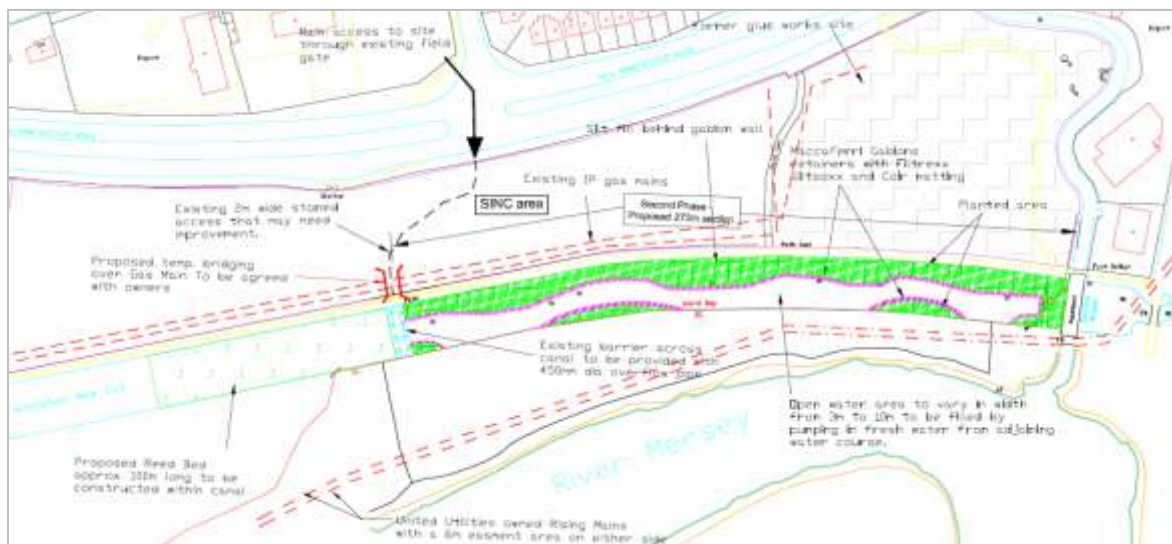


Restoration and biodiversity enhancement of Warrington's New Cut Canal and Urban Ecology Park using Bespoke Green Gabions, Manufactured Soil and Remediated Silt.

1. Background

The Woolston New Cut Canal, Warrington, was originally constructed in 1821 to bypass large bends in the River Mersey and to improve the navigation of the tidal river section for vessels travelling from the Port of Liverpool to Manchester. Industrial development along the canal consisted of a chemical works, a gun powder factory, a tannery and an abattoir. The sediments in the canal were undoubtedly influenced by the numerous industries and by spillages from ships/barges travelling along it. In 1978 the canal fell into disrepair and flows of water ceased. Water levels dropped and standing water and wet sediments were colonized by dense vegetation. Previous academic research trials, between 2002 and 2006, investigated phytoremediation at Woolston New Cut Canal. The research recommended stabilising the contaminated silt and rewetting the canal. The current restoration project created a live demonstration to showcase novel wetland and contaminated land restoration techniques, demonstrate potential markets for recycled products, enhance and create habitats and improve public access. Figure 1 illustrates the proposed restoration design for the remodelled canal bank.



2. Project Partnership

The restoration of a section of a 300m section of Woolston New Cut Canal forms part of a wider project called Woolston Urban Ecology Park. The project was largely funded via REVIVE (Regenerating the EnVironment InVests in the Economy); a sub regional programme of soft end-use land reclamation, delivering public open greenspace on brownfield land, funded by the Northwest Development Agency and managed by Cheshire West and Chester Council). Day to day project management of the project was conducted by Warrington Borough Council. Additional collaborating partners included WRAP (Waste & Resources Action Programme), Peel Holdings (Land and Property) Ltd, Liverpool John Moores University, Environment Agency, Envirolink, Filtrex International, Ecological Restoration Consultants and Mint Green Environment. The REVIVE programme, provided £1.18M funding for site investigation, consultation, design and delivery of construction and landscape works plus maintenance and aftercare for 15 years, to ensure benefit from the investment is sustained.

