

## Geotechnical Division Case Study SYC 12 miles, 1400 yards - Brick Kiln Lane, Whitchurch

### Sheet piling and embankment stabilisation works to remove speed restriction from a railway

The site is located approximately at 12m+1200 yards on the Shrewsbury and Crewe railway line and consists of a section of embankment approximately 100m in length. The railway is twin track sat on a 4 to 5m high embankment.

The site was a long-term track geometry problem site, proving very difficult to maintain line and level of the track. Regular maintenance to manually and mechanically lift, pack and tamp the track was required every few months over a period of 5 years. As a result of the track geometry problems a long-term temporary speed restriction was in place at 20mph on one line and 55mph on the other instead of permitted 75mph. Delay minutes and compensation associated with the speed restriction were resulting in significant costs which were not sustainable.

There was a common perception that salt rock dissolution was responsible for the track settlement issues owing to salt mining being undertaken in the area, however an intrusive investigation was completed which confirmed this was not the case, however the investigation did discover that the actual ground conditions varied from those published. Griffiths undertook initial surveys of the site inclusion of ecological and ground investigation works to support the design in 2016.

The site is located on the edge of what was an advancing and retreating ice sheet subject to many depositional and erosional processes during the last ice age and hence is not surprising to find the actual ground conditions vary from those that are published. The topography is low-lying, and the site forms a natural low point of the area.

Up to 3m of soft alluvial and organic soils were found to be present in a depression which was present approximately at the centre of the site. Terrestrial flooding over geological time had filled a swallow hole associated with previous glaciation with soft soils – on top of which the railway embankment was constructed. Years of rail maintenance, ballast raising and tamping to correct the defect had simply fuelled continuous foundation extrusion and settlement within the soft underlying soils.



Fig 1) Train running on embankment whilst sheet piles are being installed.

Fig 2) Sheet piles visible across the track prior to being hammered to level.

Once the ground model and failure mechanisms were confirmed, Griffiths worked with the designer to establish an effective solution to the problem.

Initial thoughts from the client was to excavate the embankment , the foundation soils and rebuild the section of embankment using new granular fills. However, Griffiths advised that foundation constraint could be an effective solution which would prevent significant disruption to the operation of the railway.

A continuous sheet piled wall was designed for a length of approximately 100m to be installed at the toe of the embankment on either side of the embankment to cover the 40m problem area plus an additional length running the piles either side to ensure full foundation soil constraint.

Enabling works were required to install access roads and a working platform to either side of the railway to access the piling equipment.. Cognisance of the environment and ecological constraints was completed by means of habitat surveys. Within close proximity to the working area, Otters were located, this required additional temporary fencing to be installed and consideration of flood light positioning for works conducted outside of daytime hours.

The piles consisted of 10 to 12m long AZ 25 profile, installed as single piles utilising a 36T excavator with Movax attachment, which could pitch vibrate the piles into place.

Installing the piles at the toe of the embankment allowed the works to be completed with trains running during day time working. An any line open risk assessment was completed which considered the collapse radius of the excavator and the piles being lifted to establish that the railway line could not be fouled. Track monitoring was completed to confirm that the vibration from the piles didn't adversely impact the track geometry further. This provided significant programme and cost efficiency compared to installing piles from the rail or further up the embankment.

During the works, the embankments were regraded to a shallower angle, with a safe cess walkway being installed.

The track was tamped and the rails res-stressed, with 6 weeks of further track monitoring completed to demonstrate that settlement had been arrested. After the period of track monitoring was completed and confirmed the success of the foundation constraint solution, the line was re-opened to full line speed.



Pictured above:  
Showing sheet piled wall and embankment regrade in progress.

Pictured above:  
Fig 3) Original track defect with significant loss of geometry.  
Fig 4) Drilling works with 36T excavator on crest and 13T excavator on the toe.  
Fig 5) Completed sheet pile on one side of railway with regrade, safe cess, handrails and fencing.

## Project at a glance

Client: Network Rail  
Location: Whitchurch, Shropshire  
Completed: October 2017  
Value: £1.5M