WHAT IS A CONFINED DISPOSAL FACILITY?
The appropriate disposal of dredged material from navigation, maintenance or deepening projects is almost always an important issue when determining the feasibility of a project. Especially contaminated dredged material can pose an unacceptable risk to the surrounding waters and land. Finding a suitable site for placing dredged materials is therefore a crucial part of the planning and management of a dredging project.

A Confined Disposal Facility (CDF), sometimes called a confined placement facility, is an area specifically designed for dredged sediments that provides complete enclosure, both horizontally and vertically, for sediments dredged from the surrounding waters or soils. The basic objective for a CDF is to retain dredge material solids and allow the discharge of process water from the confined area. For sites receiving contaminated material an added objective is to isolate contaminated dredged materials so that the quantity of materials is reduced and they are prevented from being transported out of the area.

WHERE ARE CDFs LOCATED?
CDFs can be constructed on land, in water as islands or nearshore using the coast as one side of the containment facility. When island and nearshore facilities are built, the dikes are constructed above the mean high-water elevation to prevent direct exchange with the adjacent waters. On land, unused borrow pits may provide good opportunities for placement of sediments, especially if there is no groundwater flow. In addition, CDFs should be located close to urban areas where they can be utilised for building materials. When more distant locations are used, the safe transport of the materials becomes an additional issue.

WHY ARE CDFs USED?
As a result of complex legislation, lack of space and public resistance, cost-effective solutions for dredged material, especially when it is contaminated, are becoming more and more difficult to find. Most commonly, CDFs are used for the placement of contaminated sediments which are not suitable for unconfined or semi-confined placement, or in case when large volumes dredged in a short timespan can’t be beneficially reused In some cases the confined area is a final destination; in others it is a temporary site for re-handling the contaminated sediment by dewatering or other means. Many CDFs receive material periodically over an extended timeframe and completely filling a CDF may take many years. Still, finding areas to use for confined placement can be a challenge. Especially near coastal areas, where the need for CDFs is the greatest, the competition for other land uses such as housing, recreation, and nature reserves is great. Since the CDFs are visible to the public, stakeholder scrutiny and political considerations can become intense and the NIMBY (Not In My BackYard) reaction must be addressed. With this in mind, the need to plan the efficient use of a CDF during exploitation and after it is filled has become imperative.

ARE CDFs AN EFFICIENT WAY OF HANDLING CONTAMINATED SEDIMENTS?
Despite the high costs and difficulties of finding suitable locations for CDFs, they are a cost-effective way of disposing of unusable dredged material. This is a good reason for optimising the storage capacity of existing CDFs and prolonging their lifespan. This optimisation can take place in several ways:

- by treating and using the dredged material, instead of simply disposing of it, for instance, by natural dewatering in lagoons or by separation of sand into sedimentation basins;
- by examining older CDFs where dredged material may have become relatively clean during natural separation and can now be reclaimed and used;
• by reducing the volume of the materials in the CDF as much as possible by vacuum consolidation or
• by raising the height of the dikes around the CDF, if financially, environmentally and aesthetically viable.

The longer a CDF can be used, the longer it is operational, the more cost-efficient for port authorities and others planning dredging operations.

WHAT ARE THE DIFFERENCES BETWEEN AN UPLAND CDF AND AN ISLAND OR NEARSHORE CDF?
An upland CDF is a facility constructed on dry land in which the dredged material is stored above the groundwater level, with an enclosing dike to confine the dredged material. In some cases, a watertight liner may be necessary to prevent emissions into the groundwater.

An island/nearshore CDF is also diked but constructed in water and the dredged material is at least partially stored under the water level. But island and near-shore CDFs can be filled hydraulically which makes them less expensive to fill. Sediments in an upland CDF, as they are not stored in the water, undergo more consolidation which is an advantage with regard to optimal volume use.

In both cases, the CDFs are visible, which makes them relatively simple to monitor, but may disturb the aesthetics of the surrounding areas to the dismay of the public. Finding productive uses for CDFs during and after their primary exploitation can mitigate these negative reactions, improve the public’s perception, whilst extending the usefulness of the CDF.

WHERE ELSE CAN CDFs BE LOCATED?
Borrow pits in river floodplains, estuaries and nearshore areas formed by extraction of sand, gravel or clay are potentially suitable for storing contaminated dredged material, in particular when the dredged material cannot be used directly in a beneficial way, e.g. as fill material. The feasibility of such storage depends on the quality of the material and the local conditions. The potential effects on the environment demand attention during the planning and decision-making processes.

GIVEN THE SHORTAGE OF SUITABLE SITES, HOW ELSE CAN THE USE OF CDFs BE MAXIMISED?
The lifespan of a CDF can also be extended by finding uses for the CDF after its operational period is over. That is, an end use may be found for the CDF once it is completely filled. Of course, environmental legislation as well as public perception and potential eco-toxicological risks must be taken into account. The long-term management of monitoring, inspection and maintenance is essential to ensuring the integrity of the CDF whilst it is being filled as well as after it is filled.

WHAT ARE SOME POTENTIAL USES OF A CDF?
CDFs may have treatment areas such as sedimentation basins. These basins take up a great deal of surface area but, by planting reed or helophytes, they can be transformed into bird habitats. Wetlands, created from the dredged material held in a CDF, also can provide an area for water purification or can act as wildlife habitats. Both these solutions not only encourage restoration of the natural environment but also create a revitalised landscape.