3. Research Trials

WRAP contributed £42k of funding to deliver two research trials, designed by Ecological Restoration Consultants Ltd, which aimed to demonstrate new markets for recycled products in brownfield restoration. The overarching aim was to demonstrate new potential markets for

recycled products containing BSI PAS 100 compost that may be of interest to civil and environmental engineers, composters, landscape architects, restoration specialists and ecologists.

Trial 1 - Aimed to demonstrate the use of a bespoke gabion design (using compost sock products) for water side restoration and canal bank creation in comparison with more traditional gabions designs that contain coir rolls. These bespoke gabions formed a major part of the canal transformation in terms of retaining stabilised contaminated silt, aesthetic improvement and enhanced conservation value.

The trial included monitoring vegetation establishment within the gabions and comparing the success of planting emergent and aquatic plants within coir rolls and compost socks. A basic assessment of the sock/aggregate filled gabion design compared with the more traditional design, incorporating rock fill and coir matting, was assessed in terms of cost, manual handling, construction, installation and labour, anecdotal pros and cons and potential future use.

Trial 2 - Aimed to manufacture low nutrient soils capable of establishing biodiverse wildflower meadow, on the newly created canal bank platform. Soil blends included recycled materials such as quality protocol aggregates and PAS 100/Quality Protocol compost.

For each of the 5 soil blends the vegetation establishment was monitored, along the canal bank, comparing the success and diversity of species during early establishment.

4. Canal Silt Remediation and Engineering Works

Celtic Technologies Ltd was awarded the remediation and engineering contract. Working closely with the partners, regulators, local authority and contractor a remediation strategy was developed. The approved remediation strategy was based on a stabilisation technique, within the confines of the site, which sufficiently treated the silt to retain any contaminants in situ and allowed the reuse of stabilised materials to provide a new canal bank profile retained by gabions. All 5100m³ of the stabilised silt was used to create the new canal bank platform (Figure 2).

Bespoke gabion design

The canal wall consists of two horizontally stacked gabion cages (each 1.0 m x 1.0 m x 2.0 m) filled with aggregate. The upper gabion only contains either three, stacked, compost socks or coir rolls which form the substrate for establishing vegetation at the waterside face of the gabion, and backfilled with aggregate.

A permeable geotextile membrane acts as an additional barrier between the stabilised silt and the gabion with the compost sock forming a partial, additional, barrier restricting movement of sediment and any further potential contaminants. The gabions were built, on site at New Cut Canal, in batches, as the dredging work progressed over an estimated 14 week period. Dredging, treated silt replacement and gabion installation occurred in tandem.

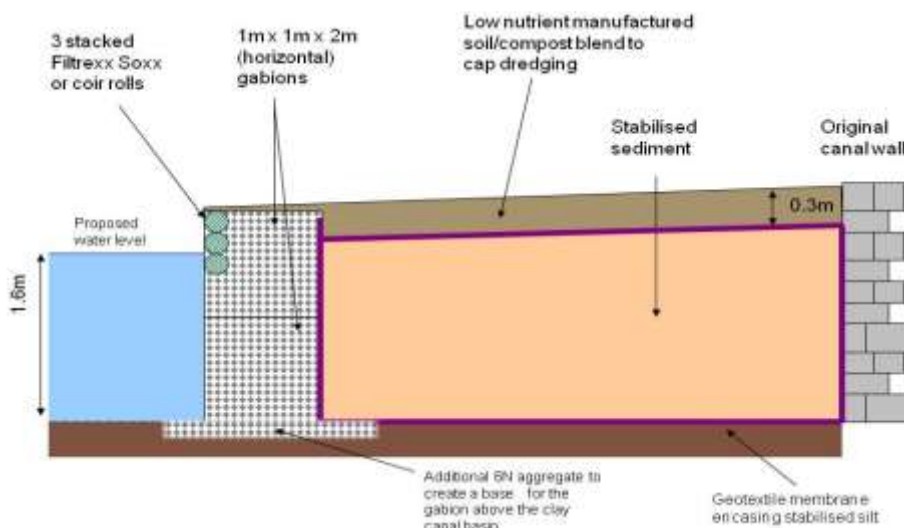


Figure 2 illustrates the cross section of the new canal bank profile

The compost socks were manufactured by Forth Resource Management under the supervision of Scotbark (Filtrex Soxx distributor in the UK) and filled with a blend of 10mm screened compost (15%), supplied by White Moss Horticulture, and Techniclay (a light expanded clay aggregate, supplied by Plasmor Techniclay). The Techniclay aggregate was used as an inert fill to retain the integrity of the roll shape whilst remaining lightweight enough to be handled manually and to keep the nutrient content relatively low. Aquatic emergent and floating plants were planted as plugs in Autumn 2010.



