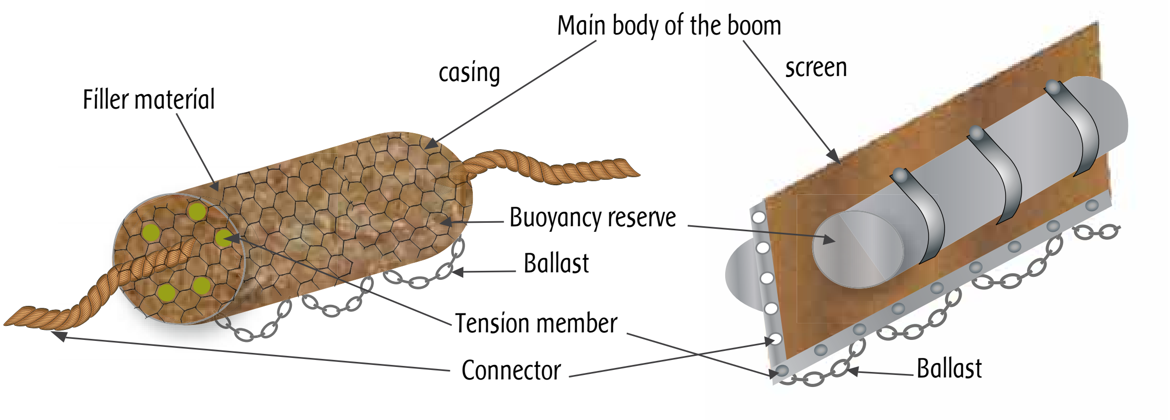
Replenishing stockpiles

The dismantling phase for custom-made barriers is conducted with a view to minimising waste production. To do so, rather than destroying them, where possible manufactured barrier components should be cleaned, restored and repackaged: structural elements, tension members and mooring components... This is even more important if they were difficult or costly to obtain.

At the end of a response operation, all elements that can be reused should be restored, inventoried and repacked for subsequent use.
On the other hand, all materials that have been consumed, damaged or destroyed will be renewed, while supplementing them with other complementary means identified by the response team based on its field experience.

See section A4 *Acquiring and managing stockpiles.*

Tables summarising materials that can be used to build custom-made barriers are provided on the following pages. They do not constitute exhaustive lists, but provide a basis for further reflection by the reader to build up stockpiles.



Schematic diagram showing the various components of a custom-made boom

Main body of the barrier: casing

Purpose of the material: to contain, possibly after folding or rolling, a filler material which, enclosed in the casing, will contain and absorb the pollutant.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Agricultural or garden mesh	In rolls, metal or plastic	⊕ Availability, resistance ⊖ Corrosion risk
All types of net: fishing nets, agricultural nets, debris netting, anti-hail netting...	All lengths and widths	⊕ Can be sewn into a cylindrical shape to form a bag
Some **geotextiles, fabrics and tarpaulins**	As above	⊕ Can be sewn into a cylindrical shape to form a bag
Agricultural sacks (made of synthetic or natural fibres)	Sacks with an average capacity of 50 litres, or more	⊕ Availability, low cost, easy to fill and use, resistance
Oyster bags	4 to 23 mm mesh, width of around 60 cm when flat, variable length	⊕ Availability, low cost, easy to fill and use, resistance

Main body of the barrier: filler material

Purpose of the material: to fill the casing, as well as to contain and possibly absorb the pollutant. Sometimes used loose, spread in front of a barrier and replaced according to its sorption rate.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Copra cake, coir, kapok, sisal, straw, hay, gorse, broom, heather, ferns, reeds, corncob, or any other sorbent plant fibres	These materials may be loose, in bales (pressed/packed or not) or faggots, or even in bags. They may also be available in the natural environment	⊕ According to the region, these materials may be widely available at low cost. ⊖ Need to monitor their sorption capacity and tendency to become water-logged and sink. ⊕ Some of these materials, like kapok, are naturally hydrophobic and have very good buoyancy
Loose wood or bark mulch, or even sawdust	Pine, conifers, other species 25, 50 or 100 litre bags or more	⊕ Available from garden centres, or sawmills, good sorbent
Brushwood garden fencing	Rolls of several metres with a height of 0.5 m to 2 m	⊕ Can be used in rolls (without casing) but also as a screen
Loose sorbent	Use sorbents that are larger than the casing's mesh (e.g. sorbent strands)	⊕ Oleophilic and hydrophobic

Main body of the barrier: screen

Purpose of the material: to form a full screen, of varying height and length according to its nature.

NB: certain materials can form a filter screen for pollutants defined by a specific diameter, for instance balls of heavy or weathered fuel oil can be contained by certain fine-mesh nets or wire mesh.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Certain geotextiles, certain fine-mesh nets	All lengths and widths	+ Easy to handle − Variable availability − Difficult to keep upright over long distances
Wooden planks	A few metres long and 0.30 m wide	+ Good rigidity and buoyancy
Sheets of plywood	Around 2.5 m by 1.2 m	+ As above
Bamboo	To be used as faggots formed according to diameter	+ Very light, high buoyancy − Sometimes needs to be ballasted
Floating polypropylene hawser (used)	A hawser for long-haul vessels is around 200 m long with a diameter of around 8 cm	Such hawsers are very flexible and can be "tripled" (by folding) to form a barrier 66 m long, with 3 sections bound together every 30 to 50 cm

Buoyancy reserve

Purpose of the material: to provide or improve the buoyancy of a boom

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Foam or polystyrene blocks or floats	Synthetic material, small dimensions Example: foam cylinder 1 to 2 m × 0.1 m diameter	➕ Very light, high buoyancy, easy to cut ➖ Fragile in the case of polystyrene
Any thermal insulation that cannot become water-logged	Synthetic or natural material	➕ Can also be used as filler material
Empty plastic drums or jerrycans, or even bottles	Any volume (1 to 200 litres) Metal or synthetic	➕ Widely available ➖ Risk of puncture and reduced buoyancy ➖ Risk of corrosion for metal
Fishing net float	Volume of a few decilitres to a few litres at the most	➕ Easily adapted to needs, existence of attachment points
Tree trunk, bamboo	Up to over 10 m	➕ Acts as a screen
Inner tube	Usual diameters of up to around 80 cm	➕ Good buoyancy and availability ➖ Risk of puncture and reduced buoyancy
Floating cube (used for modular jetty systems)	L=0.5 × W=0.5 × H=0.4 m (or 0.2 m) for a cube. Other possible dimensions	➕ High resistance, modular ➖ High cost, limited availability
Floating polypropylene hawser (used)	Up to 200 m long for a diameter of around 8 cm	➕ Can be used as buoyancy reserve or alone

Ballast

Purpose of the material: to weigh the boom down and keep a fence boom upright despite inclination due to wind or current.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
All types of **metal chain**	From 2 to 5 kg per metre for the most suitable chains	⊕ Perfectly suited to needs, attached using nylon or polyamide cable ties
Any very dense, low cost material with at least one attachment point		

Tension member

Purpose of the material: to mainly provide a screen made of geotextile, fine-mesh netting or some other flexible material with vertical rigidity.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Bamboo	For this specific purpose, average length of around 1 m with a diameter of less than 2 or 3 cm	⊕ Can also be used for buoyancy and ballast (lower section filled with sand and sealed)
Pile made of wood or other material	Possible height of up to 3 or 4 m	⊖ Can also be used to position the barrier and fix it to the bottom

Connector

Purpose of the material: to connect various elements both when building and installing barriers

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Any synthetic or natural rope or **metal wire**	These ropes and wires are defined by their diameter and strength	To be adapted for the given use, on a case-by-case basis
Any ties, in particular nylon or polyamide cable ties	Cable ties are available in different lengths (around 10 to 40 cm)	⊕ Versatile, low cost, strong

Piles and anchoring or mooring points

Purpose of the material:

- To attach the custom-made barrier to the bottom, therefore statically positioning it on the water body. Piles can also be used to support a boom that is heavier than water and to reinforce it if necessary. Furthermore, anchors require chains or ropes. A complete anchoring system will include: anchor, chain and buoys.
- To provide a mooring point on the bank or shore.

Purpose of the material or substance	Usual type and dimensions	Strengths and weaknesses
Pile (used in the water)	Generally wooden. 3 to 4 m long or more	⊕ Perfectly meets requirements, according to the bottom type
Pile (used on bank or shore)	Wooden, 0.5 to 2 m long	⊕ Possibility of assembling 2 or 3 piles (or more) to ensure better hold
Anchor	Use anchors with a weight of 15 kg maximum	⊕ Perfectly meets requirements ⊖ Mainly directional hold. Use 2 small anchors rather than one large anchor
Makeshift grapple	Metal tube onto which 4 curved claws (made of reinforcing bars) are welded	⊖ More fragile than an anchor
All types of sinkers, and in particular **concrete-filled tyres**	For the same holding capacity, their weight can reach up to 5 times that of an anchor	⊖ Heavier than an anchor ⊖ Poorer hold if the sinker is not buried ⊕ Omnidirectional hold
Screw-in ground anchor	Metal corkscrew-type device of varying size	⊕ Good hold in ground (on bank) ⊖ Moderate hold in sand, poor hold in mud
Driven pile	Metal U- or H-shaped pile	⊖ Need for heavy machinery
Any object on the shore with sufficient resistance (e.g. tree trunk, ring, bridge pier...)		

