Southern Testing
Environmental & Geotechnical

ST Consult
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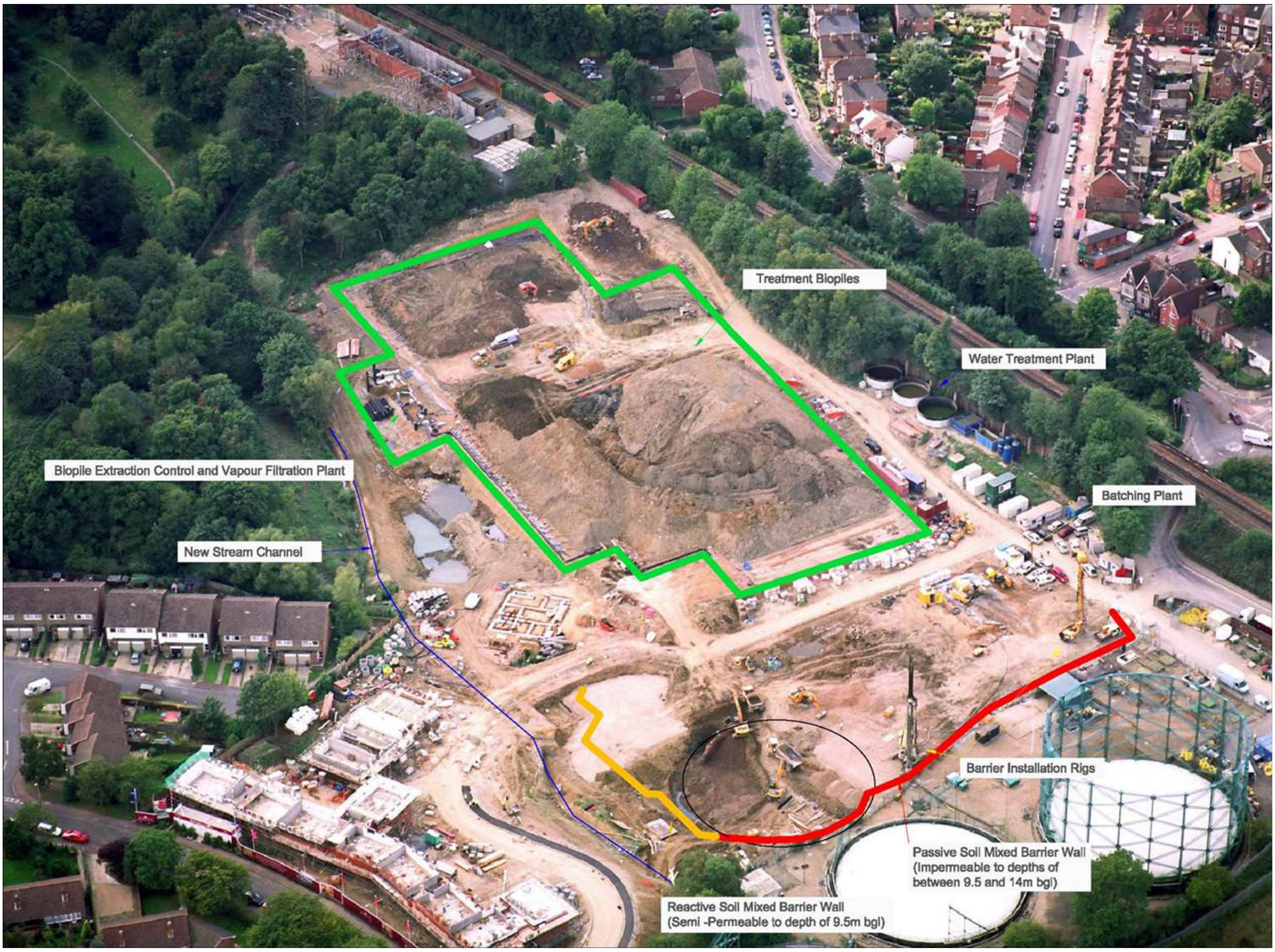
Gas Works Remediation for Residential Development



Synopsis

The remediation to a standard suitable for residential development was always going to be a challenging exercise. To achieve this in the context of a very commercially driven timeframe, within a strict regulatory regime, whilst keeping to budget required a highly innovative design and an unprecedented degree of partnering between all stakeholders. This complex project resulted in successful treatment and re-use onsite of over 99% of the approximately 40,000 tonnes of contaminated soil processed. The project, from initial investigation to first residential occupations was achieved in a period of less than 16 months.