Manufactured soil cover

To cap the stabilised sediment, an additional geotextile layer and a 300mm covering of low nutrient manufactured soil blends (including crushed brick, crushed limestone, demolition fines, and sandy soil each with a 15% (by volume) blend of PAS 100/Quality Protocol green compost addition) were used to provide a four suitable growing media blends for diverse wildflower ground flora along the newly created canal banks. In terms of the compost and aggregate requirements, within the compost socks and the manufactured soil blends, Quality Protocol compliant materials were sought where possible to negate the need for waste exemptions. Replicate sections of each blend were placed along sections of the remodelled New Cut Canal, in early summer 2010, forming a temporary patchwork effect once completed. The canal bank was sown with custom mixes of wildflower and wild grasses in October 2010. These manufactured soil blends contained low concentrations of major nutrients designed to encourage the development of wildflower meadow grassland. The image (right), taken in July '10, shows the early stage of refilling the canal with water abstracted from the River Mersey under license.



5. Vegetation monitoring

Success of establishment and growth of aquatic plants inserted in compost socks or coir rolls.

The relative growth and number of surviving aquatic plants was assessed in March 2011, October 2011 and August 2012. Monitoring emergent and floating aquatic plants inserted as plug grown individuals in either compost socks or coir rolls, inserted into the external gabion walls of the canal, produced a strong contrast. Survival and growth of aquatic plants was considerably better in the compost socks than the coir rolls for the majority of the species. Although plants in the coir rolls had survived, generally the difference in survival and abundance of plants between compost socks and coir rolls, noted in March 2011, was maintained when the site was assessed in October 2011 and August 2012. The most recent assessment demonstrated an abundance of wildlife using the canal including frogs, smooth newts, dragonflies, waterfowl and aquatic invertebrates such as water snails and water boatmen

Coir rolls, planted with plug plants of aquatic species, have been used for protection of river banks from erosion for many years. The construction of revetments provides a



bio-engineering solution for prevention of erosion and scouring of river banks. The results of the project at Woolston New Cut Canal strongly suggest that compost socks containing a blend of PAS 100 green compost and expanded, inert, clay aggregate, despite being 25% higher cost to install initially, would achieve a more cost-effective combination of bank stabilisation and re-vegetation than coir rolls in the long-term.



Establishment of meadow vegetation on blends of recycled materials with PAS 100 green compost.

Assessment of the relative abundance (percentage foliage cover) of wildflower meadow species and wild grasses was undertaken in February 2011, September 2011 and August 2012. National Vegetation Classification (NVC) categories of grassland were assigned using 'TABLEFIT' software. In addition measures of species diversity of the vegetation were calculated.



Initial monitoring on meadow grassland in early spring 2011 on the four different substrate blends demonstrated that germination and early establishment of grasses and meadow wildflowers was prolific and a good population density of seedlings was achieved many of which were well-established. Monitoring in August 2012 demonstrated that diverse meadow grassland was well-established on blends containing demolition fines, crushed brick and crushed limestone that conformed to NVC MG5 meadow (Crested dog's-tail - Common Knapweed) species composition of the vegetation community. There was a contrast with the sandy subsoil blend that was too fertile and supported a higher biomass, less diverse grass dominated community.

6. What are the lessons learned from this project?

a) Represents innovative thinking and adaptation, rather than proprietary materials used in their usual place.

The project design and remediation strategy included the retention and reuse of all remediated silt within the site. 5100m³ of remediated silt was effectively used to create a platform for a series of manufactured, low nutrient, soil blends to be laid and seeded with a biodiverse wildflower meadow.