Past experience

Erika, France 1999

On 11th December 1999, the oil tanker *Erika*, carrying 31,000 tonnes of n°6 heavy fuel oil, was travelling from Dunkirk (France) to Livorno (Italy) when it was caught in a storm. The crew were safely evacuated the following day before the vessel broke in two around thirty nautical miles off the south of Finistère (Brittany). An estimated 19,000 tonnes of fuel oil was spilt. The first aerial observations indicated several slicks at sea, drifting eastwards. Over the following days, aerial observations revealed a string of slicks composed of thick patches (5 to 8 cm), which tended to fragment while continuing to drift. From 17th December, the slicks showed a tendency to sink a few centimetres below the surface. Meanwhile, many protection measures for sensitive coastal areas and activities were taken by the land authorities, in particular by deploying large stretches of manufactured boom. However the extent of the area threatened as well as the oil's tendency to sink led the authorities to consider other protection techniques, including the use of a wide variety of custom-made barriers. Several types of barriers were built in an emergency situation to protect water intakes at oyster farms, salt marshes and agricultural plains. Later, during clean-up operations, other systems were developed to recover the oil from washing effluent.

Filter cartridges made of perforated sheet metal and sorbent fibres installed in individual water intakes

Protecting a stream using big bags and angled pipes

Protecting a stream using a filter barrier and sorbent fibres

D1

Protecting the sea inlet at Le Croisic, which feeds into Guérande salt marshes, using a straw filter barrier

Protecting a stream in Bourgneuf Bay using straw-filled mussel nets

Filtration system made of oyster shells, feathers and pozzolana (porous volcanic rock) at the entrance to a mudflat

Barrier made of plywood panels to contain effluent

Recovering washing effluent using nets and sorbent pads

Prestige, Spain 2002

Following the sinking of the oil tanker *Prestige* on 13th November 2002, oil drifted towards Arcachon Basin (France), causing a ban on the sale of shellfish to be instigated on 3rd January 2003. It was decided that the protection of this ecologically and economically sensitive basin would be reinforced. A technical committee developed and installed 9 custom-made devices for specific protection against tar balls and patches.

Four of these perfectly illustrate how specific protection devices can be designed for sensitive sites:

- **Protection of oyster farms using netting** in order to prevent oil from being deposited on the oyster bags in the most exposed farms and to facilitate its recovery. Conclusive trials in terms of cost, protection, deployment time and weather resistance.

- **Localised permanent protection by groins** to reduce, or even stop, the transfer of pollutant along the southern section of the basin, where navigation remains complicated due to currents and shallow waters. This device is composed of flexible floating pontoons (set up at a 45° angle to the shoreline), fitted with ballasted polyethylene knitted nets on the open side of the basin. Furled to the pontoon, the nets were only deployed when the alert was raised and were replaced when damaged or clogged. This device functioned correctly but was not able to be tested on medium to large-scale arrivals of oil.

- **Protection of water intakes** to prevent contamination of seawater supply networks for oyster farms within the basin. Based on devices installed during the *Erika* spill, custom-made barriers composed of fine-mesh nets (eel nets) stretched across wooden piles were set up to recover debris and tar balls. Meanwhile, small-scale trials were conducted, with a view to permanently protecting these water intakes, on adaptable metal frames into which, when a pollution alert was raised, filter cartridges made of loose sorbents could be inserted.

- **Protection using nets** in order to protect certain oyster farms or mooring areas, barriers built in situ using materials available from the sea professionals involved and from local equipment cooperatives: fine-mesh nets, ballasted rope, biconical buoy and tarpaulin.

Ambès, France 2007

On 12th January 2007, in an oil depot, the base of a tank containing 13,500 m^3 of crude oil ruptured. A wave effect caused around 3,000 m^3 of crude oil to spill over the top of the retention tank. The oil spread across the ground and rapidly reached the site's drainage channels, the network of trenches in the neighbouring marshes, the trenches along the main road as well as the River Garonne. To prevent the oil from spreading through these networks, sorbent booms and various types of custom-made barriers were set up, and renewed as often as necessary. They remained in place until the end of September 2008.

Complete blockage of a trench by a bund and plastic sheeting

Complete blockage by cofferdam at the outlet of a road drain in which oil had accumulated

D3

Earthen dam with angled pipes and sorbents

Cofferdam fitted with a pipe with a valve to regulate upstream water levels

Filter barriers made of mesh and absorbent fibres together with a sorbent boom(↑→)

Filter barriers made of mesh and absorbent fibres together with sorbent pads

Filter barriers made of mesh, geotextile and straw together with sorbent booms

Gabon, 2007

During the night of Sunday 22nd to Monday 23rd April 2007, in a an oil depot, a diesel leak was caused by one of the tanks overflowing. The diesel accumulated in the retention tank, where it mixed with heavy fuel oil already present, reaching a height of 1.5 m. The retention tank was not oil-tight and an estimated 600 m^3 of oil mixture spilt into the depot's water networks and reached a stream running next to homes below the depot over a distance of over 1 km. Containment measures involved the deployment of sorbent booms and the set-up of different types of custom-made barriers at the site's outfalls as well as along the polluted stream. These custom-made devices were mainly barriers with angled pipes made of bags of sand and PVC pipes and filter barriers made of mesh and foliage and fixed with piles cut on the banks.

D4

Filter barriers made of mesh and scythed vegetation

Barrier with angled pipes laid in an outfall (←) and in a stream (→)

Theys, France 2009

A spill of an estimated 6 to 9 m^3 of heating oil occurred on 12th June 2009 from a storage tank at a holiday club in Theys in the French Alps (Isère). The oil flowed across a slightly sloping prairie and into a mountain stream, polluting its bed and banks before oiling wetlands which this stream fed into.

The initial measures consisted in deploying sorbents and manually recovering the pollutant. However, accumulations of oil remained in the wetlands as well as in the bed and on the banks of the stream, forming a permanent source of pollution. To protect the downstream area, a barrier made of bags of sand and angled PVC pipes was set up. It was sufficiently large to cope with periods of heavy rainfall and was reinforced with ropes. The oil that accumulated at the surface behind this device was regularly recovered by pumping. Three filter barriers made of mesh and filled with loose sorbents completed the set-up to protect against any leaks from the first device. Later, during clean-up, other filter barriers were set up along polluted areas to recover the oil in the water used to rinse polluted areas. The whole system was kept in place for several months.

Barrier made of bags of sand and PVC pipes

Filter barrier made of mesh and sorbent fibres

Filter cartridges made of mesh and filled with loose sorbents laid just downstream of the wetland clean-up site (←) and in a stream (→), with a sorbent pad

D5

Aber Ildut, France 2010

On 30th December 2010, in the sea inlet Aber Ildut (Finistère, Brittany), due to an error in the delivery of heating oil to a cattle feed and fuel wholesaler, a tank overflowed as it was being filled. Around 5 m^3 spilt into a small area of wet grassland below the facility and rapidly reached a stream then a mill race, and finally the River Ildut, thus contaminating the whole of the Aber Ildut.

The initial measures taken were sorption and containment using sorbent pads and booms laid on the ground in the grassland or across streams. Much of the oil remained trapped in the ground and in the vegetation of the grassland and banks, constituting a source of chronic pollution. Cleaning and washing operations were then conducted to release the trapped oil. Beforehand, the initial filtration and sorption arrangements were reinforced. Larger filter barriers were set up on the stream and the mill race to ensure they lasted throughout clean-up operations and thereafter, until the first major rainfalls and as long as sheen was observed. This set-up (barrier hold, sorbent renewal) was regularly maintained.

Initial sorption measures. At the bottom of the grassland area, sorbent pads placed on the ground, where the waters converged towards the stream

Reinforced measures: sorbent pads and loose sorbents in a plastic mesh pod held in place with wooden stakes

Initial sorption measures in the stream: sorbent pads placed upstream of a barrier (wooden pallet)

Reinforced measures: (1) filter barrier (double series of stakes with plastic mesh filled with sorbents) and sorbent pads and mats upstream (2) sorbent boom and pads

D6

Initial sorption measures in the stream: sorbent boom held in place with stakes with sorbent pads upstream

Reinforced measures: (1) filter barrier (double series of stakes with plastic mesh filled with sorbents) and sorbent pads and mats upstream (2) sorbent boom and pads

Initial sorption measures in the stream: sorbent boom held in place with branches with sorbent pads upstream

Reinforced measures: sorbent boom with skirt, attached to banks

Sorbent boom and mat at entrance to mill spillway

Sorbent boom and pads.