Introduction

The site extends to approximately 4 hectares and had been used previously for gas production from the early 1890s until mid-1970 (Figure 1), and then subsequently as a Transco Depot. SecondSite undertook ground investigations in early 2000 to assess the extent of contamination and associated environmental liabilities. Remediation was undertaken in 2002 as part of a risk reduction exercise. Some areas of highly contaminated soil were excavated and removed from site to landfill as part of a "dig and dump" strategy. The remediation only met a specified site end use of "securely fenced vacant land" and residual elevated levels of hydrocarbon contamination were reported to be present still.

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Regeneration

The site was purchased for residential redevelopment with a scheme comprised of 176 units of mixed “market” and “affordable” dwellings, together with private gardens and open landscaped areas. Proposals included: adoptable access roads, cycle and pedestrian access linking with the nearby parkland, retained woodland to be enhanced as part of the wider parkland, and the “opening up” of a culverted stream that runs the entire length of the site to create a landscape feature which would be designed and managed to enhance its ecological diversity and to increase wildlife populations

Community and Stakeholder Acceptance

We were employed by the developer to investigate the extent of the residual contamination and to determine the scope of remedial works required to meet the planning conditions attached to the development proposals. The site presented a number of immediate issues; previous remediation works had not been signed off by the Regulators, nor did the level of the clean up meet the requirements for the proposed residential end use. We recognised the concerns raised both within the local community and by the regulators, and arranged extensive consultations with the Developer, Environment Agency (EA), Environmental Health Officer (EHO), Planning Authority (PA) and residents at a very early stage. An Investigation strategy was discussed upfront and submitted for approval prior to commencement of any site works. The regulators were kept informed of site progress throughout the investigation and monitoring phase, conceptual design, pilot and laboratory trials, and they also undertook several site visits. This unprecedented degree of early involvement was instrumental in obtaining the approval of the EA and EHO for the remedial strategy during the later stages of the design process, and helped to streamline the validation process.

Site Characterisation

The site is underlain by Wadhurst Clay at the base of a valley where there is fairly steeply sloping ground. A culverted stream marked the eastern boundary, while the site is bounded by a railway to the west and a remaining Gas Holder Station to the north. Ground conditions encountered comprised a significant depth of made ground over a silty laminated and fissured clay and mudstone (Wadhurst Clay). The substructure to several of the historical gas works buildings, including a gasholder, remained intact below ground. Generally the soils were found to be contaminated with PAH’s, TPH, and BTEX compounds which are typically associated with town gas production. Significant hydrocarbon contamination was identified along the boundary with the remaining Gas Holder Station. A shallow compacted clay wall had been constructed as part of the earlier risk reduction exercise along part of this boundary. However, investigation indicated this to be ineffective and the ground was saturated with contaminants migrating from the adjoining site.

Although located on a non-aquifer, groundwater modelling was complicated because of the nature of the underlying soils. Seepages were encountered as perched water within the made ground and laterally limited bodies throughout the underlying clay and mudstone. Ground water was found to be locally contaminated with PAH’s TPH, BTEX compounds, phenols, cyanide and ammonia, particularly at the northern end of the site around the historic process buildings and structures.

Assessment of Remedial Options

Our remediation strategy as illustrated in Figs 2-5, identified contaminated zones of soils and a risk of contaminant migration both on to the site from beneath the existing neighbouring Gas Holder Station, and offsite. A dig and dump solution was considered to be an unsustainable and excessively expensive approach, and the design brief demanded a totally balanced site with no net loss of material. Both in-situ and ex-situ techniques were considered, however it was felt that an ex-situ treatment technique offered the best solution on a site of this nature, given the generally clayey nature of the underlying soils and the impersistent nature of the contamination. An ex-situ solution gave the added benefit of dealing with physical obstructions and improving the overall validation process. A number of ex-situ techniques were identified and stabilisation and bioremediation were considered to be the most suitable.