The use of compost socks within a 'green' gabion is novel in to the UK whilst Filtrex International and Filtrex Soxx are a well established company and brand in the US. The use of a Techniclay/compost fill, as an alternative to standard coir rolls, is a ground-breaking approach. The light weight aggregate (85% by volume) the manual handling and placement within the gabion cage. An equivalent stone aggregate would have been too heavy to lift without equipment therefore the compost socks were very easy to manipulate into position. The high aggregate content helped to retain the integrity of the sock shape reducing the potential for gaps to form at the top of the gabion cage. Plug planting within the compost sock was much easier than within the coir rolls.

The research trials showcased the potential market for commonly available recycled aggregates plus PAS 100/Quality protocol compost used for landscape and enhances habitat creation applications. Ongoing monitoring provides evidence for the effectiveness of the techniques and the sustainability and robustness of the new habitat. The project integrates an ecological approach with a complex engineering project that delivered a solution for containing severely contaminated canal silt, created a valuable habitat and green space and

provides opportunities to demonstrate the sustainable use of recycled materials to professionals, academic students and the community.

b) Is a technique or adaptation that can be easily and cost effectively applied to other temporary or permanent works

The use of manufactured soil blends for habitat creation and enhancement is a technique applicable to restoration sites from small to large scale. The trial provides a best practice example for the use of novel techniques, which incorporate compost, in a wetland project and highlights the need for professional advice to avoid excess nutrient load in water systems. Compost socks, filled with a blend of green compost and Techniclay are a superior alternative to the use of traditional coir rolls or matting for the fast establishment and sustainable growth of aquatic plants demonstrating enhanced plant survival.

The potential markets for the use of compost in higher value products, such as compost socks, are diverse. In the US, the application of compost socks, by Filtrexx International, in soft engineering of river banks and the creation of wetlands in Sustainable Urban Drainage Systems are well established. Additional applications include stabilisation of banks and prevention of bank slips, erosion and undercutting, stormwater management, protection of tree roots and creation of aquatic ledges in rivers and canals for enhanced marginal vegetation. In the UK, WRAP has also funded a handful of demonstration trials using the product in river and slope stabilisation scenarios as the market begins to grow.

c) Indicates a sustainable re-use of materials within the economic timescale of the needs of the project

The outcome of the project provides a model for progressive, ecologically-minded, design professionals to adopt and adapt for the re-use of recycled aggregate materials in order to create new green infrastructure and diverse landscape habitats. Flexible selection of recycled mineral substrates can be geared to material locally available thereby enhancing sustainability. PAS 100/Quality Protocol compost is locally available for the majority of sites in England and lowland Scotland. For the canal restoration project, the proposed option to use locally available crushed cockle and whelk shells was replaced, at a late stage, by crushed limestone in response to a processing factory ceasing production. The use of crushed limestone, as a substitute aggregate, is more commonly used to manufacture alkaline soils and allowed the soil blends, incorporating crushed brick, demolition fines and subsoil, to demonstrate the efficacy of using recycled materials that are fit for purpose compared with virgin materials

d) Compliance with recognised protocols

The reuse of remediated and stabilised silt demanded a vigorous method of verification, as part of the approved Remediation Strategy, to ensure the contaminants pose no risk to water quality or human health in the context of the increased public access and contact with the new greenspace.

The specification for 'green' gabion trials and manufactured soils met the practical requirements of the project and led to the establishment of vegetation trials along the waterside of the canal and new bank. The source aggregates were all either Quality Protocol Compliant or recognised product,

(e.g. Techniclay/limestone). The compost was also PAS 100/Quality Protocol compliant.

The manufactured soil blends were tested in line with BS3882:2007 The British Standard for topsoil. Whilst only a single sample of sandy subsoil was compliant with BS 3882 as multi-purpose topsoil, for the purposes of establishing the target vegetation, non compliance with BS 3882:2007 was not presumed to be detrimental. The BS 3882 failure was most often caused because N, P and K concentrations were too high for compliance with the



specification for lowest fertility topsoil grade. However the wider implication is that it may be difficult to utilize recycled materials in a cost-effective manner if BS3882 is a set specification required by a client or landscape architect. It is also important to ensure that raw materials are inspected carefully before delivery to monitor quality and ascertain that the materials are fit for purpose.