

St. Peters Road Rugby: Treatment-based remediation of chlorinated solvents and hydrocarbons



Project description

St. Peters Road is a 2ha historically contaminated former industrial site in Rugby, being redeveloped with 140 mixed tenure housing units. This site was occupied from the early 1900s by a factory used to manufacture spark plugs and, more recently, advanced ceramics used in specialist products such as bulletproof vests. Contamination of the site included chlorinated solvents (soil, DNAPL and dissolved phase), lubricating oils (soil, LNAPL), PAH and arsenic (soil).

When operations were relocated to a new factory in Rugby in 2005, Miller Homes Ltd acquired the site for redevelopment for housing. RSK and RemedX were appointed to carry out a turnkey (design and construct) site investigation and assessment, pilot testing and remediation. All work was carried out in-house with subcontracting limited to well drilling and off-site manufacture of *in situ* remediation plant to RSK requirements,

Ground investigation and risk assessment

RSK carried out two stages of ground investigation and risk assessment between 2003 and 2005. The first phase comprised an environmental and geotechnical site assessment, and identified areas of ground contamination, allowing the site conceptual model to be developed. These areas were delineated in the second stage, which also included pilot testing for *in situ* remediation techniques.

Both stages of investigation were fully integrated with the detailed quantitative risk assessment to generate robust input data for the modelling. This showed that human health linkages were the risk driver for remedial targets. More refined data from the second phase of investigation and remedial pilot testing was used to increase the robustness of the risk assessment. Markedly less conservative remedial targets protective of both human health and controlled waters were derived and agreed with the regulatory authorities.

Remediation

Key remediation requirements were for the site to be suitable for a housing end use for an early completion of the northern part of the site for housebuilding, and for minimum disruption affecting neighbouring residential areas. RemedX designed a remediation scheme that met these objectives by using both *in situ* and *ex situ* methods on different parts of the site. Despite the site's proximity to established residential areas, no complaints of nuisance or disruption were received by either the site or the EHO.

Remediation works were implemented by RemedX in 2005–6 using our own in-house plant and personnel resources. Impacted soils from the north of the site were transferred to a treatment area in the south of the site for *ex situ* treatment, allowing an early handover of the first development phase. *Ex situ* treatment of chlorinated solvents consisted of an innovative approach using chemical oxidants mixed into windrows of soil. The southern part of the site was remediated by an *in situ* treatment method, high vacuum multi-phase extraction, to minimise ground disturbance and earthmoving near to houses.

Both remedial methods were successfully implemented and validated. End point concentrations were substantially below remedial targets and the time taken, and the cost, was substantially below the contract allowance.



Project details

Managing the client's best interests

RemedX demonstrated managing the client's best interests as follows:

- Understood the client's objectives (including cost, time, remedial outcome) for the development at pre-contract stage
- Proposed a scheme that met all these objectives
- Agreed an activity schedule-based payment mechanism that included fixed price elements for definite works and provisional items for items with uncertain scope or that might not be needed
- Implemented innovative solutions, for example installing *in situ* wells and pipework in original buildings before demolition
- Programmed remediation works in sequence with development programme to keep remedial activities off development critical path
- Developed value engineered solutions to allow handover of Stage 2 development area six months ahead of original programme and avoid relocation of site office compound
- Maintained co-operative and open, but where necessary robust, approach to regulatory authorities.

These successful outcomes were recorded on the project:

- Agreement of realistic remedial targets achieved by robust risk assessment
- Phased remedial sign-off negotiated with regulators
- 20,000 tonnes of waste, and up to 1000 lorry movements avoided by treatment-based remediation
- No complaints received from residents or the public
- Remediation kept off development critical path by innovative and flexible approach
- Mid-development relocation of site compound avoided
- Early handover of Phases 2 and 3, six and three months ahead of schedule
- House building started within six months of factory closure and first houses occupied within twelve months
- Cost £150,000 below pre contract estimate.