Straw barrier

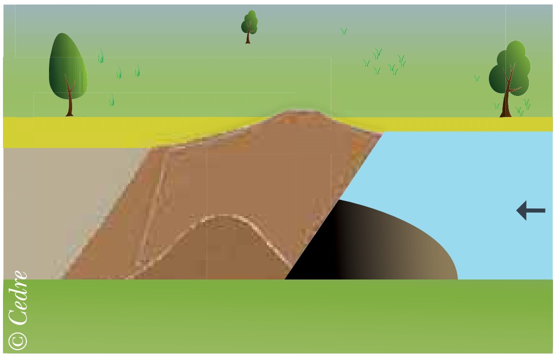
Practical barrier-building sheets

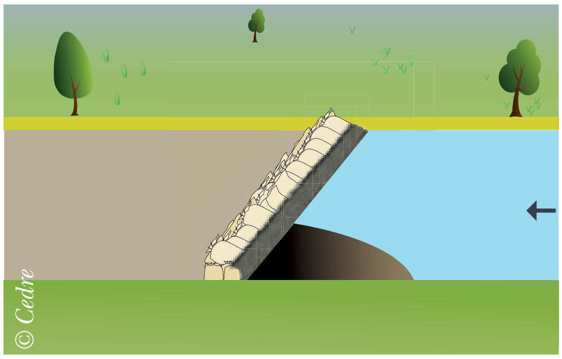
Earthen dam with pipes to let water through

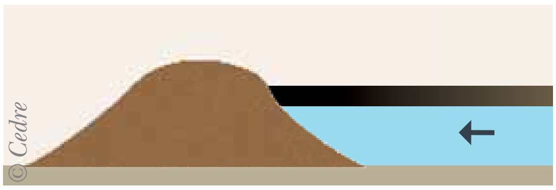
E

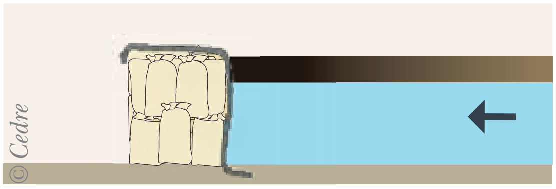
Complete blockage by a bund

- **Substances:** floating, particles dispersed in water column, sinking, dissolved.
- **Environment:** tidal flat and marsh channels, streams of low to moderate width (avoid deep waters), oxbow of a stream, run-off on the ground.









- **Equipment required for a barrier 3 m long by 1 m high**

Building materials and equipment	• Rubble, sediment. Used loose or in bags or big bags • Rubble sacks, agricultural sacks or oyster bags made of synthetic or natural fibres (jute sacks, vegetable nets, oyster bags or big bags)	→ 2 m^3 (in bags) to 3 - 4 m^3 (if used loose)
Tools	• Excavator or other machinery, manual shovels, staple gun	

- **Construction time:** 30 minutes to 1 hour for 3 people
- **PPE:** gloves, safety boots or waders, helmet, goggles and life jacket according to conditions

Advantages	Drawbacks
• Good mechanical strength • Oil-tight system • Rapid restoration of the environment in the case of bagged sediment • Limited maintenance	• If earthmoving machinery is used: high cost and need for suitable access • Rapidly increasing logistics with the size of the water body to be closed off • Possible cost of processing loose materials • Disturbance to the circulation of aquatic fauna • Impact on the environment when on-site soil is used • Risk of overflow (for instance in case of rainfall)

- **After use:** store in skips. For oiled materials, prioritise treatment at a specialised plant.

Implementation using sacks or big bags

1. Prior to deployment, fill manually or using an excavator then close.

2. Place the sacks or big bags on the bottom.

For loose materials: spread backfill across the section to be blocked off

Blocking off a trench after a road tanker had overturned

Closure of a stream at risk using sediment

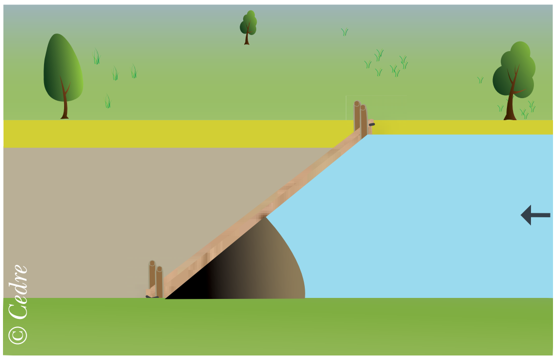
Building an earthen dam at a polluted drain outlet

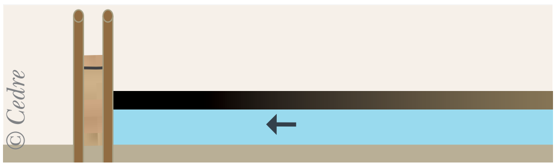
Tips and pointers

- Avoid using bunds for extensive periods of time.
- In areas where the water flow needs to be maintained, prioritise the use of an "angled pipe" barrier (see SHEET 6).
- Pre-position backfill directly on the chosen site to save time in the case of a spill.
- Arranging sacks in staggered rows reduces leaks through the barrier if one of the sacks becomes packed down or collapses.
- Cover the front of the sacks with plastic sheeting to improve oil-tightness.
- Where access is difficult for earthmoving machinery, place the device nearer to a bridge from which the sacks or big bags can be unloaded.

Complete blockage by planks

- **Substances:** floating, particles dispersed in water column, sinking, dissolved.
- **Environment:** outfalls, tidal flat and marsh channels, streams of low to moderate width (avoid deep waters), oxbow of a stream, run-off on the ground, streams with low current, shoreline and clean-up sites.





- **Equipment required for a barrier 3 m long by 1 m high**

Building materials and equipment	• Planks (3 m × 0.2 m × 0.04 m) • Or panel of plywood (3 m × 1.20 m) • Plastic tarpaulin • Piles, stakes (wood, iron) 1.8 m long and 5 cm in diameter • Clamps	→ 6 → 1 → 3 m × 1.50 m → 8 → 4
Tools	• Sledgehammer, staple gun	

- **Construction time:** 20 minutes for a pair of trained operators
- **PPE:** gloves, safety boots or waders, helmet and life jacket according to conditions

Advantages	Drawbacks
• Rapid deployment with inexpensive materials • Oil-tight system • Equipment can be reused if only lightly contaminated	• Possible difficulty in driving in piles • Risk of overflow (for instance in case of rainfall) • Disturbance to the circulation of aquatic fauna

- **After use:** clean and repack if materials are only lightly contaminated or store in skips and treat polluted wood and plastic at a specialised plant.

Implementation

1. Drive the piles into the bottom and insert the planks between the piles, pressing them into the banks.

2. Place the tarpaulin in front of the planks.

3. Hold the device together using clamps or staples.

Other examples

Blocking off an oiled trench liable to flooding

Containment of effluent during a clean-up operation

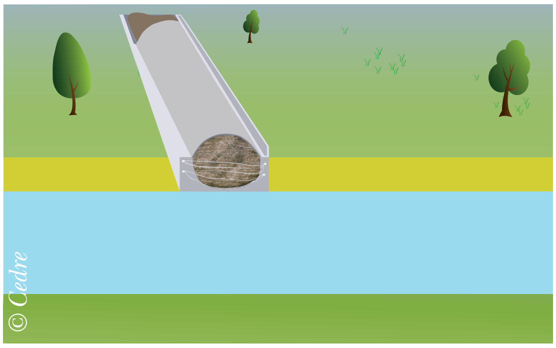
Run-off blocked in a concrete outfall using planks and plastic sheeting

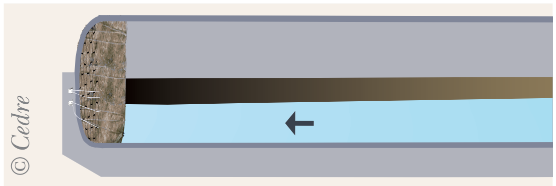
Tips and pointers

- Avoid complete blockage for extensive periods of time.
- In areas where the water flow needs to be maintained, prioritise the use of an "underflow" barrier (see SHEET 5) or "angled pipe" barrier (see SHEET 6).
- Use water resistant wood (prioritise plywood over chipboard).
- Possibility of using a staple gun to attach the plastic sheeting to the wood.

Complete blockage of a pipe by a plug

- **Substances**: floating, particles dispersed in water column, sinking, dissolved.
- **Environment**: this technique can be used on outfalls, pipes and concrete structures with a maximum of a 1 m diameter.





- **Equipment required to block the flow of an outfall 50 cm in diameter**

Building materials and equipment	• Casing: fine-mesh net (5 mm), geotextile or fabric • Filler: loose sorbent or other hydrophobic materials • Rope (10 mm in diameter) • Metal wire	→ 3 m × 2 m → 0.2 m^3 → 5 m → 1 roll
Tools	• Staple gun, wire cutters	

- **Construction time:** 15 minutes for 1 person
- **PPE:** gloves, safety boots or waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Very effective if plug is sufficiently oil-tight • Gives operators the time required and necessary conditions (reduced flow rate) to set up a more permanent solution	• High maintenance (to ensure durability and remove trapped oil and oiled materials) • Temporary (the upstream water level will rise)

- **After use:** sort and store in skips or on oil-tight tarpaulins. Polluted sorbents and nets should be treated at a specialised plant.

Implementation

1. Unroll the net on the ground.

2. Fold and staple it to form a cone.

3. Insert the chosen sorbent or hydrophobic material into the net and pack down.

4. Close the cone with rope that will be used to remove the device from the outfall. Position it in the outfall, making sure that it fits snuggly into the walls.

