SITE SPECIFIC WORKING PLAN

Remediation Works at the Former BOA Warehouse Site, St Helier, Jersey

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Original	June 2019	Original	David Slater Technical Manager	Simon Farr Project Manager
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Introduction:

Envirotreat Technologies Limited [Envirotreat] has been engaged by ROK Construction Limited to develop and agree a Remediation Strategy and Remediation Method Statement for the redevelopment of the former BOA Warehouse Site in St Helier, Jersey.

This document provides the Site-Specific Working Plan [Working Plan] requirement for the Waste Management Licence application required by the Government of Jersey, which incorporates elements of the proposed Remediation Strategy and Remediation Method Statement for completeness and clarity.

The site has been subjected to a number of site investigations, the most recent being carried out by Site Remedial Services. Contamination has been confirmed in both soil and groundwater consistent with the site's historical activities (as part of the former St Helier Gasworks). Following remediation, the site will be developed for mixed residential / retail end use.

The overall remediation strategy is designed to address both source and pathway contamination issues with the intention of protecting both human health and controlled waters receptors. The contamination sources as identified within the numerous investigative reports will be addressed by E-Clay stabilisation which will immobilise the contaminants of concern. The groundwater pathway will be addressed by the installation of an E-Clay Permeable Reactive Barrier along predominantly the western site boundary to intercept the natural flow of groundwater leaving the site. The barrier will treat the groundwater which will mitigate the risk to off-site receptors.

Within England and Wales, Envirotreat routinely deploy their Mobile Treatment Licence for sites that require remedial (i.e. waste management) activities, supported by the submission of aworking plan (often referred to as "supplementary information") which details the plans, arrangements, methodologies and risk assessments associated with the proposed remediation works. This document is being submitted to the States of Jersey Government in support of the Waste Licence application to enable the remediation works to be carried out at the site.

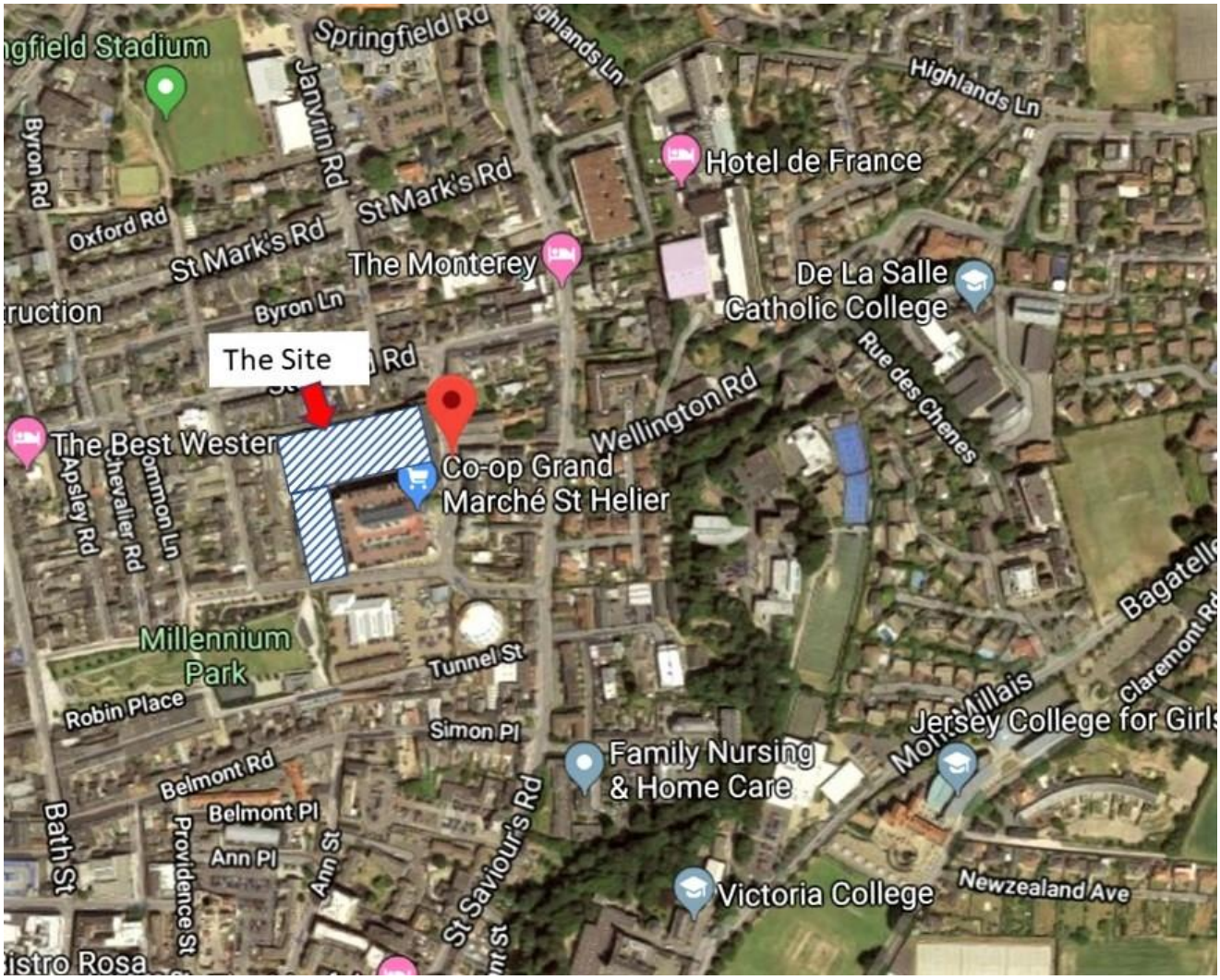
Site Overview and Location:

Site Location:

The site address is BOA Warehouse, La Rue Le Masurier, St Helier, Jersey. JE2 4YE. It is located near the centre of St. Helier, Jersey between La Rue le Masurier and L'Avenue Et Dolmen di Pre des Lumiieres. The location is shown on figures 1 to 3 below and overleaf.

- JTM Grid Reference – 42602E 66003W

Figure 1 – Location of the BOA Warehouse Site



The site boundaries are shown as red lines in Figure 2 below.

Figure 2 – Site Boundaries

The site is located within a mixed residential and commercial area of St. Helier and comprises a large derelict warehouse (BOA Warehouse) in the north of the site and multiple smaller buildings which have been converted from the former gasworks buildings in the south and east of the site. Several commercial companies occupy the smaller buildings in the site.

Site History:

The site formed part of the St. Helier Gasworks which underwent four stages of development from its initial construction in 1830 to 1976 when the gasworks was decommissioned. The first and second phases of the gasworks were constructed to the southwest of the site between 1830-1850 and 1850-1902 respectively.

Historical mapping shows the site to comprise of agricultural land and orchards until 1902, when the southern part of the site became incorporated into the expansion and modernisation of St. Helier Gasworks. Structures within the south of the site at this time included a coal store, underground liquor tank, by-products processing plant and maintenance workshops. Plans from 1954 show new structures (i.e. exhauster house, electrostatic deterrer and Livesey Washer) constructed in the south of the site and a new retort house constructed adjacent to the south of the current warehouse building. The gasworks was decommissioned in 1976 and the associated buildings were sold off.

By 1978, the current warehouse building had been constructed in the northern half of the site. It was originally owned by Le Masurier (a local brewer) and was most likely used for bottling, labelling and shipping of goods from the brewery located in St. Anne's Street. More recently the building had been used as a distribution centre for Play.com until March 2013 when the company closed its direct retail business. The warehouse has been vacant since then.

The original layout of the St. Helier Gasworks is shown in Figure 3 overleaf with the BOA warehouse area shown in Figure 4 below.

Former BOA Warehouse, St. Helier, Jersey – Site Specific Working Plan – Revision 1