Project delivery

RSK and RemedX were appointed to deliver site investigation, risk assessment, remedial design and implementation as a full service turnkey contract. The management of the entire project as an integrated whole avoided contractual issues and formed the basis of the flexible and innovative approach used throughout the project.

RemedX held the duty of CDM Principal Contractor, and RSK Health and Safety was appointed by the client as Planning Supervisor under the CDM regulations. A comprehensive Health and Safety Plan was prepared and adhered to during the works.

There were no injuries or lost time accidents during the remediation works. The RSK reporting system was used by site staff to report a "near miss" concerning contact with chemical oxidant during the *ex situ* bioremediation works. This was investigated and addressed by automating the addition of oxidant to the soil using equipment adapted by RemedX's field technician.

Application of risk-based procedures

Risk assessment was used as a remediation design tool as well as a site assessment tool throughout the project. The detailed quantitative risk assessment was reviewed on several occasions either in response to new data or at the behest of the regulators. Key uses of the risk assessment included:

- Delineating the three dimensional volume of contaminant "exceedance"
- Designing remedial layouts
- Establishing robust but achievable remedial targets
- Addressing an issue of naturally occurring arsenic in surface soils
- Establishing a robust groundwater monitoring system.

Treatment technologies, initial and residual concentrations

In the southern portion of the site, *in situ* remediation was carried out to extract solvents and from the soil and groundwater beneath the site by a high vacuum/multi-phase extraction process, using an array of wells. The process was actively managed on site, with wells sequentially put on stream to "sweep" extractive effort across the site. Remediation was completed once sampling had proved that the contamination was reduced to below target levels, and following post-remediation "rebound" monitoring. *In situ* remediation was completed in nine months, ahead of the scheduled 12-month period.

- **Example concentrations:** trichloroethene, dissolved phase – initial, 87,000 µg/l, remedial target, 4,000 µg/l, achieved 1,000 µg/l

Impacted soil from three defined areas on the centre-east, north-east and north-west part of the site was excavated and transferred to an *ex situ* remedial treatment area in the central area of the site.

In a major value engineering-led change to the remedial approach, with the objective of achieving an early handover of the second development phase for housebuilding, the *ex situ* treatment was changed from soil vapour extraction to chemical oxidation after trials demonstrated the speed of this process. Successful completion of the *ex situ* treatment enabled the second phase area to be handed back six months before originally programmed.

- **Example concentrations:** trichloroethene in soil – initial, 9,000 µg/kg, remedial target 6,000 µg/kg, achieved, 200 µg/kg



Magnitude and range of costs

- Cost of "excavate and dispose" option estimated >£1.3m
- Cost estimated in RemedX proposal £0.8m
- Actual out-turn cost £0.65m

Details of additives used

Around four tonnes of chemical oxidant (potassium permanganate) was used in the *ex situ* chemical oxidation. This was kept in a separate chemical store on site away from fuels and carbon. The additives were handled in accordance with RemedX's COSHH assessment.

Material disposed off site

If a traditional Excavate and Dispose solution had been adopted, around 20,000 tonnes of soil – around 1,000 lorry movements - would have needed to be removed from the site and transported through residential streets. The cost of this option would have amounted to around £1.3m, which is double the out-turn cost for the remediation methods adopted.

The only off-site disposals were small volumes of black ash fill with high metal content, materials surplus to the site mass balance, and a small volume (100 tonnes) of additional impacted soil located after the end of the *in situ* remediation. Less than 1,000 tonnes total was taken off site.

Mitigation of negative environmental effects

24/7 operation of the remedial plant could be sensitive in a residential area. Close liaison was maintained with the local authority EHO, and the remedial system was designed to minimise potential disturbance to residents. Odour problems from chlorinated solvents were eliminated by keeping stockpiles and windrows covered. All potentially adverse impacts were monitored.

Contact details for the RemedX site supervisor were displayed on signs around the site. No complaints from local residents or the public were received during the remediation works by site personnel, the client or the local authority.

For further information, please contact:

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