Other examples

Plug made of geotextile, vegetation and plastic sheeting

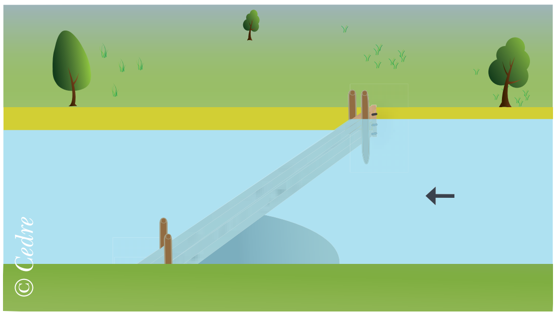
Plug made of bales of straw wrapped in geotextile

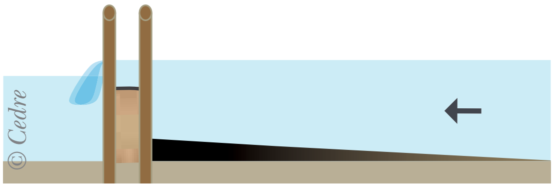
Tips and pointers

- Avoid complete blockage for extensive periods of time.
- In areas where the water flow needs to be maintained, prioritise the use of an "underflow" barrier (see SHEET 5), "angled pipe" barrier (see SHEET 6) or a "filter cartridge" (see SHEET 8).
- Do not hesitate to set up several devices in series for maximum effectiveness.
- A filter plug can be made, thereby maintaining the water flow, by less densely packing the cone.
- When deploying a plug upstream of an outfall, ensure that the accumulation of liquid will not push the plug into the outfall, making it difficult to retrieve (using the rope).

Containment by an overflow dam

- **Substances**: sinking.
- **Environment**: outfalls, channels, canals, trenches, streams, rivers, creeks, pipes, outfalls of limited width, depth and current.





- **Equipment required for a barrier 3 m long by 30 cm high**

Building materials and equipment	• Wooden planks (3 m × 0.2 m × 0.04 m)	→ 2
	• Or panel of plywood (3 m × 0.4 m)	→ 1
	• Or bags of sand or rubble	
	• Piles, rods (wood, iron) in the presence of current	→ 8, at least 1.5 m high
	• Metal wire	→ 1 roll
	• Plastic sheeting	→ 3 m × 0.3 m
Tools	• Saw, screws, wire cutters, sledgehammer, screw gun, staple gun, clamps	

- **Construction time:** 20 minutes for 2 people
- **PPE:** gloves, safety boots or waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Maintains flow of watercourse • Reusable materials and equipment	• Limit of use when current is too strong (risk of entrainment of the pollutant over the top of the barrier) • Need to work with arms in the water, sometimes without visibility • Disturbance to the circulation of aquatic fauna

- **After use:** sort then clean and repack material if only lightly contaminated or recycle and treat polluted wood and plastic at a specialised plant.

Implementation

1. Dig slots in each side of the bank to insert the barrier's planks. Cut the planks to this width.

2. Drive in the piles on each side of the river to hold the planks in place.

3. Insert the planks into the slots and slide them down to the bottom of the river.

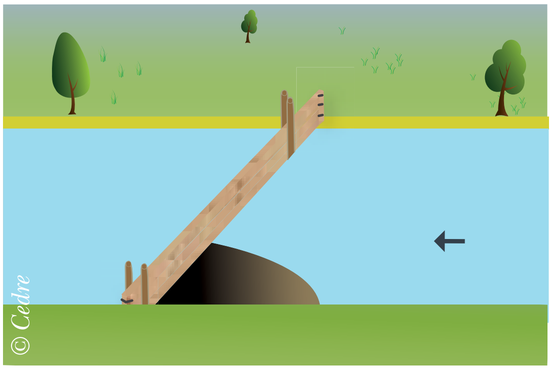
4. Reinforce the barrier by clamping the piles together.

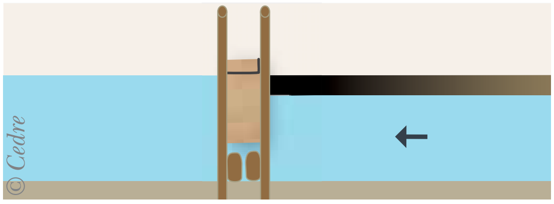
Tips and pointers

- Scythe vegetation on the banks if necessary to clear the area around the barrier.
- Use water resistant wood (prioritise plywood over chipboard).
- Wrap the planks in a plastic tarpaulin or position strips of rubber or neoprene along the joins between planks to improve oil-tightness.
- Sorbent booms can be added in front of the planks, at the ends of the barrier, to prevent leaks of pollutant around the edges of the barrier.

Containment by an underflow dam

- **Substances**: floating.
- **Environment**: outfalls, channels, canals, trenches, streams, rivers, creeks, pipes, limited depth and current.





- **Equipment required for a barrier 3 m long by 60 cm high**

Building materials and equipment	• Wooden planks (3 m × 0.2 m × 0.04 m) • Or panel of plywood (3 m × 0.6 m) • Piles, rods (wood, iron) • Metal wire • Plastic sheeting	→ 3 → 1 → 8 sections of 1.8 m → 1 roll → 3 m × 0.6 m
Tools	• Saw, screws, wire cutters, sledgehammer, screw gun, staple gun, clamps	

- **Construction time:** 20 minutes for 2 people
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Reusable materials and equipment	• Limit of use when current is too strong (risk of pollutant escaping under the barrier)

- **After use:** sort then clean and repack material if only lightly contaminated or recycle and treat polluted wood and plastic at a specialised plant.

Implementation

1. Dig slots in the bank to insert the barrier's planks.

2. Cut the planks to the required length, slide them in place and reinforce them with piles if necessary.

3. Cover with a tarpaulin to improve the barrier's oil-tightness and attach it using clamps.

4. In the case of a vortex effect, place a plank or vegetation in front of the barrier.

Other examples

Underflow barrier made of planks and plastic sheeting in an outfall

Underflow barrier made of plywood placed on wooden blocks in a stream

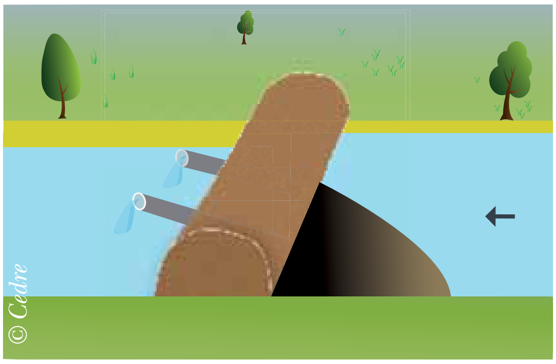
Tips and pointers

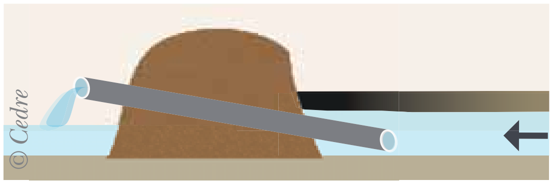
- If necessary, place a base on which the barrier can sit (bags of sand, stones...) on the riverbed; their size and number can also help to regulate the water flow under the device.
- To facilitate the work and prevent pollutant floating in front of the barrier from contaminating the banks, scythe vegetation on the banks where necessary and protect the banks (geotextile, roll sorbents).
- Use water resistant wood (prioritise plywood over chipboard).
- Wrap the planks in a plastic tarpaulin or position strips of rubber or neoprene along the joins between planks to improve oil-tightness.

SHEET 6

Containment by a bund with angled pipes

- **Substances**: floating.
- **Environment**: rivers, streams, canals, tidal flat and marsh channels, creeks, outfalls on the shoreline and in land. Avoid deep waters.





- **Equipment required for a 3 m barrier in 50 cm water depth**

Building materials and equipment	• Rubble, sediment. Used loose or in bags or big bags	→ 2 m³ (bagged) to 3 - 4 m³ if used loose
	• Rubble sacks, agricultural sacks or oyster bags made of synthetic or natural fibres (jute sacks, vegetable nets, oyster bags or big bags)	→ enough to contain 2 m³ of sediment
	• PVC or metal pipes 10 to 20 cm in diameter and 2 m long	→ enough to cover the width of the watercourse
	• Plastic sheeting for oil-tightness	→ 3 m × 1 m
Tools	• Excavator or other machinery, manual shovels, saw, metal wire	

- **Construction time:** 30 minutes to 1 hour for 3 people
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Maintains water flow and can handle possible variations in flow (self-regulation by pipes) • Durable over time • Reusable equipment	• Does not allow free circulation of aquatic fauna

- **After use:** sort then clean and repack material if only lightly contaminated or recycle and treat polluted plastic at a specialised plant.

Implementation

1. Cut pipes to the length required to pass diagonally through the bund that will be built.

2. Lay rows of bags until they emerge above the water surface, but not above the banks. A tarpaulin can be added to improve oil-tightness. Lay the pipes on top of the bags, through a hole pierced in the tarpaulin.

3. Hold the pipes in place by adding another row of bags on top of them. Continue in the same way across the entire width of the water-course.

4. Check that the number of pipes is sufficient to allow for a slight rise in water level upstream, without the watercourse bursting its banks.