Figure 3 – Original Layout of the St Helier Gasworks

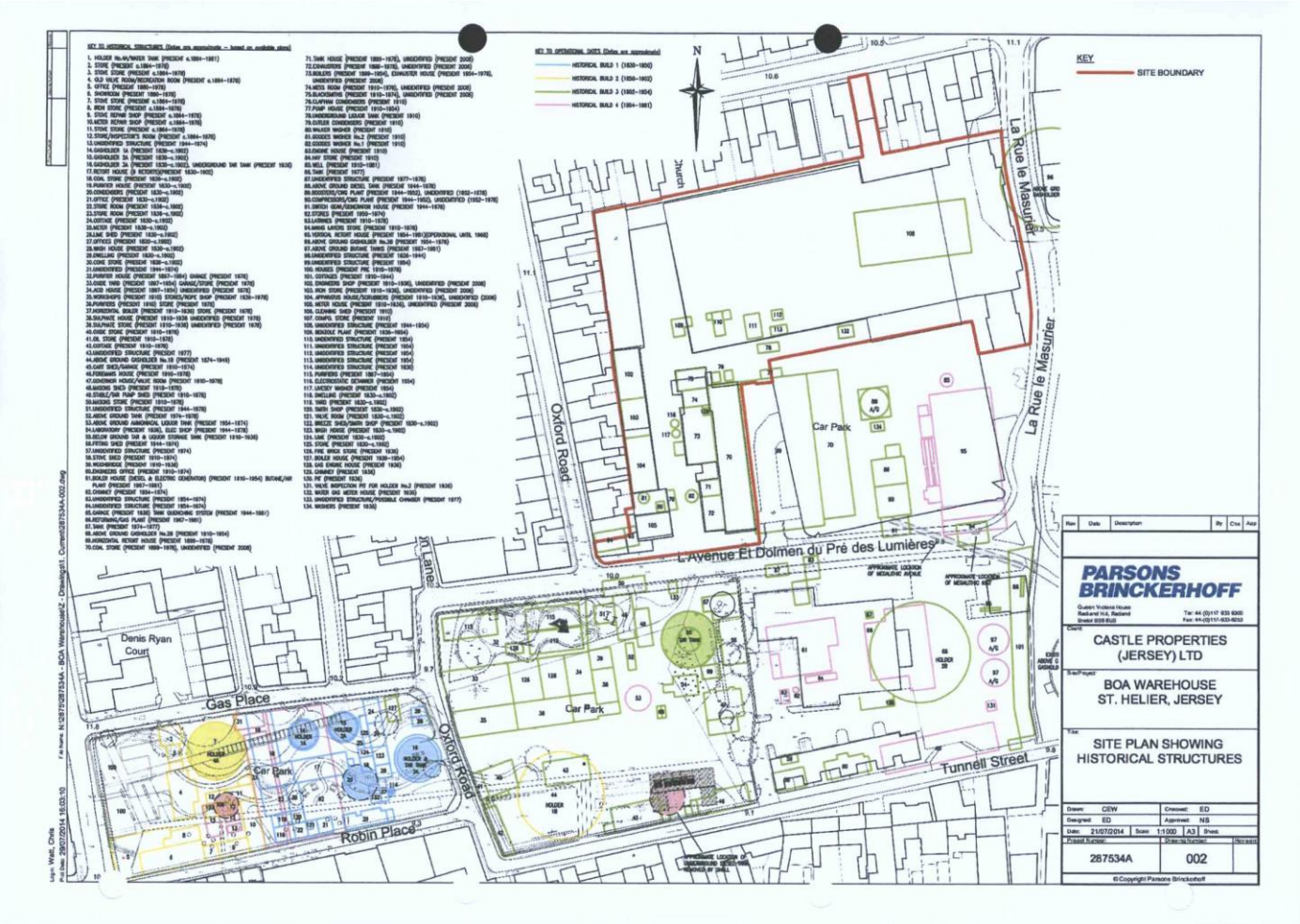
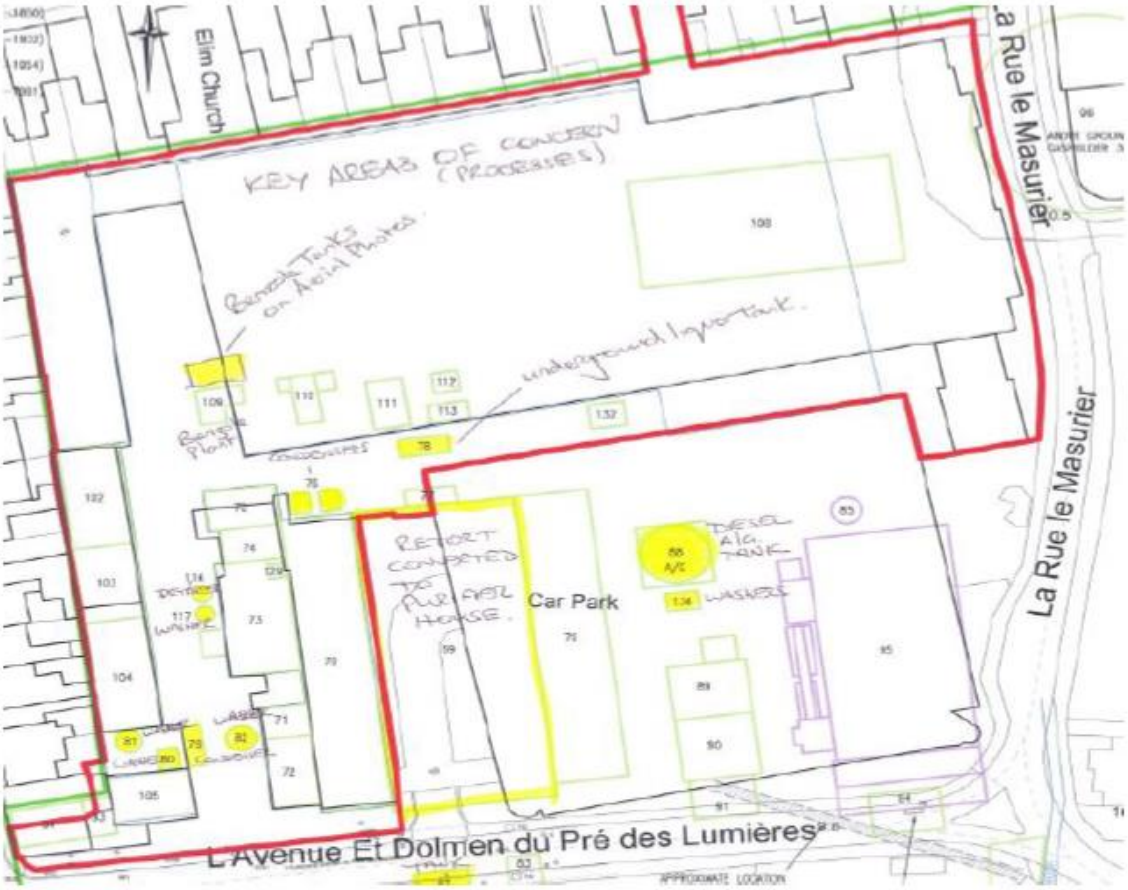


Figure 4 – Original Layout of the St Helier Gasworks [Warehouse Area]



Site Investigations:

The following site investigative reports have been provided to Envirotreat:

- '*Phase 1 Desk Study, Walkover and Risk Assessment, BOA Warehouse, St. Helier, Jersey'* - dated July 2014 produced by Parsons Brinkerhoff for Castle Properties (Jersey) Limited;
- *'Site Investigation Report – BOA Warehouse, St. Helier'* - Report No. 1398-01 dated September 2014 produced by Geomarine Limited for Castle Properties (Jersey) CI;
- *'Phase II Intrusive Investigation Risk Assessment Report – Geomarine Investigation BOA Warehouse, St Helier'* – dated October 2014 produced by Parsons Brinkerhoff for Castle Properties (Jersey) Limited.
- '*Contamination Summary Assessment'* produced by Site Remedial Services Limited for Castle Properties (Jersey) CI;

- *'Detailed Quantitative Risk Assessment – BOA Warehouse, St. Helier, Jersey'* - Report SRS/18/1377 RPT 2 dated October 2018 produced by Site Remedial Services Limited for Castle Properties (Jersey) Limited;
- *'Remediation Options Appraisal – BOA Warehouse, St. Helier, Jersey'* - Report SRS/18/1377 RPT 3 dated October 2018 produced by Site Remedial Services Limited for Castle Properties (Jersey) Limited

The findings and conclusions are summarised below:

Parsons Brinckerhoff / Geomarine:

The Desk Top Study undertaken by Parsons Brinckerhoff [PB] highlighted potential on-site sources of contamination associated with the former usage as a gas works (both soil and groundwater). The study also identified potential contamination associated with an historic fuel spill [2000].

Following the Parsons Brinkerhoff Desk Study, it was recommended that a Phase II investigation be carried out – this investigation was undertaken by Geomarine Limited - Report 1398- 01 referenced above. PB were commissioned to provide an interpretive report and risk assessment based on the findings of the Geomarine site investigation – the PB report is dated October 2014. The Geomarine investigations comprised of five borehole installations [BH1 – BH5] and ten trial pit excavations [TP1 – TP9 and TP9A] – the locations of the boreholes and trial pits are shown in Figure 5 below.

Figure 5 – Locations of Borehole Installations and Trial Pit Excavations [Geomarine]

PB summarised the soil exceedances within their report and in summary showed soil exceedances for, arsenic, barium, lead, naphthalene, benzo(a)pyrene and total petroleum hydrocarbons when compared to both commercial and residential generic assessment criteria [GAC]).

PB summarised the groundwater exceedances for copper, lead, manganese, nickel, naphthalene, ammonia, chloride and total petroleum hydrocarbons when compared with Environmental Quality Standards [EQS] / GAC and drinking water standards where applicable (groundwater samples were taken from a trial pit and four borehole locations (five samples in total)).

PB provided a baseline condition summary as follows:

Baseline Condition Summary:

Controlled waters - there are no specific classifications of water bodies in Jersey; however, the site is underlain by a groundwater resource that is used locally for abstractions and is considered as a receptor. The Fauxbie Brook is located adjacent to the site and has been identified as a receptor. Elevated contaminated concentrations above the GAC have been recorded in groundwater beneath the site, which have the potential to impact the identified receptors.

Built Environment - the site is occupied by existing buildings and services. No deleterious effects have been reported; however contaminant concentrations have been recorded in underlying soils and groundwater which have the potential to impact foundations and services.

Construction Workers - elevated contaminant concentrations above GAC have been recorded in Made Ground and natural soils beneath the site. which potentially may pose a risk to construction workers during development.

Residential and Commercial End Users - elevated contaminant concentrations above GAC have been recorded in Made Ground and natural soils beneath the site. The remains the potential for vapour sources to be present.

These sources have the potential to pose a risk to risk to future site residents (depending on the exact nature of the development). Elevated ground gas concentrations were recorded which have the potential to pose a risk to future site users.

PB provided a summary of the potential impacts and constraints on development as follows:

Potential Impacts on Development:

Controlled Waters (construction and operational phase) - during the construction phase of the scheme, there is the potential for the creation of new migratory pathways (for example, from deep excavations or piled foundations) for contamination, which could impact on groundwater and surface waters. There is also the potential for the increased mobilisation of contaminants by leaching, resulting from open excavations at the site. Migration of free or dissolved phase contaminants could have an adverse impact upon groundwater and surface water. The potential significance of contaminants concentrations and associated pollution of the underlying aquifer I surface waters is to be determined is the future. However, the implementation of remediation measures would mitigate any potential on-going impacts to groundwater or surface water during the operational phase of the development

Built Environment (construction and operational phases) - chemicals that are destructive to concrete have the potential to constrain the design of the scheme. The chemicals most likely to attack concrete are sulphates and acids, and elevated sulphate concentrations and slightly acidic groundwater conditions were recorded.

Construction Workers (construction phase) - excavation works associated with the construction of the site Workers would create the potential for adverse impacts to the health of the, by creating potential exposure pathways to the contaminants and the generation of soil derived dusts. These impacts would be mitigated by working under a risk assessment with appropriate controls such as PPE.

End Users (Operational phase) - post-construction, there is the potential for adverse impacts to site-users by the creation of exposure pathways to underlying contaminants, which include soils and vapour sources. Potential risks via dermal contact, ingestion and inhalation pathways from soils are likely to be mitigated by the presence of hardstanding, however vapour and ground gas pathways may still be viable. Mitigation of potential vapour risks would be achieved by removal of any identified source materials. Potential gas risks would be mitigated by adoption of appropriate protection measures within the design.

The Envirotreat Remediation Strategy and supporting Remediation Method Statement is designed to address the identified risks during both the construction and operational phases. The operational phase would incorporate the need to provide gas protection measures and capping layers where required for the protection of end users.

Development Constraint (Waste Disposal):

Waste Disposal options are limited on Jersey, with no on-island facility for receiving hazardous soils. The La Collette reclamation facility receives inert wastes. with some limited derogation of the inert criteria for use of unsuitable soils within the ash cell area.

Analytical data from the site investigation indicates that a substantial proportion of the Made Ground soils and some of the underlying alluvium would be unsuitable for acceptance under the La Collette inert criteria. This material would therefore require shipment abroad, or on-island treatment / recovery as required.