Figure 1 - Former Gas Works Layout

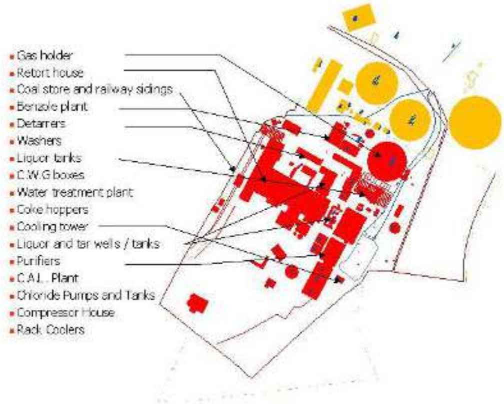

Figure 2 – Excavation of Tar Tank Structure

Figure 3 – Zonal Excavation and Remediation

Figure 4 – Contamination around Culvert

Figure 5 – Remediated Zone

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Technical Innovation (Best Practice)

The developer wished to incorporate a variety of sustainable and innovative techniques that were designed to meet the planning, environmental and geotechnical requirements of the site while managing the longer term environmental liabilities. We proposed that the best remediation strategy for the site would be one that utilised a combined treatment system. Following successful treatability studies, the Specialist Remediation Contractor carried out soil treatment using “ex-situ bio-piles”. During the 12-week treatment process pipes were installed within the soil stockpile as shown in the attached schematic (Figure 7 & 8) with amendments (Nutrients) were added to allow optimum conditions to be created for the natural degradation of contaminants. They also provided a system for collection and treatment of waters encountered in excavation, prior to discharge and under consent to the foul sewer.

To mitigate against risks of both onsite and offsite contaminant migration, Specialist Remediation Contractor was appointed to design and implement “in ground barriers”. To prevent recontamination of remediated soils and reduce the risks of future onsite migration of contaminants from beneath the adjoining gas holder station, a non-reactive / impermeable “in ground barrier” was constructed to a depth of between 9.5 m and 12.5m along the length of the northern site boundary (approximately 100m) keying into the clean underlying Wadhurst Clay.

As a consequence of the highly variable permeability of the clay materials underlying the site, groundwater flow modelling was extremely complex. Risk analysis suggested there was a possibility that potentially contaminated ground waters may form spring lines or migrate via through-flow towards the lower site areas adjacent to the stream. For this reason, allowance was made for installation of a semi-permeable reactive clay barrier along the eastern boundary (approximately 80m long to a depth of 9.5m) to intercept any such migrating water. The technique utilised modified clay, which was organiphillic so that contaminants were removed by adsorbing to it (Figure 9). The effectiveness of the modified clay was trialled in laboratory treatability studies using samples taken from site. Construction precautions within the properties included; hydrocarbon vapour membranes within the floor slab construction, well-ventilated sub floor voids; and the selection of suitably resistant pipes with respect to utility services and drainage.

In addition, a new stream channel was designed to incorporate a hydrocarbon resistant liner, by utilising a puddle clay surround and an erosion mat. An engineered site surfacing is proposed for all garden and open landscaped areas to provide positive drainage for infiltration in a fully clean environment.

Sustainability

Biogenie successfully treated approximately 30,000m³ of soil to meet the strict validation criteria agreed with the EA and EHO for reuse onsite. The alternative to this scheme would have resulted in significant and unjustified additional loading on landfill and some 4,000 unnecessary lorry movements through the local area and beyond to remove and reinstate soils. Less than 300 tonnes of contaminated soil, which was mainly cyanide-impacted and not treatable, was segregated and disposed of at the landfill site.

Reduction of Pollution

An exceptionally contaminated site, which was unusable and a blight to the surrounding area, underwent successful remediation using sustainable methods to provide an aesthetically pleasing addition to the local community. The works were carried out within a very commercially driven timeframe, the treatment times being, on average, 12 weeks. The treatment achieved significant pollution reduction. PAH contamination, for example, was reduced by 90% and TPH by 82%. The work on this site gained STL a Brownfield Briefing Remediation Innovation Award for "Best Use of Combined Systems".

Figure 7 – Schematic Ex-situ Biopile

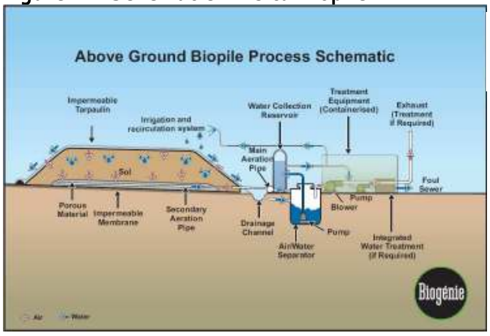

Figure 8 - Bio-Pile Collector Pipework

Figure 9 - Reactive Barrier Wall Installation

Figure 10 – Phase 2a Complete. Barrier wall beneath footpath and new stream channel

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