

Clough Foot Minewater Treatment Scheme

delivering environment improvements within the Upper Calder valley

by
J Bagnall

This Minewater Treatment Scheme is located in the village of Clough Foot, near Todmorden, West Yorkshire. The area has a long history of mineral abstraction, leading to the pollution of the Midgelden Brook, a tributary of the River Calder, with ochreous minewater. The scheme is part of a long term programme of remediation throughout the UK by The Coal Authority.



Photograph of ochre staining of Midgelden Brook

Courtesy of The Coal Authority

The Problem

The polluting discharge emerges from a 1km long adit, associated with the workings of the former Clough Foot Colliery. The average flow from the adit is 20 l/s, peaking at up to 45 l/s. The primary contaminant is iron which enters into solution as the oxidised pyrites dissolve when the mine workings become flooded. Iron levels within the discharge range from 17-58 mg/l. Periodically the discharge can also contain significantly elevated levels of aluminium. The discharge was prioritised by the Environment Agency for remediation.

As the minewater leaves the workings the dissolved iron oxidises, depositing a layer of iron ochre along the stream bed, smothering aquatic flora and fauna. To date the pollution has impacted the Midgelden Brook and a section of the River Calder for a distance of up to 8.5km from the discharge point. The completed scheme will have a positive impact on both the flora and fauna of these affected watercourses.

Limited land availability and the steeply sloping topography of the site has been a significant constraint on the development.

Project Scope

The scheme involved the construction of:

- Pumping station at the adit discharge location – comprising wet well, adit collection system and control building. All buildings have been constructed in traditional materials to blend in with the local environment;
- Reinforced concrete valve chamber housing cross-over pipework, NRVs, and swab launch points;
- Twin 600m long, 225 OD MDPE rising mains to the treatment site;
- Two culverted crossings of the Midgelden Brook to create a safe access route;
- Aeration cascade;
- Dosing channel;
- Reinforced concrete Settlement Lagoons (4500m³ capacity per lagoon). The settlement lagoons had to be constructed in concrete due to the limited land availability and challenging geological conditions;
- 1800m² wetland planted with reeds;
- Dosing building housing a caustic storage tank and dosing equipment.



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The main works contract was awarded in late June 2009. All construction works are being undertaken by the Coal Authority's framework contractor J N Bentley.

The detailed design and NEC Project Management role has been provided by Mott MacDonald.

Scheme Development

The project has required significant effort by all involved, throughout the development process as a consequence of the high visual amenity of the area and local sensitivities.

Process Design

The Coal Authority's scheme hierarchy gives preference to passive schemes, due to their lower environmental impact, complexity and cost. However, the minewater chemistry at Clough Foot, where the pH can be as low as 3.5, meant that a chemical dosing system would be required. This raises the influent pH to a level where oxidation and precipitation of the iron can occur while the flow is detained in the settlement lagoons.

The minewater discharges from the rising mains into an aeration cascade. This is the first step in the treatment to promote oxidation in the settlement lagoons.

The influent is then dosed with caustic soda (47% concentration) to achieve a target pH of 8.5. The caustic is introduced into the influent via a static channel mixer to ensure thorough blending across a range of flows, controlled via continuous pH measurement downstream of the mixer.

After dosing, the minewater passes into settlement lagoons sized for 2 days retention to allow the influent to be fully oxidised and the iron ochre to settle within the lagoons. The total iron loading will be reduced to 10mg/l within this stage. The scheme is expected to generate 1000m³ of sludge per annum. The tanks have been sized to

allow one to be taken off-line to allow the sludge to consolidate, increasing the density, and minimising the volume that has to be removed from site.

The final stage of the process is an 1800m² wetland where the iron concentration is further reduced to below 1mg/l through a combination of sedimentation, filtration and absorption before the treated water is discharged back into the Midgelden Brook.

Construction Challenges

It was realised early in the project that access to the site would be critical. As a result, an enabling works package was let in February 2009 to construct the access into the site and across the Midgelden Brook.

During the design, the site was modelled using 3D ground modelling software to achieve a cut and fill balance, eliminating the need to remove or import significant quantities of materials. The output from this work also allowed the site to be visualised for design and planning purposes.

Programming of the works has been largely dictated by the need to stockpile excavated material within the limited site area available. This has given restricted access to some areas of the permanent works until backfilling around the settlement tanks could be commenced.

The earthworks have proved challenging through the contract, primarily due to the weather that was experienced at this exposed site. The material excavated is highly sensitive to water and becomes virtually unworkable as the moisture content increases. Excavated slopes have been monitored for movement on a daily basis to ensure stability and a safe working area.

Additionally the excavated material is argillaceous. Compressible boards have been used on the outside faces of the lagoon walls to



View of settlement lagoons under construction

Courtesy of The Coal Authority



Christmas at Clough Foot

Courtesy of The Coal Authority

mitigate the compressive forces which would otherwise be applied to the structure as the material swells. This allowed excavated material to be used as backfill against the structure, eliminating the need to import some 1400m³ of granular fill.

The main works start was delayed until late June due to the uncertainty of Grant in Aid funding for the scheme being available to The Coal Authority. This resulted in construction of the reinforced concrete tanks being carried out during the winter months. Programme delays, due to snow and cold weather, were mitigated as far as possible by provision of extensive tenting and heating to maintain suitable temperatures for concrete placement to continue.

The Contractor initiated CLIP (Construction Lean Improvement Programme), facilitated by the Building Research Establishment, to improve financial performance and minimise waste on the project

through collaborative planning, involving the client, designer and sub-contractors.

Conclusion

The scheme is on target for completion in August 2010. Despite numerous challenges the project team has worked in a collaborative manner to deliver the scheme. At the time of writing the settlement lagoons have been completed, tested and backfilling has commenced. The scheme is expected to be delivered within the Target Cost. Over 40,000 hours have been worked with no reportable Health and Safety incidents.

Note: The Editor and Publishers thank Jim Bagnall, Project Engineer with Mott MacDonald for providing the above article. The author wishes to recognise the efforts and involvement of Mouchel Parkman and Scott Wilson during the initial scheme development. ■



Completed lagoons during water test

Courtesy of Mott MacDonald



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