Baseline monitoring at a pilot site for sediment reuse

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Introduction: The Interreg NWE SURICATES project aims to promote dredged sediment reuse for climate change adaptation, flood protection and coastline defence [1]. Reuse options and supporting research were investigated during an earlier project [2]. In order to provide port and waterways operators and related industries, with full scale case studies, large scale pilot tests are led at Scottish and Dutch sites.

At Bowling, 30 km west from Glasgow, a regeneration site lies between the River Clyde and Forth & Clyde Canal. The project includes a housing development, green areas and canal recreational uses. A former railway line, to be converted into a cycle path, divides the site. Sediment will be applied on low-lying areas for land uplift and flood mitigation, and used to construct coastline protection.

Methods: Before pilot works begin, a baseline survey was completed using a portable XRF (pXRF) to test feasibility of the method for identifying potential inorganic contaminants in soils, riverbanks and sediments to be dredged. Existing boreholes allowed a shallow groundwater survey at a network of observation wells (multiparametric probe profiles and adaptive water sampling). This baseline survey does not supersede the regulatory requirements. Instead it is aimed at demonstrating how field measurements can be used to inform sustainable remediation options in the early design stage and to facilitate effective site monitoring.

Surface soils were analysed with a Niton XL3t-980 pXRF on raw or 2mm sieved soil and on riverbank sediment along traverses at < 50 m intervals. Dredged sediments from the canal as received (water 60-80%) were reduced (to water 25-35%) with a hand operated filter press. In this range, measurements carried out on wet pressed pellets correlate well with laboratory analyses [3].

Results: The resulting data (Fig.1) suggests that canalside soils (and possible areas of sediment deposition) north of the old railway line are more homogeneous and have lower contaminant levels than the soils and made ground along the Clyde and former railway sidings.,.

Further measurements on dried pellets and laboratory analyses will allow us to distinguish residual moisture bias from instrumental bias.

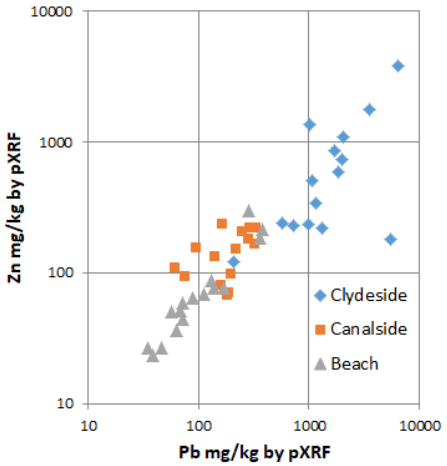

Fig. 1: Pb and Zn concentrations by pXRF (mg/kg) in soil and Clyde beach sediment.

A shallow groundwater survey of observation wells (multiparametric probe profiles, Fig.2, and adaptive water sampling) at the site showed rainfall-affected water (EC = 300-400 µS/cm) at the surface but more saline waters at depth (EC of 500, 800 or 1400 µS/cm), and seawater-affected wells (EC about 15 mS/cm). The water table is shallow (0.7 to 6 m) and affected by tide (up to 1 m). Water composition changes, therefore, with higher EC expected at high tide. Further information is expected from ongoing contaminant analyses.

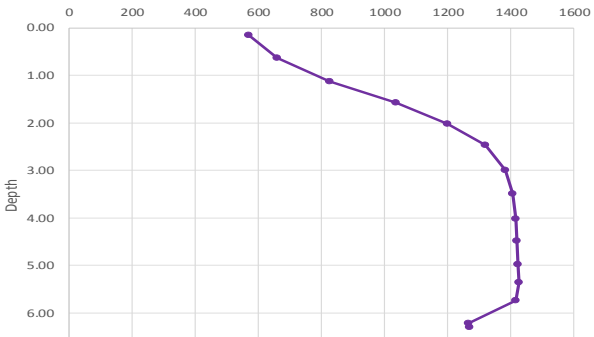

Fig. 2: Conductivity profile by multiparametric probe (µS/cm) in shallow groundwater, BH19.

Discussion: Site-specific threshold values for pXRF measurements can be derived from regulatory limits after calibration. They can be used during works to identify potentially off-specification sediments in quasi real time.
Such measurements will be developed at pilot works and post-pilot stages, and are expected to facilitate operational management decisions. We will replicate this scheme at other pilot sites (Fort William, Scotland; Rotterdam, Netherlands) and report at the next SedNet conference.

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References: [1] Wijdeveld, A. et al., (2017) *SedNet conference*; [2] Debuigne, T. et al., (2015) *SedNet conference;* [3] Lemière, B. et al., (2014) *GEEA* **22**:222-233.

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