

Client

**TAYLOR
WOODROW**

Main Contractor



envirotreat®

Environmental Consultants

Knight Environmental

central section of the Cook's Shipyard site and the land of owned by the Environment Agency. The waste disposal license held for the site expired in 1988. The site prior to remediation is shown in figure 1 below:

Figure 1 – The site prior to Remediation



Site Background & History

The Cook's Shipyard site occupies an area of approximately 3.0 Ha. It is located to the south of Anglesea Road and comprises a shipyard with hard standing and derelict buildings on the western two thirds and grassland on the eastern third. It is bounded by the River Colne to the south, Wivenhoe town centre to the north and west and a flood defence bund to the east.

Historically, the shipyard with its associated buildings occupied the site between 1897 and 1983. A gasworks site including two gas-holders occupied the northwest corner of the site from 1897 to 1967. A sewage pumping station was located in the north west of site between 1936 and 1958. Part of the former Cook's Shipyard area was historically used as a waste disposal site for demolition and construction waste, industrial process waste and inert waste. It is understood from historical records that the waste disposal site covered the

The former Gas Board site has been the subject of previous site investigations by WS Atkins and RSA Geotechnics Limited. The site was remediated and validated by WS Atkins in 2001. The former Cook's Shipyard site was investigated by Knight Environmental Limited in 2001, by RSA Geotechnics in 2003 and more recently by Knight Environmental Limited again in 2005. The results indicate the principal contaminants of concern in soils are arsenic, copper, lead, nickel, zinc, polyaromatic hydrocarbons and total petroleum hydrocarbons, primarily associated with the Made Ground on the site. Monitoring for soil gases within the gas monitoring wells indicated elevated concentrations of soil gases.

Envirotrear was engaged by Knight Environmental to agree an appropriate Remediation Strategy and Methodology with the Local Council to enable the discharge of the relevant planning conditions for the proposed residential development. The overall remediation strategy was designed to address the source and indirectly pathway contamination issues, with the intention of protecting human health and groundwater receptors. The remedial operation involves the ex-situ treatment of the main contamination sources (i.e. the identified hot-spots of Total Petroleum Hydrocarbon (TPH), Polycyclic Aromatic Hydrocarbons (PAH), Copper and Zinc contaminated material associated with the former landfill facility on-site and wastes, spillages and by-products from the former gasworks and industrial activity on site) utilising the Envirotreat E-clay® Technology. From the Site Investigation data, available the contamination hotspots are concentrated predominantly in the western third and to a lesser extent the central third of the site to a maximum depth of approximately 2 m

Ex-situ E-Clay Stabilisation / Solidification of the soil hotspot areas

E-Clay slurry was prepared in the treatment area (see figure 2 below). The E-Clay slurry produced was mixed thoroughly with excavated soils from the identified hot spot areas using an Allu bucket attached to a conventional excavator to ensure optimum homogeneity of the mixture (figures 3, 4 and 5 below):

Figure 2 – Treatment Area Set Up



Figure 3 – Allu bucket used for mixing operations



Figure 4 – The ex-situ mixing operation



Figure 5 – The ex-situ mixing operation



Cementitious materials were added to the soil / E-Clay mix to produce a stabilised / solidified mass which could be reused on site, this is shown in figure 6 below

Figure 6 – The stabilised / solidified soils



Validation and Verification.

Treated soil samples were collected from the hot spot stabilisation and submitted for leachate analysis. The Remediation Target Criteria are shown below

| Contaminant | Remedial Target Values (leachate $\mu\text{g/l}$) |
|--|--|
| Copper | 900 |
| Zinc | 16,000 |
| Benzo(a)pyrene | 0.3 |
| Naphthalene | 65 |
| Aliphatic TPH C ₈ -C ₁₀ | 80 |
| Aliphatic TPH C ₁₀ -C ₁₂ | 80 |
| Aliphatic TPH C ₁₂ -C ₁₆ | 130 |
| Aliphatic TPH C ₁₆ -C ₂₁ | 500 |
| Aromatic TPH C ₈ -C ₁₀ | 180 |
| Aromatic TPH C ₁₀ -C ₁₂ | 180 |
| Aromatic TPH C ₁₂ -C ₁₆ | 180 |
| Aromatic TPH C ₁₆ -C ₂₁ | 180 |
| Aromatic TPH C ₂₁ -C ₄₀ | 180 |
| TPH (C ₈ -C ₄₀) | 500 |



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CASE STUDY

E-Clay Stabilisation

Cook's Shipyard, Wivenhoe
Essex

The leachate results obtained were all well below the agreed target criteria. This confirmed that the hot spot areas had been effectively treated using Enviro-treat E-clay stabilisation technology in accordance with the agreed Remediation Strategy and Methodology.

Sole Providers of E-CLAY® Technology

Stabilisation • Bioremediation • Reactive Barriers • In-situ / Ex situ Remediation