Other examples

Barrier made using angled pipes and bags

Barrier made using angled pipes and bags

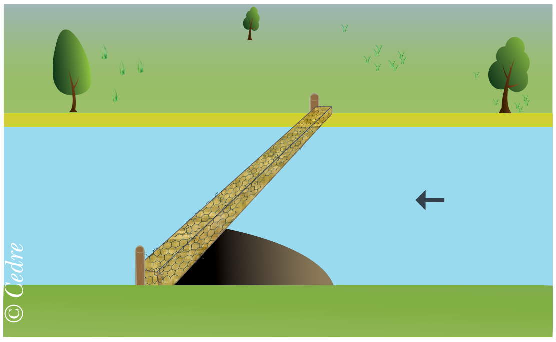
Tips and pointers

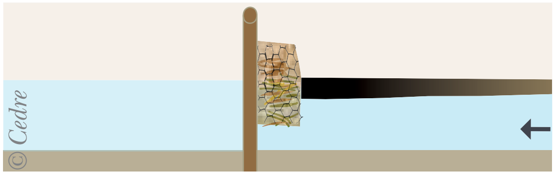
- The height of pipe outlets should not be greater than the height of the barrier to prevent the pollutant from escaping over the top of or around the barrier before the water flows through the pipe (use a line level to determine the height to be reached for the pipe outlet in relation to the bank).
- Do not hesitate to add more pipes if the flow rate is liable to increase (rainfall forecast...) and place the pipes across the whole section of the watercourse (if necessary, open and close them using plugs to regulate the flow of the watercourse).
- To prevent the pollutant from being pulled by a vortex effect, use a dogleg pipe or install a T-section at the underwater end of the pipe with free air intake, or place a plank at the surface above the pipe inlet.
- Place sorbents along the banks, upstream of the barrier, to prevent contamination by the pollutant.

SHEET 7

Containment - Trapping - Sorption at the surface

- **Substances**: floating. The more viscous the substance, the greater the efficiency.
- **Environment**: rivers, streams, canals, channels, creeks, sheltered coastal and harbour areas, edge of mangroves (avoid areas with strong currents).





- Equipment required for a barrier 3 m long x 0.5 m x 0.5 m

Building materials and equipment	• Casing: wire or plastic mesh/netting (chicken wire, debris netting, anti-hail netting, windbreak, eel net...) or agricultural sacks or oyster bags made of synthetic or natural fibres (vegetable nets, oyster bags, mussel nets...) • Filler materials: vegetation (straw, palm leaves, bagasse) or loose sorbent fibres • Mooring/anchoring: piles (wood, iron) with a minimum length equal to the water depth + 1 m, rope at least 10 mm thick, cable, wire	→ Length = 3 m → Width = 1.5 m for mesh → ½ m^3 → 8 15 m minimum, 1 roll
Tools	• Wire cutters, clippers, sledgehammer, staple gun for mesh	

- **Construction time:** 15 minutes for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Requires a limited quantity and small range of widely available equipment and materials • Low cost if natural materials are used	• Difficulty in driving piles into certain riverbeds • Permanent monitoring and regular maintenance required • If the filler material is not very hydrophobic, the barrier can sink and become heavier to handle.

- **After use:** sort, reuse structural and mooring elements, compost or incinerate vegetation. For manufactured materials (especially sorbents), prioritise treatment at a specialised plant.

Implementation:

If the casing is made of mesh, netting or any other material stored in rolls: how to build one section

1. Spread out the casing on the ground and fill with the filler material.

2. Close the casing.

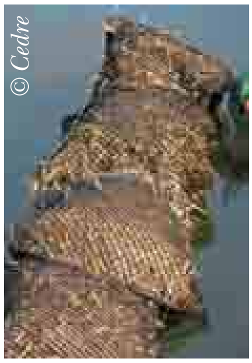
3. Attach the mooring points and connect to any other sections, then place in the water.

If the casing is made of pockets

1. Fill the pocket with filler material.

2. Close the pockets and connect them together.

3. Attach the mooring arrangements and place in the water.

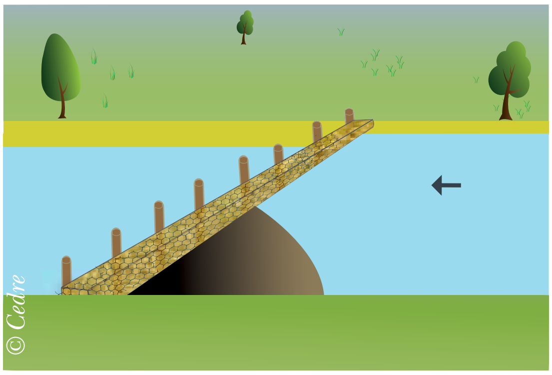


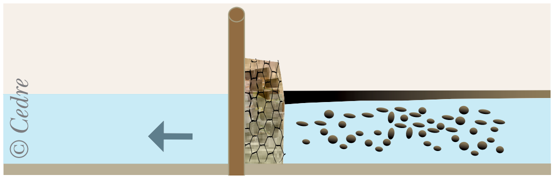
Tips and pointers

- To improve efficiency, position several barriers in series and replace them as soon as they are saturated.
- Efficiency is improved by using loose sorbents as a filler material.
- If the barrier tends to sink, add floats (empty jerrycans/bottles, foam blocks...).
- If the pollutant rapidly flows through the barrier, form a thicker amalgam upstream by spreading loose natural absorbent materials (e.g. peat).
- Plan for the renewal of vegetation by creating a stockpile in advance near to the barrier.

Water column filtration by a filter cartridge

- **Substances:** floating, particles dispersed in water column, sinking. The more viscous the substance, the greater the efficiency.
- **Environment**: rivers, streams, canals, channels, creeks, outfalls, water intakes, coastal and harbour areas. Avoid areas with strong currents as well as deep waters.





- **Equipment required for a barrier 3 m long by 1 m high**

Building materials and equipment	• Casing: wire or plastic mesh/netting (chicken wire, debris netting, anti-hail netting, windbreak, eel net...) or agricultural sacks or oyster bags made of synthetic or natural fibres (vegetable nets, oyster bags).	→ Length = 3 m → Width = 1.5 m for mesh
	• Filler materials: vegetation (straw, palm leaves, bagasse) or loose sorbent fibres	→ ½ m^3
	• Mooring/anchoring: piles (wood, iron) with a minimum length equal to the water depth + 1 m, rope at least 10 mm thick, cable, wire	→ 8 15 m minimum, 1 roll
Tools	• Wire cutters, clippers, sledgehammer, staple gun for mesh	

- **Construction time:** 30 minutes for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Requires a limited quantity and small range of widely available equipment and materials • Low cost if natural materials are used	• Difficulty in driving piles into certain riverbeds • Difficulty in determining the right thickness and density for the filter in order to let water through while trapping the pollutant without creating excessive head loss and excessive pressure of the water on the barrier • Need for constant monitoring and regular maintenance • The filler material can slump down in the filter and become heavy to handle if it is not sufficiently hydrophobic • Possibility of scouring at the bottom of the barrier if the current is too strong

- **After use:** sort and reuse structural and mooring elements, compost or incinerate vegetation. For manufactured materials (especially sorbents), prioritise treatment at a specialised plant.

Implementation

1. Spread out the casing on the ground and fill with the filler material.

2. Close the casing using wire or staples.

3. Drive in the piles and moor them to the banks (tree trunk, metal rods).

4. Attach the filter to the piles.

Other examples

Barrier at an outfall

Barrier made of vegetation

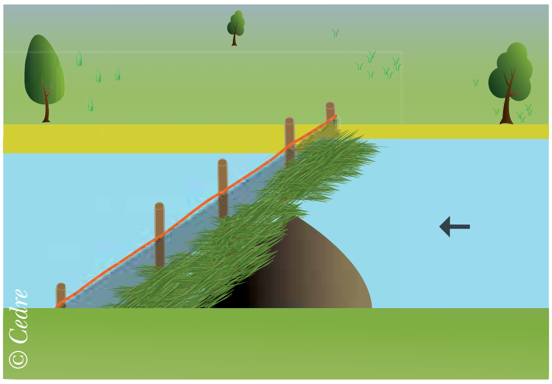
Filter barrier

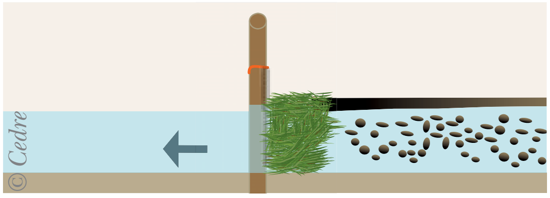
Tips and pointers

- Leave the top of the barrier open so as to access, and even replace, the filler.
- Possibility of tufting the casing to hold the filler in place (like a tufted cushion).
- If the pollutant flows through the barrier, form a thicker amalgam upstream by spreading loose natural absorbent materials (e.g. peat).
- In the case of large barriers, build the filter in several sections to facilitate handling and dismantling after use (filler material heavier when saturated with pollutant and water).
- Plan for the renewal of vegetation by creating a stockpile in advance near to the barrier.

Water column filtration by vegetation held by a barrier

- **Substances:** floating, fragmented into particles in water column, sinking. The more viscous the substance, the greater the efficiency.
- **Environment:** rivers, streams, canals, channels, creeks. Avoid areas with strong currents as well as deep waters.