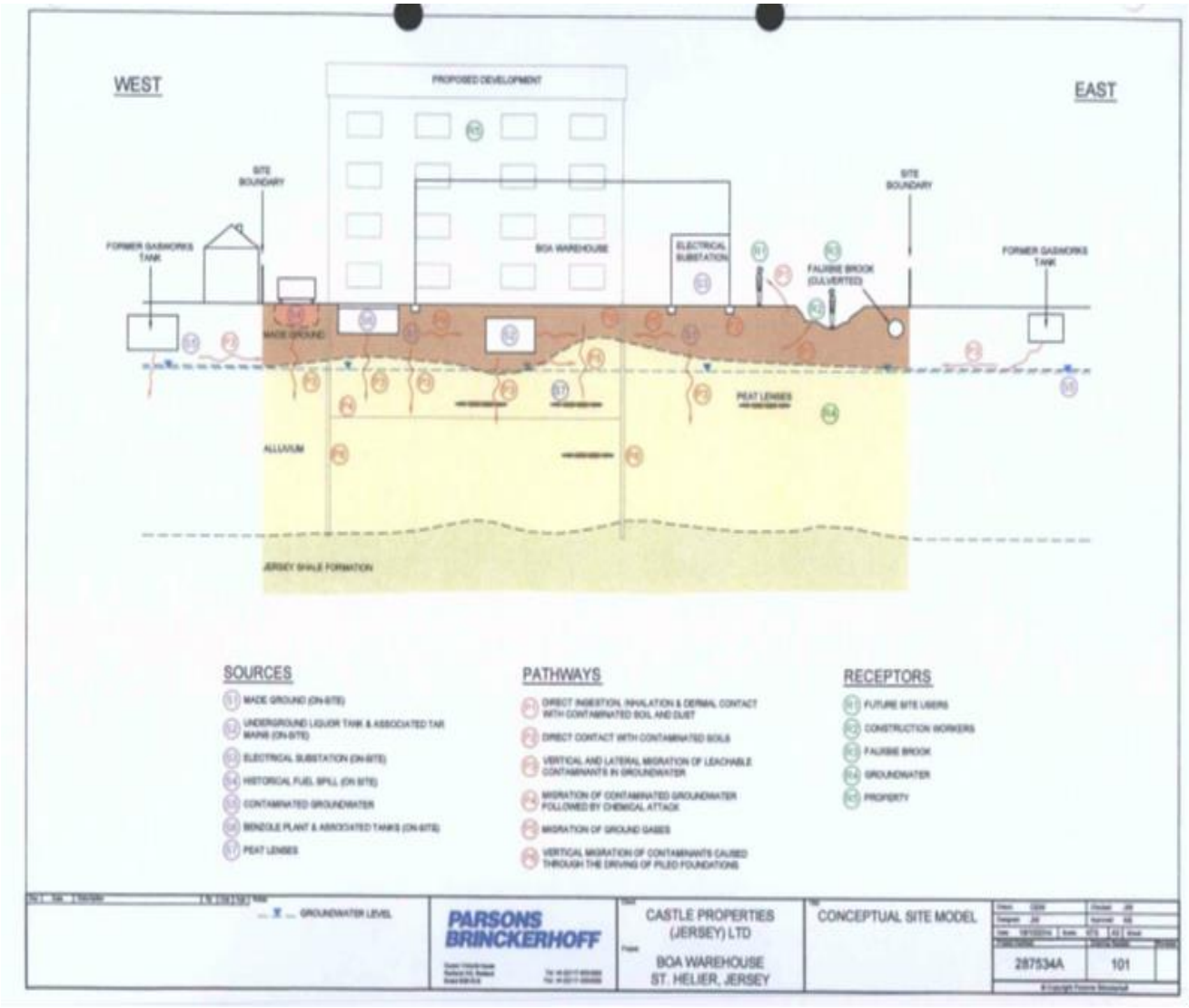
Envirotreat will carry out a full assessment and delineation of contaminated soils as required.

Contaminated soils will either be set aside for treatment *ex-situ* or treated *in-situ* [in-place] depending on the practicalities of treatment and site logistics. The contaminated soils will be treated by E-Clay Stabilisation to enable reuse on-site in accordance with the agreed reuse criteria for the site – the E-Clay Stabilisation Process is licensed as a waste recovery operation.

'Clean' (i.e. compliant) soils will be set aside for offsite disposal as part of the required 'cut' element of the site enabling works. In the event that insufficient 'clean' (compliant) soils are generated to provide the required 'cut' element of the works, then *the lesser* contaminated soils will be treated (by E-Clay Stabilisation) to achieve the required acceptance criteria for offsite disposal at the La Collette waste disposal facility. Envirotreat has already undertaken confirmatory treatability trials in this respect.

The conceptual site model [CSM] developed by PB is shown in Figure 6 below.

Figure 6 – Conceptual Site Model



Site Remedial Services:

In 2018, Site Remedial Services Limited carried out a ‘Contamination Assessment’, a Detailed Quantitative Risk Assessment [DQRA] and subsequently a Remediation Options Appraisal. SRS subsequently developed a Remediation Plan for the project.

SRS undertook a total of one hundred and thirty-seven soil samples from the boreholes were analysed using the Niton XRF Analyser (for quantification of heavy metals) and the QED rapid hydrocarbon analyser (for qualitative and quantitative determination of organic compounds). This was supported by the collection of fifty soil samples during the investigation works. Eleven soil samples were selected for leachate analysis. During subsequent monitoring works a total of nine groundwater samples were collected from within the alluvium deposits and sent to the laboratory for chemical analysis.

The exploratory hole locations are shown in Figure 7 below.

Figure 7 – Exploratory Hole Locations

The SRS contamination assessment concluded the following:

- the highest concentrations of organic concentrations where located within the western section of the site.
- the investigations indicated significant levels of sulphates and cyanide along the western section of the site
- the leachate results showed that the identified contaminants of concern were leachable and therefore potentially mobile
- hydrocarbon groundwater contamination was noted in the western section of the site, which could not be directly attributed to a local source
- the monitoring works also identified the presence of LNAPL in BH112 – this was confirmed by Envirotreat during borehole monitoring in May 2019

SRS concluded from their investigations that:

- the majority of the areas of concern requiring further consideration are likely to be constrained within the western section of the site
- the soil contamination depths are predominantly in the 1m - 3.0m bgl and 4.5 - 6.5m bgl ranges
- there is the strong likelihood that the historical subsurface structures may contain substances which could be adversely impacting on the site
- there is the presence of NAPL in the vicinity of BH112 which will require subsequent removal at remediation stage
- it is likely that groundwater might require treatment (subject to the results of the DQRA). Groundwater treatment may also be adapted to deal with the soil at depth (>5.5m)

The SRS conclusions from the DQRA are as follows:

For the human health risk, the results indicate the following:

- *Residents in Block D will be affected by naphthalene from soil leaching*
- *Residents in Block D will be affected by naphthalene and benzene from groundwater volatilisation*
- *Residents in Block C are unlikely to be affected by the hotspot of contamination found in BH5*
- *Residents in Block H and M might be located upgradient from the hotspot of contamination found in BH5*

With respect to the quality of groundwater as a possible source of groundwater, exceedances of the surface soil SSTLs are noted for cyanides, arsenic, selenium, 1,3,5-trimethylbenzene, sec-butylbenzene, n-butylbenzene, 2-methylnaphthalene and 9,10-anthraquinone, up to 400m from the site. Exceedances of the drinking water standards were found at 400m for 1,3,5-trimethylbenzene, 2-methylnaphthalene and carbazole.

For the underlying aquifer as a receptor, a large number of contaminants of concern have been shown to deteriorate the underlying groundwater through soil leaching, by up to 4 orders of magnitude. With respect to the current state of the underlying groundwater, the results show that SSTLs are exceeded for a great number of contaminants of concern, by up to 5 orders of magnitude.'

Based on the testing undertaken by SRS, two plots were produced to indicate potential areas of concern within the soil and groundwater - these are reproduced in Figures 8 and 9 below.

Figure 8 – Identified Areas of Concern Within the Soils [SRS]

Figure 9 – Identified Areas of Concern Within the Groundwater [SRS]

SRS produced a Remediation Plan for addressing the identified contamination risks as summarised below:

The objectives will be to eliminate or reduce the risks associated with the above contaminant linkages to render the development suitable for its intended end use, and to meet stakeholder's and regulatory authorities' requirements. It is anticipated that the works have the following key objectives:

- *to reduce or eliminate the risk posed by contaminated soils recorded at the site to acceptable levels*
- *to reduce or eliminate the risk posed by the significantly elevated volatile compounds and ground gases recorded at the site to acceptable levels*
- *to reduce or eliminate the risk posed by the presence of Non-Aqueous Phase Liquids (NAPL) recorded at the site to acceptable levels*

- *to reduce or eliminate the risk posed by underlying contaminated groundwater recorded at the site to acceptable levels*
- *to reduce or eliminate the risk posed to materials and services by the elevated contaminants recorded at the site to acceptable levels*

In addition to the above objectives, it is required that the generation of waste material as part of the development is kept to an absolute minimum. The means to deal with heavily contaminated material is limited on the Island and as a result, the costs can be prohibitive. The works will need to incorporate the use of treated shallows soils.

It is understood that the site is being developed for mixed residential and commercial use with associated car parking, storage and landscaping. The proposed redevelopment is shown in Figures 10 and 11 below.

Figure 10 – BOA Warehouse – Proposed Redevelopment – Level 00 Plan [Car Park]

Figure 11 – BOA Warehouse – Proposed Redevelopment – Level 01 Plan [Podium]

Planning Conditions:

The proposed development has been granted outline planning consent – planning application PP/2015/1538 refers.

The Department of the Environment, Planning and Building Services has consulted both the Environmental Health and Environmental Protection Departments who have raised no objections to the proposed development but have stipulated planning conditions in relation to site contamination.

Planning Conditions – Environmental Health:

The stipulated planning conditions are as follows.

COMC005 Remediation strategy - following Phase 1 (Desk Top Study):

No part of the development hereby approved shall be occupied until the levels of potential contaminants in the ground have been investigated, any risks to human health or the wider environment assessed and mitigation measures proposed in a remediation strategy to be submitted to and approved in writing by the Department of the Environment. The approved remediation strategy shall be implemented in full, in accordance with the requirements of Supplementary Planning Guidance Planning Advice Note 2 - Development of Potentially Contaminated Land, as amended. Any changes to the strategy require the express written consent of the Department of the Environment prior to the work being carried out.

COMC006 Watching Brief - following Phase 1 (Desk Top Study):

Notwithstanding the conclusions reached within the Phase 1 Desktop Study, following the commencement of development during the demolition and construction phases, should any contamination not previously identified be found, the Department of the Environment shall be informed as soon as possible. No further development shall be carried out (unless otherwise agreed in writing with the Department) until the levels of potential contaminants in the ground have been investigated and any risks to human health or the wider environment assessed and mitigated, in accordance with the requirements of Supplementary Planning Guidance Planning Advice Note 2 - Development of Potentially Contaminated Land as amended.

COMC007 Contaminated Land Completion - for all:

No part of the development hereby approved shall be occupied until a completion report and contaminated land completion certificate demonstrating completion of the works and the effectiveness of any remediation set out in the approved scheme, is submitted to and approved in writing by the Department of the Environment. Where required by the Department the completion report shall also include a plan for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action and for the reporting of this to the Department.

