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CASE STUDY

Site Investigation / Risk Assessment

Former Gas Works – Port St Mary, Isle of Man

Client

HAVEN HOMES

Site Investigation & Specialist Remediation Contractor

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The former gas works site is situated 2km north of Port St. Mary and is adjacent to Port St. Mary Railway Station**.**

A number of gas production facilities were built on the Isle of Man between 1836 and 1898 to serve the local communities. Gas production facilities were constructed at Douglas, Castletown, Ramsey, Port St Mary and Peel. It is understood that the Port St. Mary facility was constructed in the 1890s.

The town gas was made by carbonising (roasting) coking coal which produced town gas (or coal gas) and a range of by-products**.**

Coal gas generation finally finished on the island in 1971 with the closure of the Port St. Mary gas works.

At its height there were three gas holders on the site, together with retort house, tar tanks and other ancillary structure associated with small gas production works.

The former gas works prior to demolition is shown in Figure 1 below.

Figure 1 – Former Port St. Mary Gas Works (Pre-Demolition)

Haven Homes has been granted planning permission (Ref: 15/00870/B) to construct 20 new homes, together with areas of public open space, car parking and associated infrastructure. The development will be known as Railway Court. The proposed development plan is shown in Figure 2 below.

Figure 2 – Proposed Development Plan

Previous Site Investigations

DEFA confirmed that they did not have any specific guidance on the assessment or remediation of contaminated land. Instead, it was agreed that UK guidance would be followed, specifically LCRM, UK CLEA tools, UK Land Contamination Technical Guidance and UK Statutory Guidance.

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Recent Site Investigation Works (2022)

Envirotreat undertook a combined Phase I and Phase II site investigation in 2022.

The Phase II site investigation comprised 6No. cable percussion boreholes and the excavation of 11No. trial pits across the site. Groundwater quality monitoring wells were installed in each borehole. Groundwater sampling was undertaken using low-flow sampling to provide a representative sample of groundwater. Soil samples were collected from a across the unsaturated zone to characterise the nature and extent of potentially volatile and mobile contaminants. The cable percussion borehole installation is shown in Figure 3 below and the low-flow groundwater sampling is shown in Figure 4 below.

Figure 3 – Cable Percussion Borehole Installation

Figure 4 – Low Flow Groundwater Sampling

Soils were also analysed for typical gas works pollutants to fully characterise the risks posed to future human health receptors – the aim is to create an effective pathway break through raising site levels (also necessary to address potential flooding risks). Soils were screened using a PID (photoionising detector) with a 10.6eV bulb. PID values and field observations of contamination were used to guide sampling.

In-situ permeability testing was undertaken on 2no boreholes on 16th June 2022 in accordance with BS5930:2015. A Rugged Troll 100 datalogger was placed towards the base of the borehole and sequential rising- and falling-head tests were completed through the submersion and removal of a nylon slug.

Recent Site Investigation Works (2023)

Envirotreat undertook supplementary site investigation works with the installation of 6No. windowless boreholes around the southern and site boundary to monitoring groundwater quality.

Figure 5 – Windowless Borehole Installation

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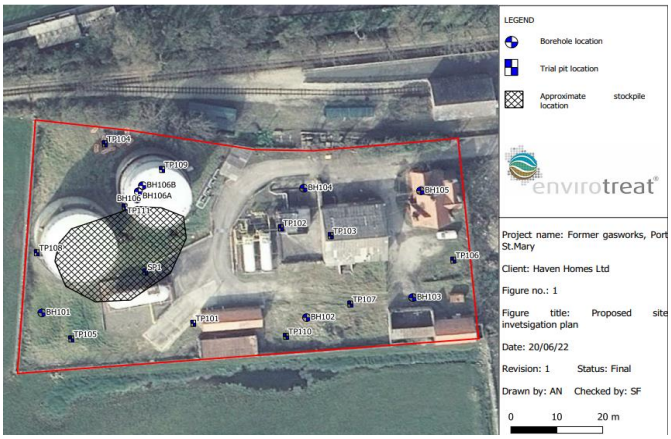
Summary of Ground Conditions

Ground conditions comprised of made ground to a maximum depth of 2.65m, overlying natural soils. The natural soils comprised of a fine-grained, cohesive alluvium to between 0.5m and 3.0m overlying sands and gravels to 7.4m and >10m. Suspected cohesive glacial till was identified below the sands and gravels in 4 of the boreholes. Groundwater strikes were noted at a range of depths in the made ground and both cohesive and granular natural soils. Where groundwater was struck in granular soils it was noted to rise rapidly to rest at shallow depths. Rest water levels were shallow and ranged from 1.06m to 1.67m bgl and is estimated to flow to the east. Hydraulic conductivity testing revealed fast flow rates, with a geomean of 6.9m per day identified in the sand and gravel. It was concluded that groundwater was likely to be perched throughout the made ground and alluvium, and that significant groundwater was present in the sands and gravels.

