Source to Tap Peat Pilot How-To Guide: Cell Bunding

The INTERREG VA Source to Tap project aims to develop sustainable, catchment-scale solutions for the protection of rivers and lakes, which are the main sources of our shared drinking water. Peatbogs provide many benefits to a catchment. The slow movement of water through a bog means the peat matrix acts as a filter, capturing contaminants from rainwater. They can also help mitigate flooding by storing and slowing storm water, reducing peak flows and increasing lag times downstream.

Afforestation on deep peat lowers the water table as trees intercept precipitation and their roots take up water. Double mouldboard ploughing (a popular technique for planting trees between the 1940s and 90s) and forestry drains exacerbate the drying effect. When peat soils dry, they become oxidised, producing dissolved organic carbon, and are also vulnerable to erosion. This increases sediment loss from the land leading to fluctuations in colour and turbidity at downstream Water Treatment Works.

The characteristic ridge and furrow pattern left behind when tree plantations are deforested must be addressed for successful restoration to occur. This is because ridges are high points where tree seedlings can recolonise and furrows provide rapid pathways for sediment and colour-laden water to escape.

The Peatlands for Water pilot carried out restoration work on a 30ha site in the Erne catchment. Restoration took place on a previously afforested peat bog and aimed to raise the water table, which over time will return the area to active blanket bog. The innovative cell bunding method was trialled on part of the restoration site. If successful, this method could be used in other catchments to help improve drinking water quality.

Aim

To construct watertight cells by building low peat walls, preventing the escape of water through furrows, oxidised peat and rotting root pathways. The watertight cells raise the water table, encouraging and sustaining the growth of Sphagnum mosses, which are the substrate of an active peat bog. Healthy growth of sphagnum requires that the water table is less than ~10cm deep, whilst pools should be no deeper than ~150mm throughout the year. Deeper pools can however create varied habitats, which increases biodiversity.

Surveying of site

A peat depth survey was carried out at the site during the planning stages of the work. Before construction work started, the contractors completed detailed topographic surveys of the site using Global Positioning System (GPS) and an unmanned aerial vehicle (UAV). The resulting topographic model of the site determined which areas of would be most suited to the bunds and gave an indication of how many bunds could be constructed.

Figure 1: Source to Tap peat pilot site before work began

Equipment Required

- Two large excavators, with undercarriage protection if on brash, or low ground pressure tracks if no brash available. Two are required in case one gets stuck in the peat.
- Plentiful supply of large timber or bog mats to support the excavators when moving across the site (brash alone is insufficient to prevent excavators getting stuck).
- Small amount of 110mm drainage pipe for overflows on high-pressure bunds.

Suitability Criteria

Slope – Cell bunding is best suited to sites that have a slope of less than 3°. Sites with a steeper profile tend to be unsuitable because more cells are needed to ensure no raised, dry areas are left. Steeper land can also lead to increased pressure on the bund walls because the weight of contained water increases with slope angle. This increases the danger of slippage or "bog bursts."

Peat Depth – Cell bunding should only be carried out on deep peat sites (> 1m depth) because breaking through the peat to the mineral soil below may cause water to leak from the cells.

The Source to Tap project would like to thank **Forest Service (DAERA)** for the use of their land for this pilot. Without their help, this pilot project would not have been possible. We would also like to acknowledge their help and support in progressing the pilot and reviewing the final documentation.

Construction

1. **Excavating the Trench** – When forestry is planted on deep peat, it causes drying of the surface layer of peat soil. This dry (oxidised) peat allows water to pass through it. The first step in cell bunding is therefore to excavate a trench through the oxidised top layer of peat to the wet "putty peat" below. The trench must be deep enough to avoid leakage of water. During this process, roots and stumps are removed from the trench into which the cell bund wall will be constructed. The 'spoil' from this can be set aside to fill the borrow pit.

2. Preparation of Borrow Pit – The construction of the bund walls requires a supply of saturated peat. This is taken from a "borrow pit" within the cell. A borrow pit is a hole dug to extract wet peat. Before the saturated peat is extracted, the top layer of brash, roots and oxidised peat is removed and set to one side. When enough peat has been extracted to form the bund wall, fill the spoil from the trench and the borrow pit into the hole (along with brash) to ensure no deep excavations are left.

Figure 2: Example of bund wall after construction

3. Construction of bund walls – After clearing a trench, take saturated peat from the borrow pit in large, intact bucketfulls using a 1.2m bucket. This bucket size was deemed most appropriate after trials with 46cm buckets formed bund walls that were not robust enough to retain water long term. Drop the bucketfulls into the trench and compact the peat with the bucket. This needs to be done after each load to ensure there are no gaps in the bund wall. The bunds should be high enough to raise the water table ~10cm above the surface of the ground, throughout the whole cell. Bunds should not, however, exceed a height of 40-50cm, as the pooled water would be too deep to sustain sphagnum growth. At greater heights, the bunds may not be stable enough to support the volume of water contained within them.

Bund walls are constructed in parallel lines, in line with the slope. Connecting bund walls are built perpendicular to the slope, joining the parallel bunds every 20-40m. This forms an enclosed, watertight cell.

In this peat restoration pilot, the bund walls were left exposed as budget was not available to cover them. Ideally bunds would be covered with available vegetation or coir matting to protect the walls and prevent them from drying out.

4. Overflow Pipes – Overflow pipes may need to be installed in the walls that make up the outside edges of the cell bunded area, at least until mosses have established. This will be the case if there is a risk of water overtopping the walls, as this can cause erosion. Overflow pipes can be set at a level at which only excess water will be drained from the site.

Each overflow pipe consists of a short piece of 110mm drain pipe (which is inserted through the bund wall) and a 90° bend, which can be swivelled to change the overflow height (Figure 3). On the Source to Tap site, overflow pipes weren't fitted at the time of construction. Instead, a simple 100mm pipe was placed on top of several bunds where water was overtopping.

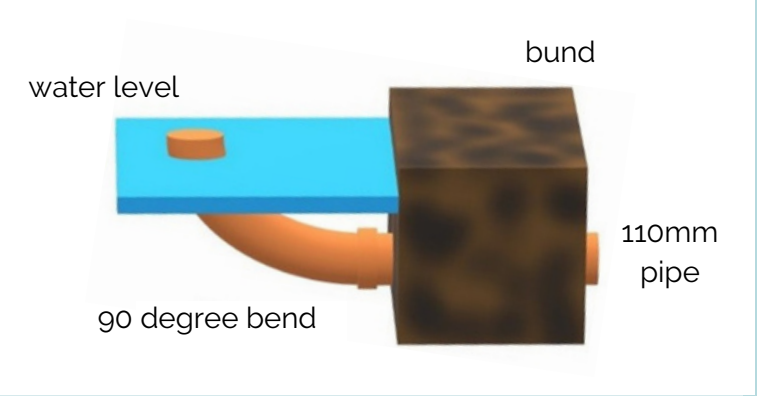

Figure 3: Diagram of overflow pipe

Outcomes

145 cell bunds were constructed on the Source to Tap peat pilot site. The majority filled with water shortly after construction, although some at the back of the site were less waterlogged. After one winter-summer season at the pilot site, monitoring results were only able to show the effects of water level and colour in shallow groundwater as a result of the cell bund establishment phase.

Further monitoring will be required into the future to show how the bunds aid peat recovery in comparison to open moor and other restoration methods

Disclaimer

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