COMC008 D/CEMP Condition:

Prior to commencement of the development hereby approved, a Demolition/Construction Environmental Management Plan shall be submitted to and approved by the Department of the Environment. The Demolition/Construction Environmental Management Plan shall be thereafter implemented in full until the completion of the development and any variations agreed in writing by the Department prior to such work commencing. The Plan shall secure an implementation programme of mitigation measures to minimise the adverse effects of the proposal on the environment, and shall include but not be limited to:

A. A demonstration of compliance with best practice in controlling, monitoring, recording and reporting on any emissions to the environment (such as noise and vibration, air, land and water pollution);

B. Details of a publicised complaints procedure, including office hours and out of hours contact numbers;

C. Details of any proposed crushing/ sorting of waste material on site;

D. Specified hours of working;

E. <any other specific issues raised through the consultation process>.

The Environmental Health Department has also referred to the possible presence of asbestos on the site and the need to address the potential / identified risks accordingly. The Department has also referenced to informative guidance for the preparation of the required D/CEMP and for the provision of necessary dust and noise controls which are noted.

The Site-Specific Working Plan includes an Asbestos Management Plan – see page 105. This is designed to address the identified concerns of the Environmental Health Department.

Planning Conditions – Environmental Protection:

The stipulated planning conditions are as follows.

COMC004 Waste management plan implementation:

Waste management shall be implemented in full accordance with the approved Waste Management Strategy. Any variations shall be agreed to in writing by the Department of the Environment prior to the commencement of such work.

COMC005 Remediation strategy - following Phase 1 (Desk Top Study):

No part of the development hereby approved shall be occupied until the levels of potential contaminants in the ground have been investigated, any risks to human health or the wider environment assessed and mitigation measures proposed in a remediation strategy to be submitted to and approved in writing by the Department of the Environment.

The approved remediation strategy shall be implemented in full, in accordance with the requirements of Supplementary Planning Guidance Planning Advice Note 2 - Development of Potentially Contaminated Land, as amended. Any changes to the strategy require the express written consent of the Department of the Environment prior to the work being carried out.

COMC007 Contaminated Land Completion for all:

No part of the development hereby approved shall be occupied until a completion report and contaminated land completion certificate demonstrating completion of the works and the effectiveness of any remediation set out in the approved scheme, is submitted to and approved in writing by the Department of the Environment. Where required by the Department the completion report shall also include a plan for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action and for the reporting of this to the Department.

COM008 D/CEMP Condition

Prior to commencement of the development hereby approved, a Demolition/Construction Environmental Management Plan shall be submitted to and approved by the Department of the Environment. The Demolition/Construction Environmental Management Plan shall be thereafter implemented in full until the completion of the development and any variations agreed in writing by the Department prior to such work commencing. The Plan shall secure an implementation programme of mitigation measures to minimise the adverse effects of the proposal on the environment, and shall include but not be limited to:

A. A demonstration of compliance with best practice in controlling, monitoring, recording and reporting on any emissions to the environment (such as noise and vibration, air, land and water pollution);

B. Details of a publicised complaints procedure, including office hours and out of hours contact numbers;

C. Details of any proposed crushing/ sorting of waste material on site;

D. Specified hours of working;

The Environmental Protection Department also welcomes the inclusion of SUDS and states that the plans do not indicate how the car park will be drained. These details should be provided at the detailed planning stage.

The status of the project in respect of the envisaged planning conditions and the approaches to be adopted to address the respective planning conditions are summarised below:

Planning Condition COMC004:

It is considered that this planning condition will be addressed by the preparation, submission and approval of a designated Waste Management Plan [WMP] for the site works / proposed remediation works. This would be provided separately.

This is a pre-commencement planning condition.

Planning Condition COMC005:

It is considered that this planning condition will be addressed by the ground investigation reports / risk assessments as summarised above and by the proposed Remediation Strategy as summarised below (referencing the proposed Remediation Plan accordingly).

This is a pre-commencement planning condition.

Planning Condition COMC006:

It is considered that this planning condition relating to 'contamination not previously identified' will be addressed by the implementation of a 'Discovery Strategy' during the remediation works. It is important to make the distinction between 'contamination not previously identified' and contamination which has already been identified on-site as documented in the site investigative reports.

It is our full understanding that the term 'contamination not previously identified' specifically relates to 'unsuspected' contamination which will be addressed by the 'Discovery Strategy' as summarised in the Remediation Strategy below.

A typical example of contamination not previously identified on a site of this nature would be the isolated presence of asbestos containing materials [ACM] which may have been historically deposited on the site.

The 'Discovery Strategy' will incorporate quarantine provisions to address the potential risks posed by 'unsuspected' contamination identified on-site. Any material designated for inclusion in the quarantine process will either be quarantined at the point of discovery (if movement is not considered practical or if there is a risk of cross-contamination by moving) or moved to a designated quarantine area for assessment. This quarantine provision will effectively address the requirement to stop the works as stated in the planning condition.

The quarantined material will be either reused on-site (following a detailed assessment and evaluation to confirm suitability for reuse) or disposed of offsite in accordance with the designated WAC / WM3 waste classification. The regulatory bodies will be notified on the agreed course of action for each quarantined material.

The objective will be to obtain approval for the 'Discovery Strategy' as a key component of the Remediation Strategy. In the event that 'unsuspected' contamination is identified it is envisaged that a verbal notification would suffice in accordance with the agreed 'Discovery Strategy' and that the remediation works can continue without the need for written notification and without the need for the submission of a further Remediation Strategy document specifically relating to 'unsuspected' contamination (thereby not causing unnecessary delays to the project).

This is essentially a pre-commencement planning condition in terms of the strategy and a post-completion planning condition in terms of the validation / verification.

Planning Condition COMC007:

It is considered that this planning condition will be addressed by the preparation and submission of a comprehensive Validation and Verification Report [Completion Report] documenting the remediation works undertaken and to confirm that the remediation works have been undertaken in accordance with the approved Remediation Strategy.

The Validation and Verification Report will include a summary of the findings (if any) of the proposed Discovery Strategy and will document any works undertaken (if any) in relation to 'contamination not previously identified'.

The report will also include a plan for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action as required by the regulatory bodies.

This is a post-completion planning condition.

Planning Condition COMC008:

It is considered that this planning condition will be addressed by the preparation, submission and approval of a designated Demolition and Construction Environmental Management Plan [D/CEMP]. This Plan will include *inter alia* the specific requirements of both the Environmental Health and Environmental Protection Departments as stated above. This would be provided separately.

This is a pre-commencement planning condition.

Proposed Remediation Strategy:

The prime objective of the Envirotreat Remediation Strategy is to provide a cost-effective remediation solution which enables the development to proceed with full regulatory support. The strategy is designed to address the remediation requirements as summarised in the Remediation Plan above.

The proposed remediation strategy is designed to address the specific remediation requirements as follows:

- *to reduce or eliminate the risk posed by contaminated soils recorded at the site to acceptable levels*

Contaminated soils will be treated by E-Clay Stabilisation - this will significantly reduce the mobility of the contaminants of concern and their ability to impact the underlying groundwater.

- *to reduce or eliminate the risk posed by the significantly elevated volatile compounds and ground gases recorded at the site to acceptable levels*

Contaminated soils will be treated by E-Clay Stabilisation - this will include the treatment of volatile organic compounds to protect site workers and end users. This will be supported by the provision of suitable gas protection measures as required (to be determined).

- *to reduce or eliminate the risk posed by the presence of Non-Aqueous Phase Liquids (NAPL) recorded at the site to acceptable levels*

The extent of the LNAPL source will be determined by trial pit investigation / delineation. Trial pits / trenches will be utilised to undertake free product recovery. Residual / non-recoverable free product will be treated by E-Clay Stabilisation.

- *to reduce or eliminate the risk posed by underlying contaminated groundwater recorded at the site to acceptable levels*

E-Clay Stabilisation will significantly reduce the mobility of the contaminants of concern and their ability to impact the underlying groundwater. The groundwater contamination will be addressed by the installation of an E-Clay Permeable Reactive Barrier [PRB] which will intercept and treat contaminated groundwater potentially migrating offsite thereby protecting controlled water receptors. The PRB will also address the potential risks posed to controlled water receptors by the creation of preferential pathways during the enabling works.

- *to reduce or eliminate the risk posed to materials and services by the elevated contaminants recorded at the site to acceptable levels*

The treatment process will address this potential risk. In addition appropriate measures will be undertaken during the development works to address this potential risk (for example by the use of chemically resistant products and materials where required).

The proposed integrated treatment strategy combines both source and pathway treatment to achieve the agreed remediation objectives. The proposed source treatment would be carried out utilising E-Clay [Chemical] Stabilisation which will address the risks posed to human health (in combination with other engineering measures) and will reduce the impact on groundwater by significantly reducing leachability of contaminants of concern. The stabilisation process will also treat the groundwater associated with the contaminated soils. Groundwater contamination will be addressed by the design and installation of an E-Clay PRB system along [predominantly] the western and south-western site boundaries of the site (pathway treatment).

The Envirotreat E-Clay stabilisation technology can also be effectively applied (as demonstrated by recent treatability trials) for the treatment of surplus contaminated soils requiring offsite disposal – in this respect it is our understanding that hazardous and non-hazardous soils will need to comply with waste acceptance criteria and may require treatment by stabilisation to achieve WAC compliance in terms of leachability.

Overview of E-Clay Technology:

The E-Clay technology would be used in combination with cementitious materials for the stabilisation elements of the remediation scheme (source treatment) and in isolation for the permeable reactive barrier installation (pathway treatment).

The E-Clay technology can effectively address both inorganic and organic pollutants and can address both soil and groundwater contamination.

The technology has been successfully utilised to treat soils / groundwaters contaminated by a wide range of chemicals including the most commonly found problem contaminants in the UK, i.e. hydrocarbons and leachable / hazardous metals. The proprietary technology relies on modification of smectite clays - these modifications allow the contaminants to become bonded [chemically immobilised] within the clay structure, thus reducing the leachability / mobility.

One of the unique attributes of these clays is the flexibility for application to a range of simple and / or complex contamination issues. Contamination can vary on a site by site and even on a hot-spot by hot-spot basis. The E-clays can be designed to treat a complex cocktail of contaminants (including organic and inorganic / heavy metal contamination, in addition to simple heavy metal contamination).

These clays are formulated by addition [intercalation] of reactive hydroxyl aluminium pillaring species between the structural sheets of the clay matrix. This creates adequate interlamellar spacing to accommodate the passage of water and pollutants through the mineral structure. The pillars abridge the sheets to prevent them from shrinkage under dehydration conditions. This clay formulation is referred to as a reactive inorganoclay.

The reactive pillaring species facilitate the sorption and effective immobilisation of anionic pollutants. The base clay provides a cation exchange medium for the sorption and effective immobilisation of cationic [toxic heavy metal] pollutants.