The site investigation works are summarised in Figure 6 below.

Figure 6 – Summary of Site Investigation



Human Health Risk Asse ssment

Concentrations of a wide range of contaminants were identified above the residential human health GAC.

It is noted that the development proposal includes raising site levels by more than 1m. It was concluded that this activity would mitigate the risks posed by non-volatile contaminants by breaking direct access exposure pathways. Exceedances of the residential GAC were noted for volatile contaminants of concern. The risk posed by volatile contaminants within the made ground was significant and it was agreed that remediation works were required to resolve this risk. The concentration of naphthalene in groundwater from borehole BH103 in the southeast corner of the site was above the adopted GAC. Given the prevalence of more granular soils in this corner of the site, the risk from exposure to groundwater-derived vapours was considered to be sufficient to justify remediation.

Groundwater level monitoring concluded that groundwater flow was in an easterly direction, potentially impacting the newly constructed neighbouring residential property. Theoretically this groundwater plume could present a vapour intrusion risk into properties to the east of the site. It was recommended that groundwater leaving the site be remediated such that the residential GAC is met. Exceedances of the public open space GAC were noted but will be mitigated through the proposed level raise. A qualitative ground gas risk assessment classified the site as Characteristic Situation 2 and, as a consequence, basic gas protection would be required in new buildings.

Controlled Waters Risk Assessment

Groundwater results were compared against drinking water standards. Exceedances were noted for ammoniacal nitrogen, sulphate, metals, PAH and PHC fractions. The risks from sulphate and metal were assessed and considered to be sufficiently low that further assessment was not required. The remaining contaminants were taken forward for detailed risk assessment.

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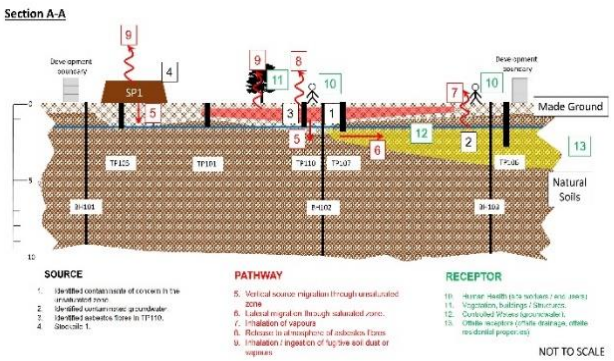
The Level 3 DQRA derived SSAC for soil and groundwater that were protective of groundwater 50m from the site boundary. The P20 model indicated that PAH contamination would not reach the compliance point within 10,000 years and thus they were discarded from further discussion. Concentrations of selected light-end PHC fractions were identified in groundwater in the southeastern part of the site above the SSAC. Remediation of this groundwater plume was therefore recommended. Remediation of source material, located across the southeastern corner and within the two gasholder bases, was also considered prudent to mitigate ongoing impacts. Ammoniacal nitrogen was identified above the SSAC in 4 boreholes located across the central and eastern parts of the site. Concentrations were greatest in the southeastern part of the site, but groundwater within boreholes BH104 and BH105 was also predicted to be impacted. Remediation of the groundwater plume was recommended. Soil exceedances of the SSAC were widespread across the eastern and central parts of the site. Remediation of these soils was recommended to prevent ongoing contamination of groundwater at the compliance point.

Envirotreat developed a pre-remediation conceptual side model [CSM] based on the findings from the site investigation and risk assessment as shown in Figure 7 below.

Figure 7 – Conceptual Site Model



Remediation Strategy

In accordance with the requirements of LCRM a remediation options appraisal [ROA] was carried out by Envirotreat based on the pre-remediation CSM. Based on the conclusions from the ROA it was agreed that the preferred remediation strategy would be a combination of source treatment combined with pathway treatment – this integrated treatment approach was considered to be the most appropriate and cost-effective solution to address the potential risks associated with the identified contamination on the site.

The agreed integrated treatment approach comprised of source treatment utilising E-Clay Stabilisation and pathway treatment by the installation of a permeable reactive barrier [PRB].

The proposed PRB on the eastern / south-eastern boundary of the site would protect the land drain on the southern site boundary and the adjacent properties on the eastern boundary from the potential risk of impacts from contaminated groundwater as it leaves the site.

Remediation techniques to mitigate the risk to human health comprised clean capping across the site and the installation of suitable protective gas membranes in the buildings (in addition to source treatment to mitigate the potential release of volatiles etc).

Conclusions

Envirotreat carried out a combined Phase 1 and 2 site investigation with the aim of characterising the below ground conditions, given the historical use of the site as a gas works. DQRAs were then undertaken in relation to the protection of human health and groundwater. The findings enabled a robust, sustainable remediation strategy to be developed with the full agreement of DEFA and their environmental consultants.