Waste Recycling Group Judkins Landfill Site: Reed Bed for the Treatment of Leachate Contaminated Groundwater

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Despite operating a landfill developed in accordance with consented requirements, during the wet autumn of 1999 the owner of the Judkins Landfill (at that time Hanson Waste Management) was faced by an uncomfortable reality.

The quarry sump which extends to a depth of 80 metres, was generating a up to 1,000 m^3/day of a groundwater which was occasionally found to be contaminated with leachate to marginally above the Coventry Canal discharge limit for ammoniacal nitrogen contamination, of 5 mg/l.

View of the quarry sump; the source of the contaminated groundwater

General view of Judkins Reed Bed in 2002

Discussions had been held with the Environment Agency, and the British Waterways Board as owners of the canal, from which it had become clear that no relaxation could be granted, and an upward trend in contamination was clearly visible in the data. If nothing was done the EA would have been forced to seek prosecution in due course of time.

Here, as elsewhere, under similar circumstances landfill operators usually look to avail themselves of the more expensive public sewer discharge option. Unfortunately, Hanson was already fully utilising all available sewer hydraulic flow capacity, and a similar a lack of spare treatment capacity at the Severn Trent Hartshill Wastewater Treatment Works (WWTW) precluded the laying of a private pipeline to deliver the leachate direct to the WWTW inlet.

View of the reed beds during construction

Hanson commissioned Enviros to report on the feasibility of reed bed treatment, utilising land previously used for the lagooning of the solids contaminated water previously generated from sump dewatering during quarrying. Enviros had about three years previously installed a similar (horizontal flow) reed bed at Monument Hill Landfill, Wiltshire (principally for the removal of iron from a landfill discharge), and had obtained monitoring data for ammoniacal nitrogen removal (Robinson et al[1]) from that site.

Enviros Consulting (then known as Enviros Aspinwall) was therefore able to apply the removal rates assessed from the Monument Hill data to the water quality projections at Judkins Landfill to provide the necessary reed bed surface area. Reed Beds are not very efficient for the removal of ammoniacal nitrogen – indeed we are not aware of their utilization elsewhere primarily for the removal of this contaminant – and all parties were initially disappointed by the large surface area required. Nevertheless, the cessation of pumping from the quarry sump was not an option as so doing would have been in contravention of the site waste Management Licence, and the only other disposal option available being tankerage by road to a WWTW licensed to accept Industrial Effluent at approximately £10/tonne, was simply not affordable.

View shows the protective blanket of geotextile laid over the HDPE membrane, before the stone is placed

Hanson therefore accepted the Enviros reed bed process design, and instructed Enviros to produce a tender document for competitive tendering, under which all the geotechnical and foundation design responsibilities were delegated to the Contractor. Enviros managed all tendering formalities, and Jones Brothers of Ruthin won the work in alliance with Symonds group as geotechnical and structural design consultants. Enviros provided advice throughout construction, acted as Safety Planner under the CDM Regulations, and supervised the all-important selection of reed stock, and bed planting.

The design adopted was one in which the risk of differential settlement affecting the performance requirements of the reed bed was balanced against the prohibitively high cost of complete removal of the lagoon silt which had already been deposited at the base of the settlement lagoons when the site was operated as a quarry. Enviros, and Hanson's purchaser WRG, agreed higher than normal permissible settlement rates for reed beds as a "best value" solution.

The 8600m^2 horizontal flow reed bed at WRG's Judkins Landfill was constructed over a three-month period, with completion in July 1999 at an "all-in" cost of £300,000 (£35/m^2), including stabilization measures over the soft ground of the site. Of this sum the cost of supply and planting of the reeds might at first seem to have been surprisingly high at £40,000 (£4.65/m^2). However, as there was no possibility of time being available for the reeds to become established before the already contaminated discharge began to be pumped through the beds, so it was important to buy pre-grown plants and plant these at close centres, for early establishment.

View shows reed bed stone being levelled

For the first two years the reed bed admirably performed the role for which it was intended. Ammoniacal nitrogen removal rates varied through with flow rates, and other factors, such that removal rates varied between 20% removal and 70% removal. The lower removal rates were associated with high flow events (with at times the beds successfully handling double the design flow at up to 2000 m^3/day), hence although the removal rate was reduced this was compensated by greater dilution and the discharge remained consistently below the 5mg/l consented maximum.

After two years had passed, the time had come for the deep sump to be infilled with waste. May Gurney Construction as the civil works contractor for the landfill phase development works in the sump, and in conjunction with WRG's site expertise tackled the contaminant problem at source by the construction of a cut-off below the sump area, to prevent further intrusion of leachate contamination into the groundwater dewatering flows. This was achieved very successfully, as the average contaminant ammoniacal nitrogen loading is now reduced to no more than 0.5mg/l, there is no longer any risk of non-compliance in the Coventry Canal discharge. The dewatering flow continues through the reed bed, and this situation is planned to continue for the foreseeable future.

View of the stone levelling operation

WRG now view the reed bed as valuable not only as a wildlife habitat, but as a future resource which will again come into use; either for some form of polishing treatment for some form of future on-site leachate treatment, perhaps for surface run-off, for example as may be required as the site reaches its "land raising Phase". Also, on-site treatment of the leachate extracted from the wastes, which currently comprises a relatively low volume, and discharges to sewer, may well become necessary as BAT principles are applied to leachate treatment by the EA under the PPC permitting regime.

Despite this reed bed being possibly the largest and most costly, in the UK, given the ground stabilization and settlement reduction measures necessary it has been highly successful in achieving compliance with consent requirements, and remains a future resource, although not actually needed at present. Let us also not forget that it is an installation which is both innovative in its primary role for ammoniacal nitrogen removal, and a solution for which there was no viable alternative when installed.

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