The clays can be partially or fully pillared. A fully pillared inorganoclay would be capable of treating primarily anionic species, whereas a partially pillared inorganoclay would be capable of treating a combination of cationic and anionic species. The inorganoclay can be formulated to address the respective concentrations of the cationic / anionic contaminations of concern on a site-specific basis by the degree of pillaring applied to the base clay.

A schematic representation of a partially pillared clay is shown in Figure 12 below. The reactive mechanism with the clay for treating cationic and anionic pollutants is shown in Figure 13 below.

Figure 12 - Partially Pillared Clay Showing Interlayer Cations (Na+) Prior to Exchange

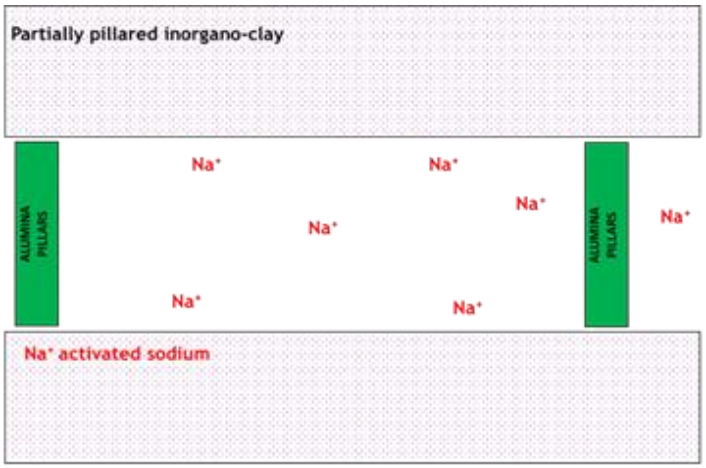
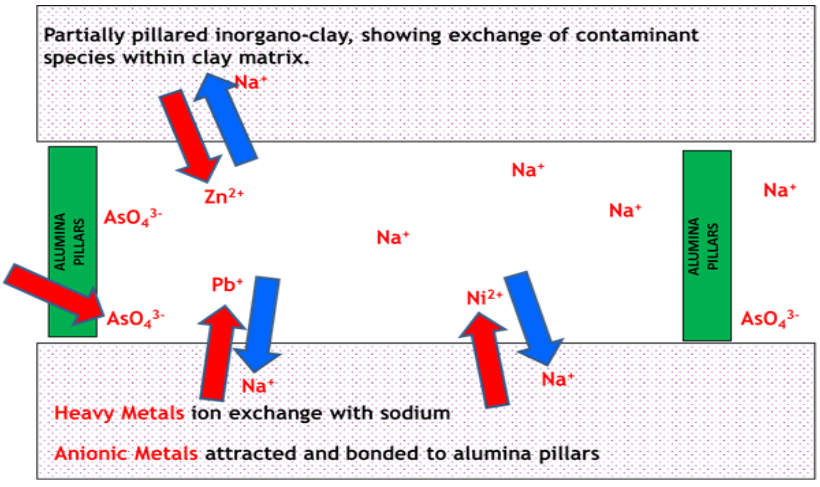


Figure 13 – Pillared Clay Illustrating Interaction with Cationic (e.g. Ni^{2+}, Pb^{2+} and Zn^{2+}) and Anionic (e.g. AsO_4^{3-}) Species



Metallic species in anionic form (e.g. AsO_4^{3-}) and certain anionic non-metals (ammonia and cyanides) react with the alumina pillars; metallic species in cationic form (e.g. Ni^{2+}) exchange onto the clay displacing Na+ cations.

The pillared clays can be further modified by addition of quaternary ammonium salts and reactive transition metal salts. Addition [intercalation] of these reactive species engenders the capability for the clays to sorb and react with a wide range of organic contaminants. These clay formulations are referred to as pillared reactive inorgano-organoclays.

A schematic representation of a pillared reactive inorgano-organoclay is shown in Figure 14 below. The reactivity of the clay is illustrated in Figure 15 below.

Figure 14 - Modified Clay Showing Inclusion of Quaternary Ammonium Salts and Transition Metal Species Producing a Pillared Reactive Inorgano-Organoclay

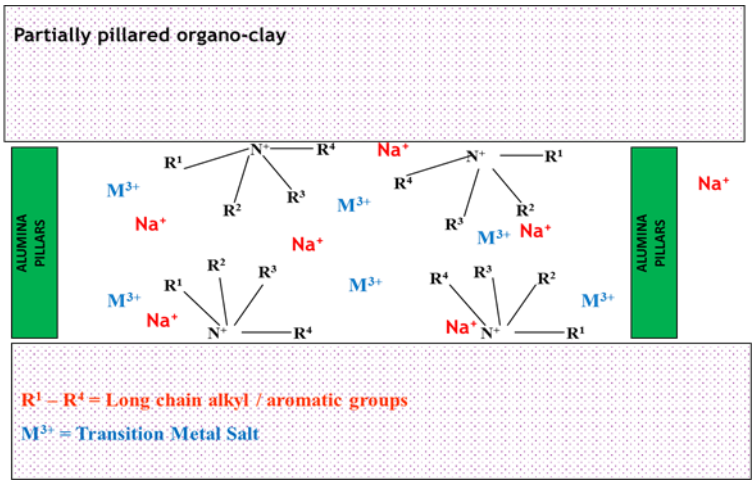
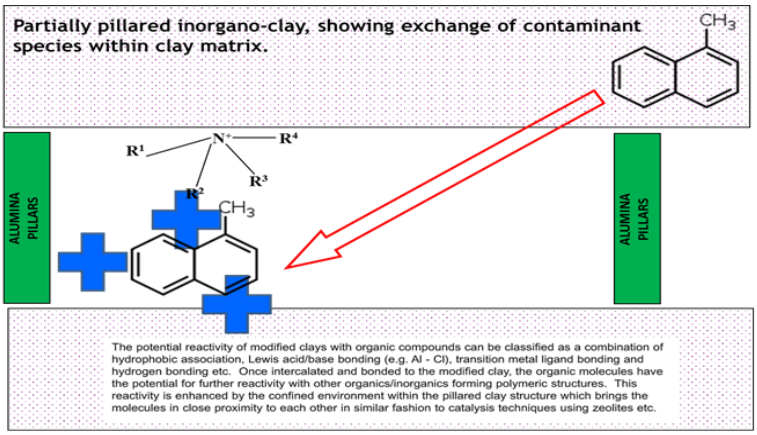


Figure 15 – Interaction of a Pillared Reactive Inorgano-Organoclay with Methylnaphthalene



The key advantages of the Envirotreat E-Clay stabilisation technology are:

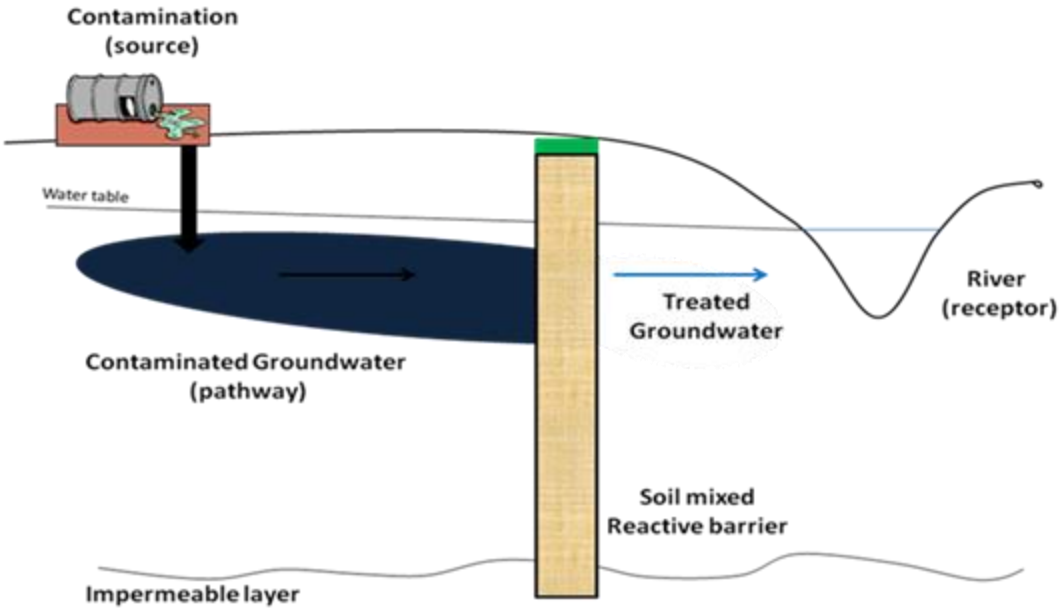
- Proven process – employed on numerous sites for the treatment of a wide range of contaminants, enabling redevelopment of sites for a broad range of end-uses
- Can effectively treat both inorganic and organic contaminants in an 'one step' operation
- Maximum re-use of material on site – Envirotreat's E-Clay stabilisation process is a waste recovery process enabling treated materials to be reused when undertaken under an Environmental Permit.
- Off-site disposal of contaminated material and associated import of clean fill is minimised
- The technology can also be applied for pre-treatment of waste streams / contaminated soils for landfill leachate compliance
- No problematic waste streams associated with the process
- Technology uses readily available plant / equipment and therefore has low mobilisation costs / implications
- Cost effective in comparison to alternative approaches
- Rapid implementation and validation. The technology can be undertaken in-situ negating the need to fuller excavate the contaminated soils (reduces time, odour / dust / VOC risks). Equally the soils can be fully excavated and treated in a batch operation. Validation is based on leachate testing of treated soils and is available in a matter of days
- The technology can be easily implemented in various ways to suit site conditions / logistics (in-situ and ex-situ)

The PRB System is summarised as follows:

In its simplest form, the permeable reactive barrier system consists of a reactive partition placed to intercept the flow of contaminated groundwater flow. The barrier is unique in that it consists of the reactive material (pillared E-Clay) mixed in-situ with the soils present. As the groundwater passes through the treatment barrier, the contaminants react with the media and are removed, resulting in compliant groundwater.

The PRB System is shown schematically in Figure 16 below.

Figure 16 – Schematic of PRB [Cross-Sectional View]



The modification of clays to produce the designated E-Clay involves the addition of a pillaring agents – these pillaring agents provide both reactivity and the necessary porosity / permeability to enable groundwater to migrate through the barrier system without any adverse effects on the groundwater regime.

The key advantages of Envirotreat PRB System are as follows:

- The barrier can be designed to effectively treat a wide range of inorganic / organic contaminants
- Once installed the barrier requires no maintenance - the barrier is designed for the required lifetime
- The barrier is designed to intercept the natural flow of groundwater and therefore minimise impact on the natural groundwater regime
- The implementation is relatively straightforward - there are minimal if any arisings generated from the barrier installation
- Additions of modified clays are small (typically less than 4%)

Envirotreat have demonstrated the capability to effectively treat complex contamination encountered on sites such as former gas works.