CDF sites can also be used for certain kinds of agriculture (non-edible plants), for instance tree farms for paper or re-forestation in general for wood products. Consider, for instance, that willows can extract contamination out of the soil. Trees again are a magnet for animal habitats, and in general well-regulated disposal sites can offer nature and habitat enhancement. Recreational enhancement is also possible such as golf courses, terrain for bicycling, fishing, boating and other water sports.

Since CDFs are often located near urbanised areas they can also be re-used as industrial and commercial sites as long as attention is given to the storage, drainage, and the chemical and mechanical specifications. Often CDFs are designed in function of port extension areas, often applied in Scandinavia. Public acceptance must also be considered. Other uses may be as a site for windmills for energy production and barrier islands for shoreline protection. These functions can have positive ecological and economic impacts.

HOW CAN THESE USES FOR CDFs BE REALISED?
In the planning stages for a CDF, prior to its design, location selection and construction, the possibilities of combining the primary function of the CDF (receiving contaminated sediment) with other functions should be considered. If this is not possible, because for some reason the secondary uses may not be immediately obvious throughout the time that the CDF is operational, other potential uses should be kept in mind.

Since CDFs function over long periods of time, even decades, this requires a level of alertness for all involved in urban and spatial planning – federal and municipal government agencies as well as stakeholders.

WHAT ARE EXAMPLES OF WELL-MANAGED CDFs?
De Slufter is a nearshore CDF close to the Port of Rotterdam and the industrial area known as Maasvlakte in the Netherlands. Started as a diked, sub-aquatic nearshore CDF 25 metres below sea level in 1987, twenty years later it is filled to sea level and in the future will be filled to 25 metres above sea level. At present sand separation and clay production for the dikes. Once it is fully filled De Slufter will be used for recreation and nature activities guarded by a system for monitoring contaminants in perpetuity.

In the USA and Canada, which both border the Great Lakes, sub-aquatic CDFs have been built, but most of them are filled or rapidly filling. Consequently efforts are being made to better manage CDF sediments by dewatering to facilitate compaction, thus creating additional capacity in existing CDFs. Other plans have created a CDF as shoreline protection structure, a barrier island, and in some places on the Great Lakes, CDFs have been converted into wildlife habitats and parklands.
where regulations have enforced control at source, total elimination of contaminated sediments from dredged materials is probably a utopian goal. CDFs will therefore remain an important tool for the storage of these materials in environmentally sound systems.

At the same time, CDF capacity will also remain an issue. Because of their scarcity and the difficulty in finding suitable locations, CDFs should only be used for materials that cannot otherwise be relocated or treated for a subsequent use. The importance of finding secondary uses for CDFs and remediating contaminated sediments and finding uses for them will remain urgent in most parts of the world. Long-term spatial planning and anticipating future needs must take place as early as possible, preferably in the design stage prior to construction. Case-specific approaches and tailor-made solutions will remain an important element in the planning and management of CDF projects and these solutions must be sought in close communication with all stakeholders in order to comply with legislation and safeguard environmental values.

In the 1990s sites for storage of contaminated sediment in the East Flanders area of Belgium was so limited that certain dredging projects had to be postponed. With the combined efforts of a private-public partnership known as CVBA Fasiver the clean-up of a brownfield which presented environmental and health risks was begun. The project comprised three stages: remediation, use of the premises as a sediment-processing centre and the final rezoning. Ultimately the site will be used as an industrial area for businesses and a green belt built on sanitised land will create a buffer between the industrial area and the adjacent residential area on the other side of the Upper Scheldt River.

Another remarkable end use for CDFs has been achieved in Japan where both Tokyo’s Haneda International Airport and the new Kitakyushu Airport are located on CDFs which have been dewatered and covered by geotextiles.

**WILL CDFs ALWAYS BE NECESSARY?**

Probably. Waterborne transportation remains one of the most efficient and environmentally clean methods for global trade which means ports and harbours will continue to need navigational and maintenance dredging. And although progress in pollution control has been made, particularly where regulations have enforced control at source, total elimination of contaminated sediments from dredged materials is probably a utopian goal. CDFs will therefore remain an important tool for the storage of these materials in environmentally sound systems.

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**Ketelmeer** is a lake in the Netherlands situated at the mouth of the IJssel river, a branch of the Rhine. For years the lake was a basin where sediments transported by the river became trapped. The waters are very shallow, less than 3 metres and the upper 30-60 cm of the fine sediment was heavily contaminated. In the 1990s the decision was made to clean up the area and to store the contaminated sediments in a newly built CDF, an artificial island named "IJsseloog", with a capacity of 20 million cubic metres. Dredged sediments that contain large quantities of sand are pumped into an adjacent sand separation lagoon. The clean, separated sand can be used for the construction of roads. The contaminated residual is then stored in IJsseloog.
FOR FURTHER READING AND INFORMATION

Great Lakes Commission [https://www.glc.org/](https://www.glc.org/)


The CEDA/IADC book [Dredging for Sustainable Infrastructure](https://www.iadc-dredging.com/en/knowledge-base) gives state-of-the-art guidance on how to design, implement and manage a water infrastructure project with a dredging component.