- Equipment required for a barrier 3 m long by 1 m high

Building materials and equipment	• Fence: temporary fencing panel, wire fence, trellis, reed fencing, netting, picket fence...	→ 3 m × 1 m high minimum
	• Filter materials: plant leaves or fibres (straw, palm leaves, bagasse) or vegetation scythed on site	→ 1 m^3
	• Attachment/mooring: piles (wood, iron)	→ 8
	• Rope at least 10 mm thick, cable, wire	→ 1 roll
Tools	• Wire cutters, clippers, sledgehammer, staple gun for mesh, sickle, brush cutter, scythe	

- **Construction time:** 20 minutes for a pair of trained operators
- **PPE:** gloves, boots, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Requires a limited quantity and small range of widely available equipment and materials • Low cost if natural materials are used • Rapid to deploy if vegetation is stored in advance	• Difficulty in driving piles into some hard substrates • Difficulty in determining the right thickness and density for the filter in order to let water through while trapping the pollutant without creating excessive head loss and excessive pressure of the water on the barrier • Need for constant monitoring and regular maintenance (replacement of vegetation) • Possibility of scouring at the bottom of the barrier if the current is too strong

- **After use:** sort, clean and reuse structural and mooring elements, compost or incinerate vegetation. For manufactured materials, prioritise treatment at a specialised plant.

Implementation

1. Drive the piles in and attach the chosen fence to them.

2. Place vegetation scythed on the banks or collected prior to operations in front of the fence

3. Check that the set-up stands strong in the current and that the vegetation stays in place.

4. Possibly lay sorbents to improve recovery.

Other examples

Temporary fencing panel, vegetation scythed on site and overwintering film

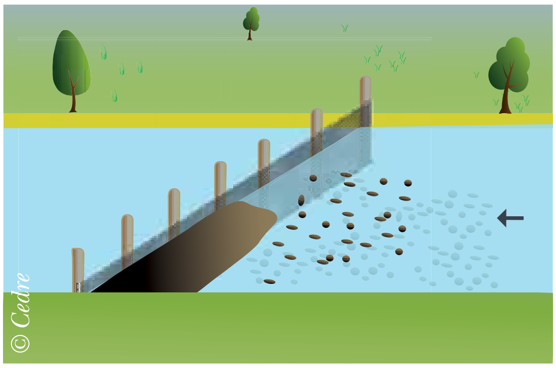
Fencing and straw

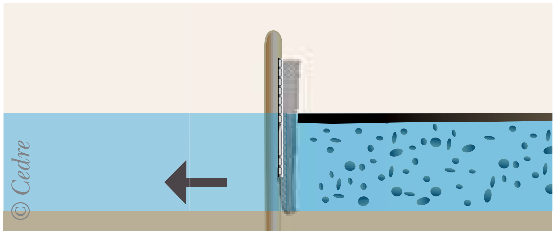
Tips and pointers

- Combine different types of vegetation within the same barrier or in several barriers to improve trapping/filtration.
- If the pollutant flows through the barrier, form a thicker amalgam upstream by spreading loose natural absorbent materials (e.g. peat).
- Plan for the renewal of vegetation by creating a stockpile in advance near to the barrier.

Water column filtration by netting

- **Substances:** large floating polluted particles or debris dispersed in the water column or sinking. The more viscous the substance, the greater the efficiency.
- **Environment:** rivers, streams, canals, channels, creeks.





- Equipment required for a 3 m barrier in a water depth of 1 m

Building materials and equipment	• Net with suitable mesh size for the particles to be caught: eel net, debris netting, agricultural netting, windbreak or fishing net	→ 3 m × 1.5 m high minimum
	• Anchoring: piles (wood, iron, concrete)	→ 6 x 2 m high
	• Attachment: synthetic or natural rope, metal wire, cable ties (nylon or polyamide)	→ 1 roll
	• Floats if necessary: foam or polystyrene blocks, plastic bottles or jerrycans, fishing net floats, inner tube	
	• Ballast if necessary: all types of metal chains, any very dense, low cost material with an anchor point, anchors, grapples	
Tools	• Sledgehammer, wire cutters, locking pliers, wood or metal saw (according to type of piles)	

- **Construction time:** 30 minutes for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Water flow maintained • Easy to handle • Low cost • Withstands current relatively well	• Difficulty in driving piles into some hard substrates • Difficult to keep upright over long distances • Disturbance to the circulation of aquatic fauna

- **After use:** sort, clean and reuse attachment, buoyancy and ballast elements. For nets and other manufactured elements that cannot be recovered, prioritise treatment at a specialised plant.

Implementation

Configuration 1: The net can be deployed across the watercourse and moored only to the banks.

Configuration 2: The net can be attached to several wooden piles.

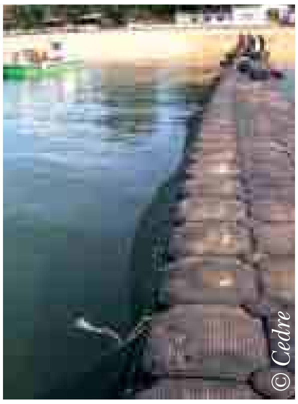
Configuration 3: Nets with different mesh sizes can be used in series to improve filtration. The piles may be made of concrete.

Configuration 4: The net, held in place by 4 piles, can be deployed in a V-shape, open facing into the current, to increase the filtration area.

Other examples

Protection by netting (buoyancy provided by polystyrene blocks), Prestige spill, 2002

Protection by nets attached to a floating pontoon, Prestige spill, 2002



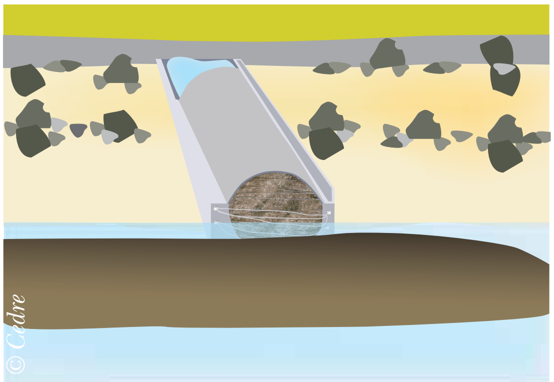
Tips and pointers

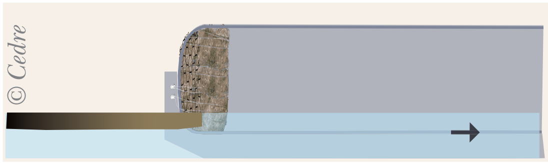
- Ballast the net to keep it in the water column.
- To reduce the strain on the net and enable free circulation of aquatic fauna, separate the net into two elements set up in a staggered configuration: the first from the bottom to midway up the water column and the second, a short distance away, from midway up to the surface (beware of the tidal range during spring tides). Angle the barrier in the direction of the flow, to prevent the formation of a pocket trapping aquatic fauna at the end of the ebb tide.
- Install a net with a larger mesh size upstream in order to collect litter and debris.

SHEET 11

Protection of a water intake by filtration

- **Substances**: floating, particles dispersed in water column, sinking.
- **Environment:** all types of pipes or structures supplying water to facilities.





- Equipment required for a 3 m wide water intake

Building materials and equipment	• Frame: - wooden planks (battens or beams) 20 cm wide - wooden struts 3 to 5 cm wide - metal or plastic mesh/netting (chicken wire, debris netting, anti-hail netting, windbreak or eel net...), agricultural or oyster nets made of synthetic or natural fibres (vegetable nets, oyster bags...) • Filtration materials: - vegetation (straw, palm leaves, bagasse) - or, better, loose sorbent fibres • Attachment/anchoring: - piles (wood, iron), ropes, concrete wall plugs and screws, wood screws, ratchet straps	 → 4 x 3 m long → 2 x 3 m long → 20 m² with 20 mm mesh max → 1 m³ → 1 m³ → according to conditions
Tools	• Sledgehammer, wire cutters, locking pliers, wood or metal saw (according to type of piles)	

- **Construction time:** 1 hour for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Requires a limited quantity and small range of widely available equipment and materials • Low cost if natural materials are used	• Difficult to find the right density of filter materials to ensure efficiency without leading to excessive head loss • Need for constant monitoring and regular maintenance • If the filler material is not very hydrophobic, it can slump down in the mesh and become heavy to handle • Only prevents visible contamination of installations without guaranteeing the water quality (no treatment of dissolved oil)

- **After use:** sort and reuse structural and mooring elements, compost or incinerate vegetation. For manufactured materials (especially sorbents), prioritise treatment at a specialised plant.

Implementation

1. Measure the water intake and cut the planks for the frame to size.

2. Assemble the wooden planks to make a frame of the required dimensions and reinforce it with wooden struts.

3. Fill the frame with chicken wire and loose sorbent fibres.

4. Attach the filter frame at the entrance to the water intake.

Other examples

Filter frame filled with straw

Mesh and straw device attached by ratchet straps and posts

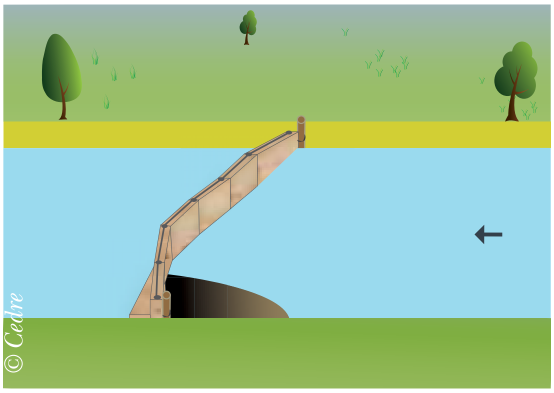
Track into which a perforated metal filter and sorbent fibres can be inserted

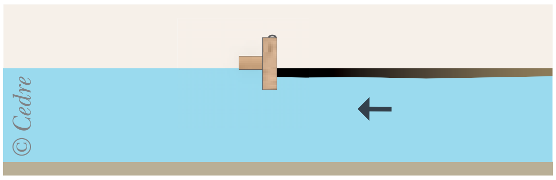
Tips and pointers

- Water intakes can be fitted with tracks into which metal filters, made to measure in advance, can be inserted.
- Monitor the filter's efficiency, do not hesitate to replace it when saturated.
- In the case of fluid pollutants, straw is not very effective, prioritise the use of oleophilic sorbents.
- A series of different types of devices will improve the effectiveness of filtration.
- On water intakes fitted with locks, valves, gates... where possible, completely close off the water intake then partially and gradually reopen it, checking the filter's hold and efficiency.

