# Monitoring sludge spill of the AMORAS underwater cell

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## Introduction

In 2006 the Flemish authorities in association with the Antwerp port authority launched the AMORAS project as a sustainable solution for maintenance dredging material from the port of Antwerp. AMORAS stands for Antwerp Mechanical Dewatering (Ontwatering), Recycling and Application of Sludge. The building of the site started in October 2008. End of 2011 the installation became operational.


Fig. 1. AMORAS production sites: 1. underwater cell, 2. Sand separation, 3. Piping, 4. Consolidation ponds, 5. Dewatering installation, 6. Water treatment, 7. Storage.

After separating the sand from the dredged material, the remaining sediment is mechanically dewatered and stored, see Fig. 1. The ambition is to finally recycle the dewatered sediment for other beneficial uses, e.g. in construction materials.

## AMORAS underwater cell

Dredged material is temporarily stored in the AMORAS underwater cell (underwater cell), step 1 in Fig. 1. An electrically powered cutter suction dredger picks up the sediments from the underwater cell and pumps it to the sand separation: step 2 in Fig. 1. The underwater cell is a local deepening, up to 16m depth (-12mTAW) in the shelter dock. The underwater cell is separated from the navigation channel by an underwater steel dam reaching up to 9m below the surface (-5mTAW), see Fig. 2.

## Problem statement

In 2013 it was noticed that from all the dredged material dumped into the underwater cell only 70% was recovered again by the cutter suction dredger and send to the sand separator. Since summer 2013 both de dredging activities inside the port and the production rate of the cutter dredger and the AMORAS dewatering site have been increased. Since that time no more that 50% of the delivered material could be removed from underwater cell by the cutter dredger. At the same time the Antwerp port authorities noticed an increasing mud layer in the neighbouring navigation channel. One could assume that the underwater cell is saturated and overflowing. The operator of the AMORAS site and the cutter suction dredger, however, claims that the cutter is still operating on

more than 12m depth (-8mTAW) in order to pump sludge with a preferable density of 1.12ton/m³ while the delivered sediment typically has a density between 1.15 and 1.2ton/m³.


Fig. 2. Location of the underwater cell.

**Methodology**

For both the operator of the AMORAS site and the authorities it was necessary to get a clear view on the spill of sludge at the underwater cell. Therefore different analyses have been performed. Densities and shear resistance inside the underwater cell and the neighbouring navigation channel have been monitored by means of two Graviprobe© survey campaigns in 2012 and 2014. The fast response of the mud levels inside the underwater cell have been monitored intensively by means of regular single beam echo sounding surveys during a normal tree-week working regime. Sediment losses during dumping of the material in the underwater cell have been measured by optical backscatter. Historical multi- and single beam echo soundings of the underwater cell and navigation channel since the underwater cell came into operation have been analysed. Finally consolidation processes of the delivered sediment have been analysed under laboratory conditions by means of consolidation columns.

Results of these analyses and recommendations to the operators and authorities will be discussed in the proposed paper.