

Demonstrate and evaluate innovative sediment reuse solutions for flood and erosion protection - XRF quick scan of sediment composition

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Introduction: Demonstrate and evaluate innovative sediment reuse solutions for flood and erosion protection. Pilot application of sediment reallocation within the system to 'reset' a natural system for bank nourishment in Port of Rotterdam. 500.000 m³ (200.000 tons) of dredged sediment were reallocated between 2019 and early 2020.

Methods: Full water monitoring was not considered as the pilot is carried out in an open system. Impact monitoring of the extraction and reallocation operations was part of the pilot programme. Receptor site being underwater, its baseline monitoring was done with traditional sampling and was part of Port of Rotterdam work programme. Sediment was sampled underwater from a sampling vessel, using either an Ekman-type sampling bucket, either a weight operated coring device (Figure 1).



Fig. 1: Bucket and core-type sediment samplers.

The on-site baseline survey was therefore limited to real-time measurements during a bottom sediments sampling cruise, on February 6th, 2019 (T0).

Then three operations campaigns (T1, T2 and T3) were led on July 2nd, September 4th, 2019 and February 18th, 2020. All were organised by Port of Rotterdam and Deltares with the participation of BRGM. At most, according to the campaigns, 20 points were sampled along the estuary (Figure 2).

All analyses were performed using the Niton XL3t980 GOLDD model. For each sample, a pellet was made using the hand press to remove as much water as possible and solidify the sediment (Figure 3). Two measurements were made on each pellet in two different places of the same face of the pellet.



Fig. 2: Location of all sediments collected along the estuary during the survey (4 campaigns).



Fig. 3: Hand press used to partly dehydrate sample.

Results: No element anomalies were recorded beyond expected geochemical background.

Time-bound variations are limited and may reflect sampling heterogeneity. Total contaminants range decrease from upstream to downstream, but are never very high (Table 1).

Tab. 1: Statistic parameters for Pb, As, Zn and Cu analysed by pXRF on the boat.

Statistic	Pb	As	Zn	Cu
Minimum	12	4	22	13
Maximum	195	66	643	128
Median	19	7	66	23
Mean	33	10	112	30
SD	41	14	138	26

Discussion: Inorganic analyses were performed in quasi-real time on board the sampling ships, using a handy dehydration press on freshly dredged samples. It was possible to obtain a first measurement of the main contaminants (Pb, Zn, Cu, Cr, As) within minutes, between two sampling stops. This would have allowed refining the sampling plan if anomalies had been encountered at sampled sites. The total contaminants range decreases from upstream to downstream, but levels are never very high.