Containment - Deflection - Protection by wooden surface barriers

- **Substances:** floating, fluid to highly viscous.
- **Environment:** calm water bodies in inland waters (rivers, canals, channels), harbour areas or mangroves.





- Equipment required for a 3 m barrier

Building materials and equipment	• Wooden planks (thickness: 4 cm; width: 20 to 30 cm; length: 3 m), class 4 or 5 if in contact with seawater	→ 2
	• Connections, attachments:	
	- rope at least 10 mm thick, cable, wire	→ 1 roll
	- hinge and removable pin	→ 2 or 4
	- brackets and their screws	→ 8 to 10
	- screw-in or knock-in metal rings	→ 4 or 5
Tools	• Saw, hammer, screw gun, drill	

- **Construction time:** 1 hour for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Good mechanical strength and hold in current • Usable several times	• Difficult to build in an emergency • Risk of entrainment of pollutant under the barrier (low draught)

- **After use:** decontaminate and store for subsequent reuse. If the materials cannot be recovered, prioritise treatment at a specialised plant.

Implementation

1. Attach the two wooden planks together using brackets and screw the hinges to the ends.

2. Attach the metal rings to the edge above the surface.

3. Connect the sections together as they are placed in the water using the hinges. Pass a cable through the rings to reinforce the device and moor it to land.

4. Adjust the device so that it is at an angle in relation to the banks.

Other examples

Stockpile of barriers made of wooden planks, Hungary

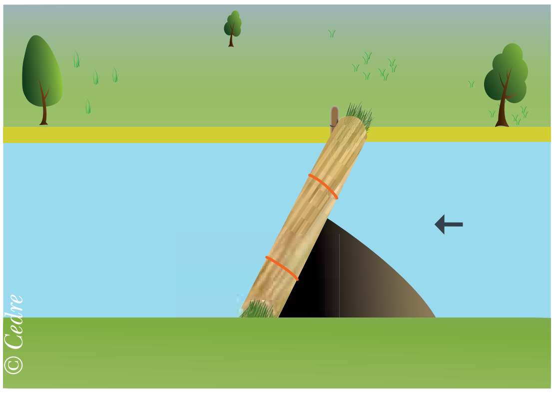
Stockpile of metal barriers, Hungary

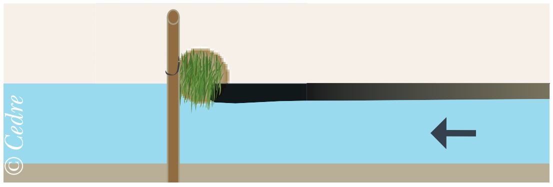
Tips and pointers

- Build barriers in advance and store them in order that they may be deployed in an emergency.
- Prioritise a barrier configuration in series.
- The more the barrier is at an angle in relation to the current (i.e. not completely perpendicular to the banks), the more effective it will be.
- Improve oil-tightness at the connection between planks by positioning strips of rubber (e.g. inner tubes) around the hinges.

Containment - Deflection - Protection by faggots of vegetation

- **Substances:** floating, fluid to highly viscous.
- **Environment:** calm water bodies in inland waters (rivers, canals, channels), harbour areas or mangroves.





- **Equipment required for a 3 m barrier**

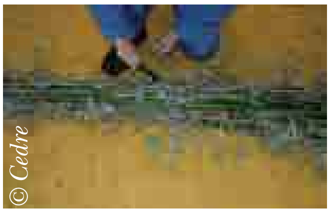
Building materials and equipment	• Vegetation: - Bamboo - Straw, hay - Reeds, pampas grass, wooden branches (such as wicker) • Rope at least 10 mm thick, cable	 → 30: 2 cm in diameter, 2 to 3 m long → 1 bale → 50 shoots 2 to 3 metres long, or more according to diameter → 1 roll
Tools	• Sickle or wire cutters, knife, cable tie gun	

- **Construction time:** 15 minutes for 2 people
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Easy to store and handle • 100% biodegradable if natural rope is used • Very low cost • Easy to build in an emergency if the materials are locally available	• If the vegetation used is only slightly hydrophobic, the barrier may sink and become heavy to handle (weight doubled in 24 hours for straw and pampas grass)

- **After use:** incinerate or allow biodegradation of vegetation. Manufactured elements (ropes...) should be treated at a specialised plant.

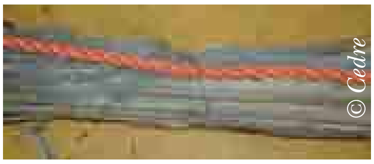
Implementation



1. Make faggots by binding shoots of vegetation together using the cable.

2. Join the faggots together, overlapping them by about 30 cm at each end.

3. Attach the mooring rope right along the barrier or, if not possible, to each end.



4. Place the device in the water, at as much of an angle as possible in relation to the current.

Other examples

Barrier made of reed fence and vegetation

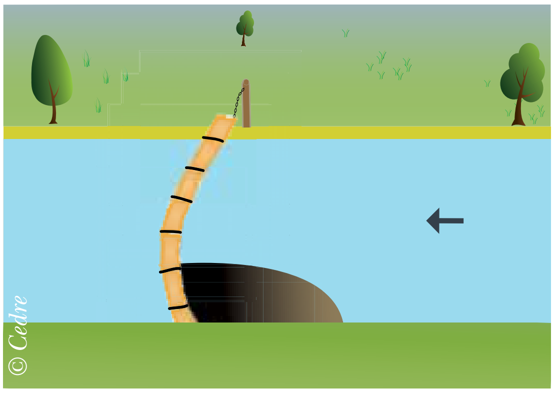
Barrier made of mesh and vegetation with buoys for increased buoyancy

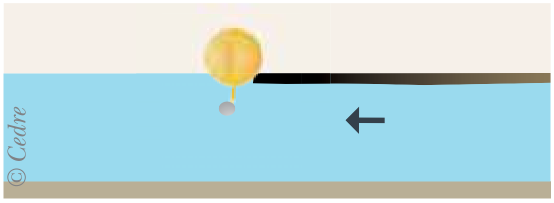
Tips and pointers

- The more the barrier is at an angle in relation to the current, the more effective it will be.
- Prioritise a barrier configuration in series.
- If the pollutant flows through the barrier, form a thicker amalgam upstream by spreading loose natural absorbent materials (e.g. peat).
- In the case of large barriers, build the device in several sections to facilitate handling and dismantling after use (filler material heavier when saturated with pollutant and water after use).
- Plan for the renewal of vegetation by creating a stockpile in advance near to the barrier.

Containment - Deflection - Protection by a custom-made floating boom

- **Substances:** floating, fluid to highly viscous.
- **Environment:** calm water bodies in inland waters, harbour areas or inshore.





- Equipment required for a 3 m barrier

Building materials and equipment	• Casing: oil-tight screen for the skirt (plastic-coated fabric, panel, thick tarpaulin)	→ 3 m × 1.20 m Enough to make 1 cylinder 3 m long by 30 cm in diameter
	• Float: any floating object that does not absorb water (jerrycan, closed empty bottle, foam block, buoy, floating vegetation)	
	• Ballast: any dense material that can be attached to the skirt (net filled with stones, metal chain, lead weights, bottles filled with sand)	→ 1 to 2 kg/m of barrier
	• Anchoring, mooring, attachment: rope, cable, wire	→ 1 roll
	• Tension member	→ 3.5 m of wooden piles
Tools	• Drill or hammer and hole cutter, wire, wire cutters, knife	

- **Construction time:** 45 minutes for a pair of trained operators
- **PPE:** gloves, waders, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Retention capacity increased with ballasted skirt • Sufficient life time so that it does not need frequently replaced • Can be attached to piles for better resistance to current	• Difficult to build a completely oil-tight device (unwelded tarpaulin) • Barrier materials more difficult to treat (plastic), after use prioritise cleaning for reuse • Significant construction time justifying the storage of pre-prepared elements

- **After use:** decontaminate and store for subsequent reuse. If the materials cannot be recovered, prioritise treatment at a specialised plant.

Implementation:

1. Roll the floats in the tarpaulin. Close the ends with wire.

2. Place the wood below the float to rigidify the device, overlapping the ends of each pile. Tie the wood and float together every 30 cm.