A selection of previous gas works sites / gas works wastes remediated by Envirotreat is shown in Table 1 below.

Table 1 – Gas Works / Gas Works Waste Remediation Projects [Envirotreat]

Location	Treatment Methodology	Primary Contaminants of Concern
Appleby Gas Works	1. In-situ E-Clay Permeable Reactive Barrier 2. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Anthracene, Fluoranthene, Phenanthrene, Benzo(a)anthracene, Chrysene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)Pyrene, Benzo(g,h,i)pyrene, Benzene, o-Xylene, Ethyl Benzene, Naphthalene, Ammoniacal Nitrogen (Ammonia), Arsenic, Copper and Phenol
Corporation Street Gasworks, Middleton	1. In-situ Stabilisation (soil mixed E-Clay and OPC) 2. Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, Phenol and Ammonium.
Millgate Gas Work, Stockport	1. In-situ E-Clay Permeable Reactive Barrier 2. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Heavy metals and organic contaminants, including Benzene, Toluene, Ethylbenzene & Xylene and Polycyclic Aromatic Hydrocarbon compounds
Pitwines Gas Works	Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Heavy Metals (Arsenic, Cadmium, Chromium, Lead, Mercury, Selenium, Copper, Nickel and Zinc), Free Cyanide, Ammonium, Polycyclic Aromatic Hydrocarbon compounds, Phenols and Total Petroleum Hydrocarbons compounds
Kingston Yard, Port Glasgow	Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Arsenic, Cadmium, Nickel, Lead, Total Petroleum Hydrocarbons compounds, Polycyclic Aromatic Hydrocarbon compounds and Cyanide
Southend Gas Works	Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc, Benzene, Toluene, Ethylbenzene & Xylene compounds, Polycyclic Aromatic Hydrocarbon compounds and Cyanide
St. Peter's Wharf, Maidstone	1. In-situ E-Clay Permeable Reactive barrier 2. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Polycyclic Aromatic Hydrocarbon compounds, Total Petroleum Hydrocarbons compounds, Ammonium, Cadmium, Total Cyanide and Mercury
Mill Street, Airdrie	1. In-situ E-Clay Permeable Reactive Barrier 2. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Chromium, Arsenic, Nickel, Benzene, Toluene, Ethylbenzene & Xylene, Phenols, Total Petroleum Hydrocarbon compounds, Polycyclic Aromatic Hydrocarbon compounds and Cyanide

Location	Project Approach	Primary Contaminants of Concern
Ansell Way, Warwick	1. In-situ E-Clay Permeable Reactive Barrier 2. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Polycyclic Aromatic Hydrocarbons compounds, Total Petroleum Hydrocarbon compounds, Heavy Metals (arsenic, lead, chromium, zinc, copper) and Benzene, Toluene, Ethylbenzene & Xylene
Rectory Lane, Guisborough	1. Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Polycyclic Aromatic Hydrocarbons, Total Petroleum Hydrocarbons and Ammonia
Belton Street, Stamford	1. Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Polycyclic Aromatic Hydrocarbons, Total Petroleum Hydrocarbons, heavy metals, Cyanide and Ammonia
St Andrews Boatyard	1. In-situ Stabilisation (soil mixed E-Clay and OPC) 2. Ex-situ Stabilisation (soil mixed E-Clay and OPC) 3. In-situ E-Clay Permeable Reactive Barrier 4. In-situ Low Permeability Barrier (soil mixed bentonite and OPC)	Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene & Xylene, Polycyclic Aromatic Hydrocarbons (primarily Naphthalene and Benzo(a)pyrene), Cyanide and Ammonia
River Yar Boatyard	1. In-situ E-Clay Permeable Reactive Barrier 2. Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, Copper, Zinc and Cyanide
Dalmarnock Gas Works, Glasgow	1. In-situ Stabilisation (soil mixed E-Clay and OPC) 2. Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Ammonia, Ammonium, Total and Free Cyanide [Spent Oxide], Chromium, Copper, Lead, Nickel, Zinc, Total Phenols, Benzene, Toluene, Ethylbenzene & Xylene and Polycyclic Aromatic Hydrocarbons (specifically Benzo(a)pyrene)
Purley Way Gasworks	In-situ E-Clay Permeable Reactive Barrier	Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons and BTEX (particularly benzene)
Eshiels, Peebles	In-situ E-Clay Permeable Reactive Barrier	Ammonia, Ammonium, free Cyanide, Chromium, Copper, Lead, Nickel, Zinc, Pentachlorophenol, Total Phenols, Benzene, Toluene, Ethylbenzene & Xylene and Polycyclic Aromatic Hydrocarbons (specifically Benzo(a)pyrene)
Barking Riverside	Ex-situ Stabilisation (soil mixed E-Clay and OPC)	Total and Free Cyanide [Spent Oxide]

Identified Site Contamination:

The site investigations carried out by both Geomarine and SRS identified the following contaminants of concern as posing a risk to both human health and controlled waters:

- Polynuclear Aromatic Hydrocarbons [PAHs]
- Total Petroleum Hydrocarbons [TPH]
- Heavy Metals
- Cyanides
- Ammonium
- Volatile Organic Compounds [VOCs]
- Semi Volatile Organic Compounds [sVOCs]

Envirotreat have demonstrated the capability to treat all of the identified contaminants of concern (on numerous previous remediation schemes carried out over a considerable time period).

Conceptual Site Model:

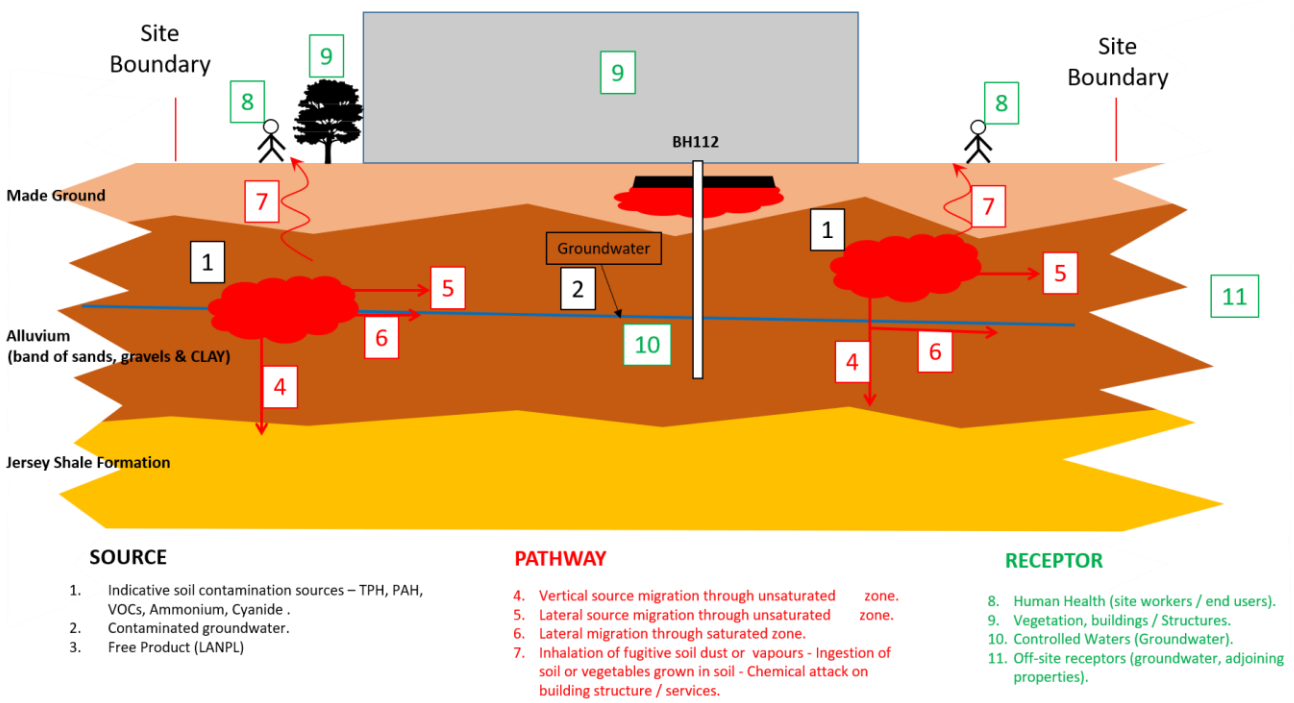
In order to assess the risks posed by potential on-site contamination sources, a conceptual site model [CSM] has been developed based on the intended end uses for the site as a whole (which is a simplification of the environmental setting of the site). The CSM is used to identify any potential pollutant linkages, which may exist when the three key elements described below are present:

- **A source** – a substance which is in, on or under the land and has the potential to cause harm when exposed to a receptor
- **A receptor** – something which could be adversely affected when exposed to a contamination source such as humans, controlled waters or an ecological system
- **A pathway** – a mechanism by which a receptor is exposed to a contamination source

Each element can exist in isolation without posing a significant risk, and it is only when the three elements are linked that a potential risk can exist and a potential pollutant linkage be created, whereby contamination can travel from a source, via an identifiable pathway, to a receptor

Based on our understanding of the site and the identified contamination issues a Pre-Remediation Conceptual Site Model has been developed as shown in Figure 17 below.

Figure 17 – Pre-Remediation Conceptual Site Model



Proposed Site Works:

It is Envirotreat's understanding that the overall works will be phased over two stages and our strategy / programme reflects this approach. The Phase 1 remediation works [Quarters 3 / 4 2019) will be predominantly be carried out in the northern part of the site. The Phase 2 remediation works will be carried out a later date and will complete the envisaged remediation works for the site.

The proposed phasing of the remediation works is shown in Figure 18 below.

Figure 18 – Proposed Phasing of Remediation Works / E-Clay PRB Installation

Proposed E-Clay PRB Installation:

Envirotreat propose the installation of an E-Clay PRB as shown in Figure 18 above – the installation includes a section of E-Clay PRB separating the two phases (shown in a dotted line). The northern PRB will be installed in Phase 1 and the southern PRB will be installed in Phase 2.

The PRB will address the risks posed to offsite receptors by potential offsite migration of contaminated groundwater offsite during both the groundworks (i.e. following the lifting of the existing floor slabs, hardstanding covering the majority of the site etc) and the ongoing / future use of the site.

The permeable reactive barrier will be installed as close to the site boundaries as practically possible. All necessary precautions will be implemented to protect adjacent buildings and residents from the potential risk of pollution whilst the works are being undertaken.

This would include the location of the Mobile Plant / Treatment Area towards the centre of the site away from the site boundary and associated receptors. The provision of an engineered containment system. The provision of robust environmental monitoring (noise, dust, odour and VOC) throughout the works as summarised later within this document.

The E-Clay Permeable Reactive Barrier is typically installed using one of two methodologies.

