

## CASE STUDY

# ST PETER'S ROAD, RUGBY, UK: TREATMENT-BASED REMEDIATION OF CHLORINATED SOLVENTS AND HYDROCARBONS

RSK



## Project description

St Peter's Road is a 2-ha historically contaminated former industrial site in Rugby, UK, which is being redeveloped with 140 mixed-tenure housing units. This site was occupied from the early 1900s by a factory manufacturing spark plugs and, more recently, advanced ceramics used in specialist products such as bulletproof vests. Contamination of the site included chlorinated solvents (soil, dense non-aqueous-phase liquids and dissolved phase), lubricating oils (soil, light non-aqueous-phase liquids), polycyclic aromatic hydrocarbons and arsenic (soil).

When operations were relocated to a new factory in Rugby in 2005, Miller Homes Ltd acquired the site to redevelop for housing. RSK was appointed to carry out a turnkey (design and construct) site investigation and assessment, pilot testing and remediation. All the work was carried out in-house; subcontracting was limited to well drilling and off-site manufacture of in situ remediation plant to RSK's 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 to enable 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 the 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 human health and controlled waters were derived and agreed with the regulatory authorities.

### Remediation

The key remediation requirements were for the site to be suitable for a housing end-use with an early completion of the northern part of the site for house building, and for minimum disruption to neighbouring residential areas. RSK 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 environmental health officer (EHO).

RSK implemented remediation works in 2005/6 using its 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 to enable 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 multiphase extraction, to minimise ground disturbance and earth moving near to houses.

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

## Project details

### Managing the client's best interests

RSK demonstrated management of the client's best interests by

- understanding the client's objectives, including cost, time, remedial outcome, for the development at pre-contract stage
- proposing a scheme that met all these objectives
- agreeing 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 necessary
- implementing innovative solutions, for example, installing in situ wells and pipework in original buildings before demolition
- programming remediation works in sequence with the development programme to keep remedial activities off the development's critical path
- developing value engineered solutions to enable handover of the second-phase development area six months ahead of the original programme and avoid relocation of the site office compound
- maintaining a cooperative and open but, where necessary, robust approach to the regulatory authorities.

The following successful outcomes were recorded for the project:

- the agreement of realistic remedial targets through robust risk assessment
- a phased remedial sign-off through negotiation with the regulators
- 20,000 t of waste and up to 1000 lorry movements avoided by treatment-based remediation
- no complaints from residents or the public
- remediation kept off development critical path through an innovative and flexible approach
- avoidance of mid-development relocation of the site compound
- early handover of the second and third phases, six and three months, respectively, ahead of schedule
- house building starting within 6 months of factory closure and first house occupation within 12 months
- cost £150,000 below the pre-contract estimate.

### Project delivery

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



RSK was the CDM principal contractor and the 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 a 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 RSK's field technician.

#### Application of risk-based procedures

Risk assessment was used as a remediation design tool and as 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 3D 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 from the soil and from the groundwater beneath the site by a high-vacuum, multiphase extraction process using an array of wells. The process was actively managed on-site. Wells were sequentially put on-stream to sweep the extractive effort across the site. Remediation was completed once sampling had proved that the contamination was below the target levels and following post-remediation rebound monitoring. In situ remediation was completed 3 months ahead of the scheduled 12 months.

As an example of the concentrations achieved, dissolved-phase trichloroethene was initially 87,000 µg/L, the remedial target was 4000 µg/L and 1000 µg/L was achieved.

Impacted soil from three defined areas on the centre-east, north-east and north-west parts 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 house building, 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.

As an example of the concentrations achieved, trichloroethene in soil was initially 9000 µg/kg, the remedial target was 6000 µg/kg and 200 µg/kg was achieved.

The magnitude and range of costs were

- >£1.3 million (estimate) for the excavate and dispose option
- £0.8 million (estimate) for RSK's proposal
- an actual out-turn cost of £0.65 million.



#### Details of additives used

About 4 t 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 RSK's COSHH assessment.

#### Material disposal off-site

If a traditional excavate and dispose solution had been adopted, about 20,000 t of soil, about 1,000 lorry movements, would have needed removing from the site and transporting through residential streets. The cost of this option would have amounted to about £1.3 million, which is twice the out-turn cost for the remediation methods adopted.

The only off-site disposals were small volumes of black ash fill with a high metal content, materials surplus to the site mass balance and a small volume (100 t) of additional impacted soil found after the end of the in situ remediation. Less than 1000 t in total was taken off-site.

#### Mitigation of negative environmental effects

Operation of a remedial plant 24/7 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 RSK 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.

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