3. When using stones as ballast, place them in a net and tie the net closed with cable.

4. Place the ballast at the bottom of the tarpaulin and close with cable.

5. Place on water.

Other example

Barrier made of plastic bottles, plastic tarpaulin and a small ballast chain

Tips and pointers

- The barrier will be moored at the bottom and top (at the ballast and below the float).
- The more the barrier is at an angle in relation to the current, the more effective it will be.

Shoreline protection by a permanent dyke

- **Substances**: floating, particles dispersed in water column, sinking.
- **Environment:** accessible shore areas that are not sensitive to machinery.

- **Equipment required** (take into account any possible variation in water level)

Building materials and equipment	• Sand used loose or in big bags, baskets or geotextile socks • Bales of straw • Excavator or other machinery, manual shovels for small barriers

- **Construction time:** variable according to conditions
- **PPE:** gloves, safety boots or waders, helmet, high visibility vest and goggles

Advantages	Drawbacks
• Good mechanical strength • Oil-tight system • Rapid restoration of the environment in the case of bagged sediment	• If earthmoving machinery is used: high cost, need for suitable access, high impact on environment • Rapidly increasing logistics with the length of coast to be protected • Possible cost of processing loose materials • Destruction of the environment when on-site soil is used, potentially higher impact than that of the pollution

- **After use:** sort, clean and reuse packaging materials, compost or incinerate straw, treat polluted sediment at a specialised plant or bury at landfill according to degree of contamination.

Examples of dykes

Constructing a protective dyke using loose sand, Deepwater Horizon, Louisiana 2010

Constructing a protective dyke using sand-filled baskets, Deepwater Horizon, Louisiana 2010

Constructing a protective dyke using bales of straw, Morocco 2004 (←), and big bags (→), Deepwater Horizon, Louisiana 2010

Tips and pointers

- Technique only for use on sites with low ecological value (man-made beaches, urban areas)
- Prioritise the use of packaged sediment to prevent their direct contamination and therefore reduce waste.

Adaptation of port or industrial infrastructures

- **Substances**: floating, or possibly dispersed in water column.
- **Environment:** coastal and port areas, rivers, canals, channels, creeks.

- **Equipment required**

Floating structures	• Pontoons, barges, pipes
Filtration or protection elements	• Floating or sorbent booms • Geotextile • Wooden planks, nets
Ballast elements if necessary	• Any type of metal chain, any very dense, low cost material with an anchor point • Anchors, grapples

- **Construction time:** 10 - 15 minutes for 2 people (for 5 m)
- **PPE:** gloves, goggles, helmet and life jacket according to conditions

Advantages	Drawbacks
• Permanent device	• Need to dismantle and clean devices after pollution

- **After use:** dismantle, sort and clean polluted structural elements. For geotextile, nets etc., store in skips then destroy at a specialised plant.

Examples of adaptation

Using a floating pontoon as a containment means in a marina

Using a floating industrial pipeline as a containment means, Deepwater Horizon, Louisiana 2010

Using a floating pontoon to contain a spill, New Caledonia

Continuous assembly of several barges for containment and recovery using trucks on board the barges, Deepwater Horizon, Louisiana 2010

Permanent containment around a pontoon using marine plywood

Permanent containment around a pontoon using geotextile attached to bamboo trellis

Tips and pointers

- Fine-mesh nets or ballasted skirts made of plastic materials can be attached to floating structures to recover the pollutant in the water column.
- Protect floating structures (pontoons) using low cost, disposable materials rather than having to clean them after the spill.

Dynamic recovery - Booms towed by boats

- **Substances**: floating.
- **Environment**: coastal and port areas, rivers, estuaries, lakes, ponds (avoid rough water bodies).

This technique requires good experience of using boats and containment devices. Even in optimal conditions, the results will only be partial.

- **Equipment required** to build a 4 m boom and its tow beam

Building materials and equipment for the boom	• Boom casing: plastic-coated fabric, geotextile, mesh, net • Boom filler: vegetation or polypropylene fibres • Ballast: any dense material (net filled with stones, metal chain, lead weights, bottles filled with sand) • Float: any floating object that does not absorb water (jerrycans, closed empty bottles, foam blocks, buoys) • Rigidification and mooring elements: rope at least 10 mm thick, cable	→ 4 m x 1 m → 1 m^3 1 to 2 kg/m of boom → 3 - 4 but variable according to conditions 1 roll
Building materials and equipment for the beam	• Hollow metal or plastic tube (diameter 50 mm) and its sheath for attaching it to the boat • Pulley and its connection elements • Metal cable or rope (diameter 10 mm) or ratchet straps to attach the tube to the front and rear of the boat	→ 4 m + boat width → 1 set, variable according to boat dimensions
Nautical support	• Light boat	
Tools	• Wire cutters, screw gun, drill, staple gun for mesh	

- **Construction time:** Beam construction and installation: 45 minutes
  Boom construction: 15 minutes for 2 experienced operators
- **PPE:** gloves, waders, goggles, helmet and life jacket

Advantages	Drawbacks
• Enables dynamic recovery of pollution spread across a calm water body • Can be used on sites which are difficult to access by land.	• Requires material, time and skills for construction and use on the water • Unworkable on rough waters or in the case of poor visibility

- **After use:** dismantle and clean the beam. Dismantle, sort, clean and recycle or reuse structural elements, ballast, floats and mooring arrangements. Destroy filler materials by biodegradation or composting in the case of vegetation or at a specialised plant in the case of polypropylene fibres.

Implementation

1. Build the boom designed to be towed.

2. Build the beam and attach to the boat.

3. Attach the boom to the beam and to the boat.

4. Adjust the boom's position and conduct a trial on the water.

Other examples

Unilateral towing of a boom made of polypropylene fibres

Example of towing two straw booms

Tips and pointers

- Drive at low speed (0.5 knots max.) or remain stationary facing into the current and wait for the pollutant to drift towards the boom.
- To improve retention of the pollutant, absorbent matter (such as peat) can be placed at the apex of the containment boom.
- Beware of floating debris which could damage the boom.
- Difficult to manoeuvre when the boom is at the side of the boat, if the boat is light.
- Pulley systems used to close the boom in against the boat facilitate turning manoeuvres.

Further information

Glossary and acronyms

Aber
Deep river estuary in Brittany.

Bagasse
Residual matter from sugarcane, that can be used to fill a barrier.

Batten
Thin wooden plank.

Beam
Long pole attached to a boat and to which booms can be lashed.

Big bag
Very large capacity sack (around 1 m^3).

Broom
Small non-prickly shrub with yellow flowers (often grows next to gorse) that can be used to fill a barrier.

Brushwood
Undergrowth vegetation (heather, gorse, broom, ferns...) that can be used to make barriers.

Bund
Construction or earth dyke, embankment.

Cofferdam
Temporary dyke or dam built on a water course using sediment, planks...

Coir
Bristly fibres from the outer husk of coconuts.

Containment
Act of containing, whereby the space available to the pollutant is reduced.

Copra
Meat extracted from coconuts.

Creek
Small channel.

Drain
Underground pipe for water run-off.

Duct
Pipe, generally made of concrete, of varying diameter.

Ebb tide
Outgoing tide.

Filler materials
Materials used to fill the casing of a barrier.

Furl
Here, fold and attach a net using pieces of rope.

Geotextile
Synthetic textile used as support and filters in the public works sector.

Gorse
Small prickly shrub with golden flowers (often grows next to broom) that can be used to fill a barrier.

Hawser
Thick rope used for mooring.

Hydrophobic
Characteristic of a substance which has no affinity with water, that water does not wet or alter.

Kapok
Impermeable, rot-proof, very light plant fibre composed of fine, silky hairs which cover the seeds of the kapok tree.

Kapok tree
Great Java kapok tree that provides kapok. Also known as the silk cotton or ceiba tree.

Modular jetty
Jetty composed of a certain number of floating elements assembled together.

Oleophilic
Property of substances presenting an affinity for oils, absorbing them selectively.

Outfall
Large pipe opening.

Overflow
Evacuation of the upper section of a water body.

Picket fence
Fence made of vertical wooden slats joined together with wire (often found along beaches to protect the dune). Can be used to make barriers.

Pool (as opposed to riffle)
Section of a watercourse characterised by a widening of the channel, increased depth leading to a decrease in current speed.

PPE
Personal protective equipment.

Race
Portion of a watercourse or navigational channel.

Ratchet strap
Strap whose tension can be adjusted with a ratchet. Can be used to attach a barrier.

Reed
Giant reed, long and flexible, used to make barriers.

Removable pin
Metal peg or pin used to assemble two parts each pierced with a hole.

Retention
Action of holding back.

Riffle (as opposed to pool)
Section of a watercourse characterised by a narrowing of the channel, decreased depth leading to an increase in current speed.

Scouring
Excavation by water flow, due to the current hitting a structure or bank.

Sinker
Anchor, mooring ring attached to a permanent block.

Sisal
Agave (plant) whose fibrous leaves are used to make a textile that can be used to fill a barrier.

Sorbent
Solid product capable of trapping and retaining a liquid pollutant.

Sorption
Capacity of certain substances to pick up and retain another substance.

Tufting

Here, as an analogy with cushion-making, to fill a casing with materials to absorb the pollutant and segment the envelope into pockets using staples or wire.

Underflow

Evacuation of the lower section of a water body.

Vortex

Whirlpool movement that can be observed when emptying a bath for instance.

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