- Trenching using more conventional plant / equipment
- CFA auger using a piling rig

The objective is to produce a soil mixed barrier of in-situ soils and the designated pillared E-Clay (added in slurry form) – it is [therefore] important that the correct volume of E-Clay slurry is added and that the soils are fully mixed.

Trenching Methodology:

Prior to commencement the location of all services will be fully determined, and the required easement will be agreed / confirmed with the appropriate authorities as necessary.

Any underground structural remnants (e.g. footings, foundations, tanks) will be removed by excavator prior to the installation of the PRB.

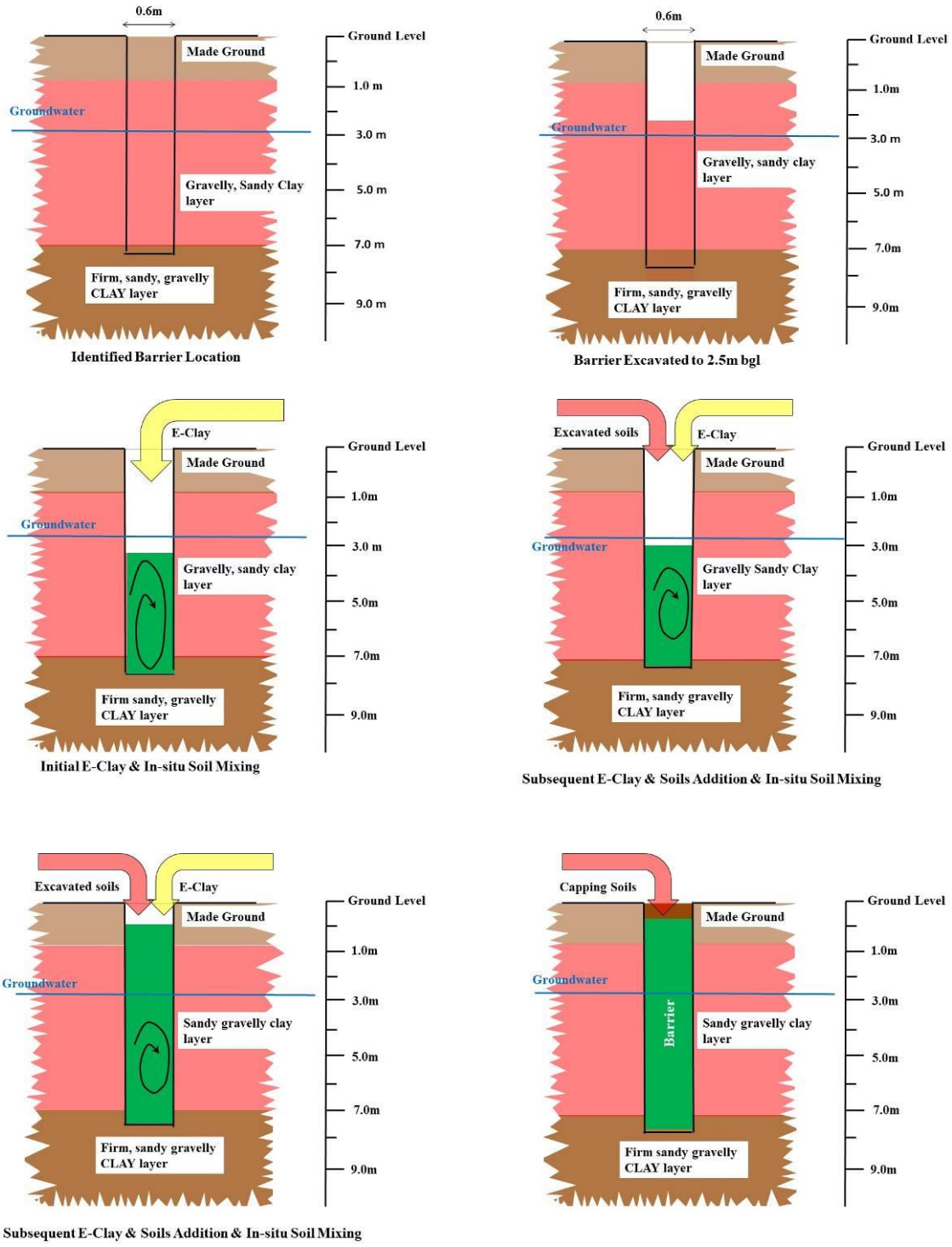
The barrier installation will initially involve the removal of the surface concrete / hardstanding / tarmac / sub-base in the area proposed for the barrier installation, this material will be stockpiled for subsequent off-site disposal or reuse. A short trench (circa 5m inn length) will be excavated (to a nominally to a depth of 1.5 – 2.5m bgl – deeper in ground conditions allow) along the barrier alignment. E-Clay slurry will be added to the trench, using the excavator the E-Clay slurry and soils will be mixed to the required depth. Depending on depth and barrier design more than one E-Clay slurry addition may be required to achieve the correct barrier design specification. Previously set aside surface soils will be reinstated on completion. These soils may also require treating similarly where shallow groundwater is present.

The overall depth of the barrier will reflect the depth of the groundwater and the depth of the underlying low permeability Alluvium (which will vary across the site). The objective will be to key the barrier into the underlying low permeability Alluvium (Clay) layer. The required installation depth will be confirmed by visual observations during the barrier installation and the excavation of trial pits along the barrier path.

The reactive barrier installation is shown in photos and schematically in Figures 19 and 20 below. The respective depths of the geological strata and groundwater will vary across the site as a whole.

Figure 19 – E-Clay PRB Installation – Trenching Methodology

Figure 20 - Schematic of PRB Installation – Trenching Methodology



Continuous Flight Auger (CFA) Methodology:

Prior to commencement the location of all services will be fully determined, and the required easement will be agreed / confirmed with the appropriate authorities as necessary.

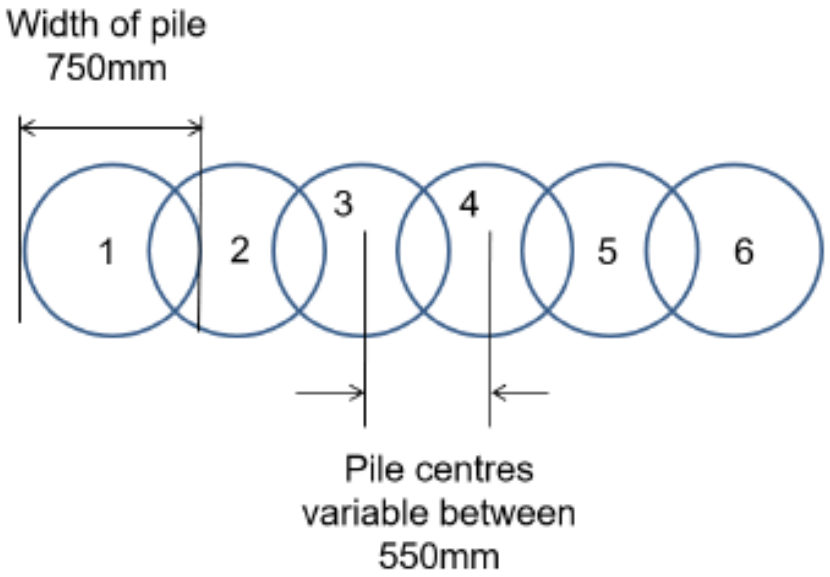
Any underground structural remnants (e.g. footings, foundations, tanks) will be removed by excavator prior to the installation of the PRB.

A short trench (circa 5m inn length) will be excavated (to a nominally to a depth of 1.5m bgl along the barrier alignment (on contain any possible runoff).

As for the trenching methodology the depth of the underlying Alluvium Clay will be determined by the excavation of a number of trial pits along the barrier length

The barrier installation will comprise of the installation of overlapping columns in a secant arrangement (to achieve a continuous barrier installation) – this is shown schematically in Figure 21 below.

Figure 21 – Schematic Showing Column Overlap (Secant Arrangement)



The actual diameter of the auger and overlap may vary depending on plant availability and barrier design.

During the instillation the auger is rotated so that soil is pushed downwards and not brought to the surface. This minimises / negates the generation of spoil arisings.

A typical CFA installation by is shown in Figure 22 below. The auger head which incorporates the injection port (for both mixing and slurry injection is shown in Figure 23 below).

Figure 22 - Typical E-Clay PRB Installation Utilising a CFA Rig

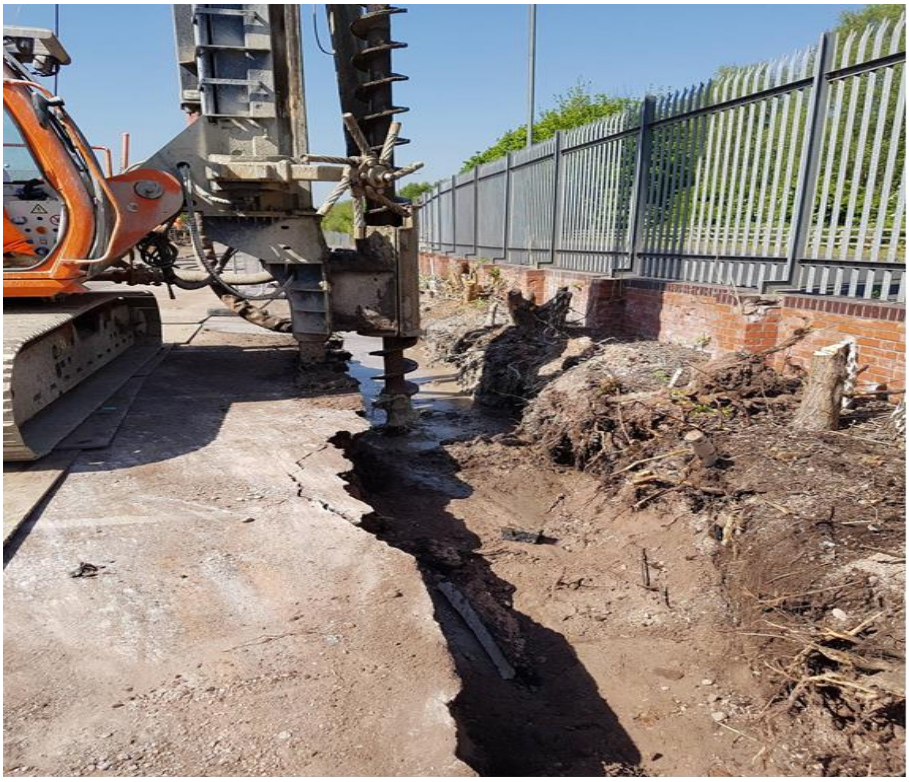


Figure 23 - Auger Mixing Head

At this stage the actual methodology for the E-Clay PRB installation has not been determined and is dependent on a number of factors, predominantly the required barrier depth, soil geology, groundwater depth, barrier width and local constraints.

