Case Study: Beneficial Use of Sediments

Project	Phytostabilisation, technosol & brownfield biofuels
Classification	*R1A_2008_UK*
Major Function	*Raw material*
Other Functions	*Remediation*
Location	*Tees Barrage, Stockton-on-Tees, UK*
Volume	*c.500 m^3*
Technique	*Phytoremediation*
Contaminants	*Potential heavy metal impacts, former industrial/mining area*
Granulometry	*Sand to silty sand sediment (loamy sand to sandy loam soil)*
Scale	*Experimental trial, 0.14 ha*
Client	*British Waterways (now Canal & Rivers Trust)*
Executor	*Clean Environment Management Centre, University of Teesside*
Research program	*BioReGen - Biomass, Remediation, re-Generation: Reusing brownfield sites for renewable energy crops (EU Life05 ENV/UK128)[1], Waste & Resources Action Programme (WRAP OMK004-029), SURICATES - Sediment Uses as Resources In Circular And Territorial EconomieS (Interreg NWE462)[2].*
Contact	*Richard Lord, University of Strathclyde, Glasgow*
Year start - end	*2008-2020*

Description of the project

Sandy river sediments arising during bridge construction were spread on a partially restored brownfield site for natural dewatering, prior to seeding with reed canarygrass (*Phalaris arundinacea*) for phytostabilisation, soil formation and perennial energy crop production (1).

Material was excavated mid-channel from the river bed in early 2008 via a temporary coffer dam required during construction of the river pier of the Infinity Bridge (3). This section of the River Tees was originally tidal until construction of the Tees Barrage in 1995 by the Teesside Development Corporation. The restoration and remediation of this extensive derelict former heavy industrial area was begun following Margaret Thatcher's famously photographed "walk in the wilderness" in 1987 (4).

In early February 2008 the excavated sediments were tipped wet onto a partially restored area of made ground, underlain by steel slag, then spread by excavator and dozer (photo 1). By early April the placed material had dried sufficiently to allow access for soil sampling and hand broadcasting of uncertified reed canarygrass seed at an application rate of 20 $kg.ha^{-1}$ (photo 2). Soil analyses confirmed that levels of heavy metals, including Cd, Cr^T, Cu, Pb, Hg, Ni, Zn, exceeded CEFAS action level 1 "trigger" concentrations but were well below action level 2 marine disposal limits (5) or any applicable guideline values, other than Zn at the limit for topsoil (6) or subsoil (7) as saleable products. The sandy-soils had a low organic matter content (2-3 %) and low nutrient status, especially for available N.

Although seed was broadcast directly on the crusted surface of the unamended and untilled soil, reed canarygrass showed rapid establishment (photo 3) and strong subsequent growth for c. 10 years without further agronomy (photo 4). Average over-wintered yields of 6 and 8 $odt.ha^{-1}$ per annum were determined for the 2011 and 2012 seasons, comparable with long-term results from other brownfield sites (8). Uptake of PTEs in the mature biomass was sufficiently low to meet standards for reed canarygrass fuel pellets (9). Longer term benefits are now being evaluated (2).

Graphical information

Figure 1. Material placement on restored brownfield site, Tees Barrage, Stockton-on-Tees, UK, February 2008.

Figure 2. Baseline sampling after dewatering, April 2008.

Figure 3. Reed canarygrass seedlings and voluntary re-vegetation, July 2008.

Figure 4. Mature reed canarygrass and briquetted biomass, February 2010 (©University of Teesside, with permission).

References/web links

1. http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2833
2. https://www.nweurope.eu/projects/project-search/suricates-sediment-uses-as-resources-in-circular-and-territorial-economies/
3. https://en.wikipedia.org/wiki/Infinity_Bridge
4. https://www.bbc.co.uk/news/uk-england-22124996
5. https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans###Suitability%20of%20material
6. BS3882:2015. Specification for topsoil, BSI Standards Ltd.
7. BS8601:2013). Specification for subsoil and requirements for use, BSI Standards Ltd.
8. Lord, R.A. (2015). Reed canarygrass (*Phalaris arundinacea*) outperforms *Miscanthus* or willow on marginal soils, brownfield and non-agricultural sites for local, sustainable energy crop production, Biomass & Bioenergy 78,110-125. https://doi.org/10.1016/j.biombioe.2015.04.015).
9. BS EN ISO 17225-6:2014. Solid biofuels. Fuel specifications and classes. Graded non-woody pellets, BSI Standards Ltd.