Irrespective for the installation methodology adopted, both methodologies will be subject to comprehensive Quality Assurance / Quality Control protocols to ensure the barrier is installed in accordance with the proposed design protocol.

Once the E-Clay PRB Phase 1 installation has been completed any hardstanding would be lifted, the underlying soils would be assessed and the contamination sources would be delineated. To achieve the required formation levels, site levels will be reduced. Where the reduced levels coincide with 'clean' soils, then these will be assessed (and where suitable) sent to La Collette for disposal. Where the reduced levels coincide with contaminated soils, then these soils will be stockpiled pending ex-situ treatment (E-Clay Stabilisation) prior to Validation and reuse onsite. Where contaminated soils remain below the formation level, then these will be treated (E-Clay Stabilisation) in-situ. This will minimise the potential for odours and VOCs (including dust) associated with the excavation of these soils.

In respect to the LNAPL identified around BH112, this will be delineated and where practically possible free product recovery undertaken using skimmer pumps. Following a suitable period of free product recovery, the resultant soils will be treated using in-situ E-Clay Stabilisation.

Source Treatment [E-Clay Stabilisation]:

It is currently estimated that it will be necessary to remediate circa 6,000 m^3 of contaminated soils and associated groundwaters.

It is also envisaged that further source treatment may be necessary as a consequence of the 'Discovery Strategy' to be implemented in order to address the requirements of any anticipated Planning Condition imposed by the States of Jersey Government) in relation to 'contamination not previously identified' under existing hardstanding / concrete slabs on the site (and in areas not previously investigated or in previously inaccessible areas).

It will be the intention to delineate and treat the identified source zones (*thereby treating both the contaminated soils and groundwater as a single operation – this is our normal treatment methodology).* This would be carried out using predominantly an in-situ process (to reflect anticipated site environmental concerns) or where there is a requirement to excavate soils, ex-situ. Both the in-situ and ex-situ E-Clay Stabilisation methodologies will involve the addition a site-specific E-Clay formulation designed to chemically immobilise the identified contaminants of concern (within the soils and associated groundwater). Cementitious materials to provide physical stabilisation of the treated material. It is <u>not</u> the intention to produce a monolithic material. Validation of the treated materials is carried out by a granular leach testing methodology by an accredited laboratory, typically at a testing frequency of one composite / representative sample per 250m^3 of treated soils.

In-Situ E-Clay Stabilisation - Soil Mixing:

A suitable area would be marked out by the Project Manager and the ground reduced to accept E-Clay slurry (typically a 5m by 4m grid – see Figure 24 below). All excavations to be supervised by a competent banksman. The depth of the contaminated soils will have been predetermined by trial pitting as part of the delineation process.

Dust will be monitored (together with VOCs, odours) during woks and maintained within occupational limits.

A delivery hose from the Grout Mixer will be extended to the excavated area and an appropriate volume of E-Clay slurry, will be delivered to the treatment area. Under the supervision of the Project Manager, the excavator will in-situ soil mix to the required depth. When instructed by the Project Manager, an appropriate amount of cement would be added to the treatment area and mixed until homogenous. Previously set aside reduced dig material would then be returned to the treatment area and mixed until homogenous.

The in-situ E-Clay stabilisation process is shown in photos and schematically in Figures 24 – 26 below.

Figure 24 – In-situ E-Clay Stabilisation Process

Figure 25 – Typical In-Situ Soil Treatment Grid Area

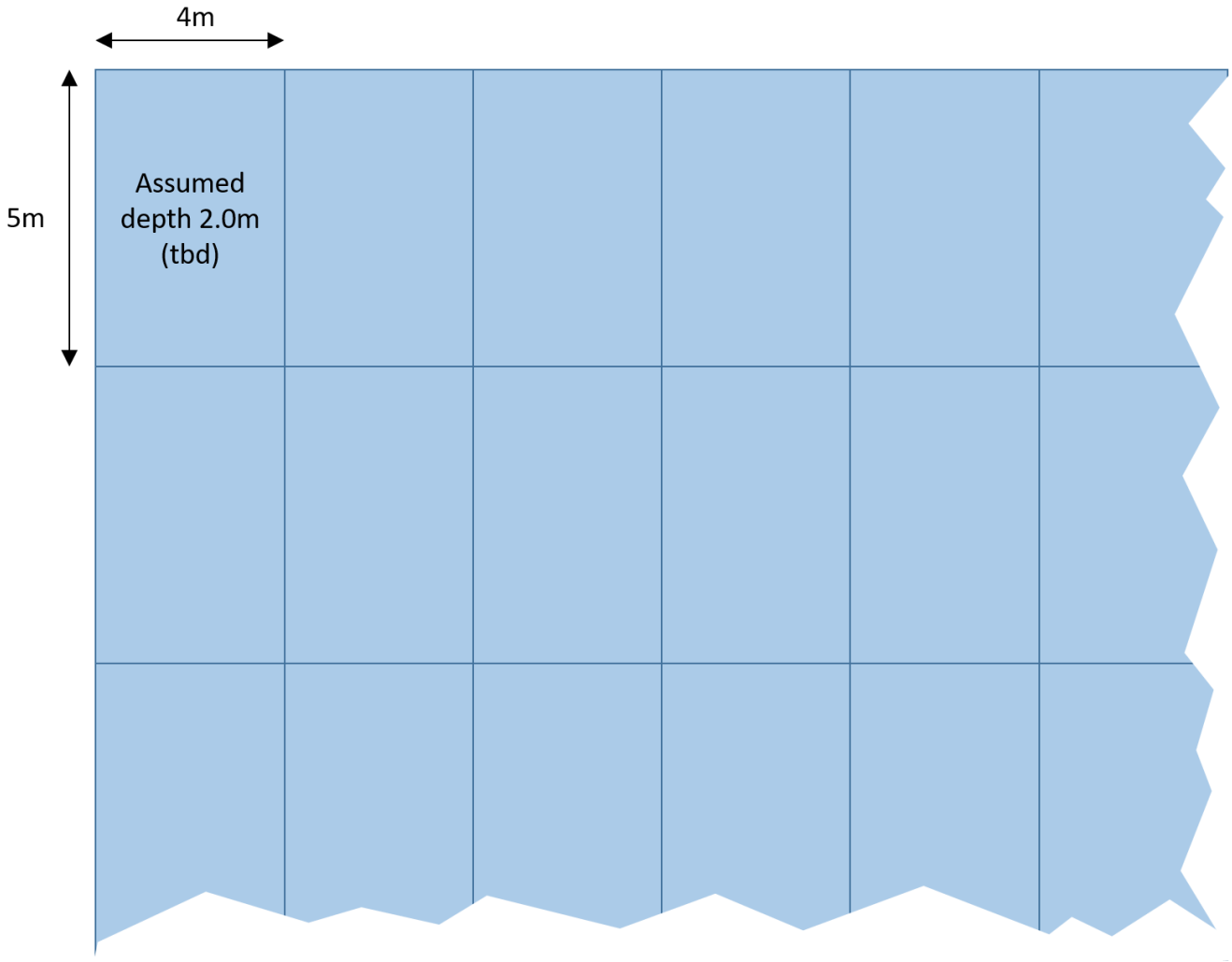
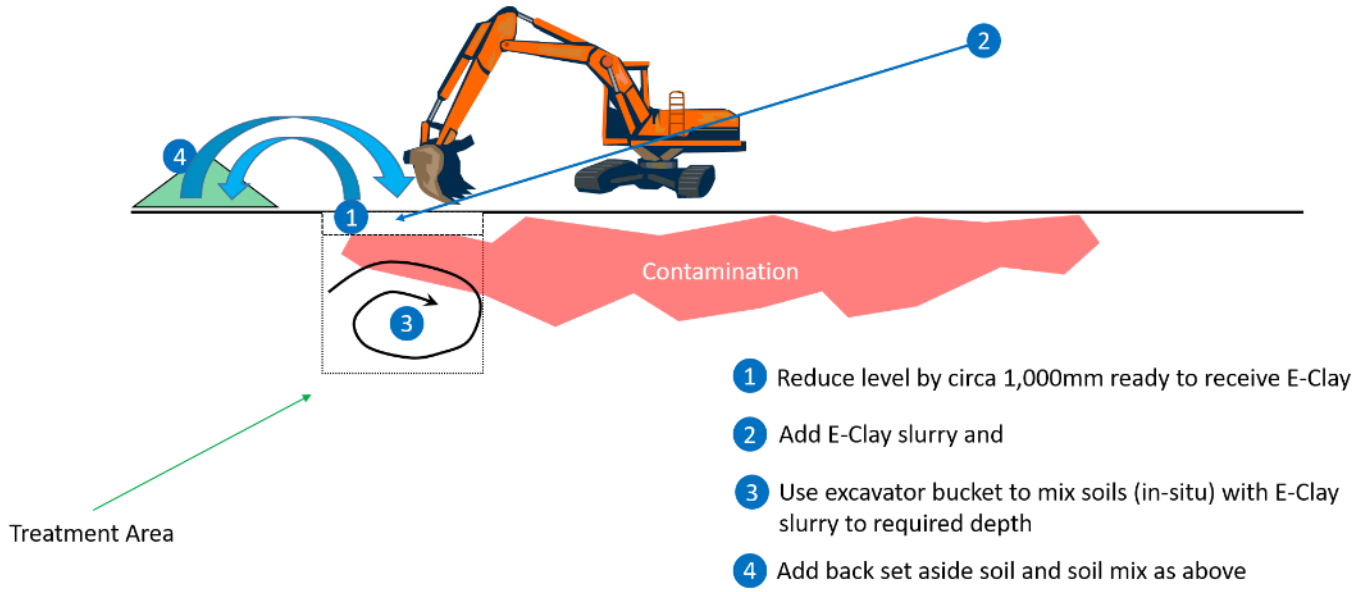


Figure 26 – Typical In-Situ Soil Mixing / Treatment



Ex-Situ E-Clay Stabilisation - Soil Mixing:

Soil to be treated ex-situ are typically stockpiled close to the Treatment Area. To control odours (including VOCs) and dust, soils are only excavated in quantities that can be typically treated within a day.

Soils are treated in a batch process of typically 15m3 per batch - a roll on / roll off skip is normally employed to mix the soils.

Dust will be monitored (together with VOCs, odours) during works and maintained within occupational limits.

An appropriate volume of soil is added to the mixing bin. A delivery hose from the Grout Mixer will be extended to the mixing bin and an appropriate volume of E-Clay slurry, will be delivered to the mixing bin. Under the supervision of the Project Manager, the excavator will soil mix the soils and E-Clay within the skip until homogenous. When instructed by the Project Manager, an appropriate amount of cement to be added to the treatment area and mixed until homogenous. Treated soils will be excavated from the bin and stockpiled locally pending validation.

The ex-situ E-Clay stabilisation process is shown in Figure 27 below.

Figure 27 – Ex-situ E-Clay Stabilisation Process

E-Clay Slurry Production (On-Site):

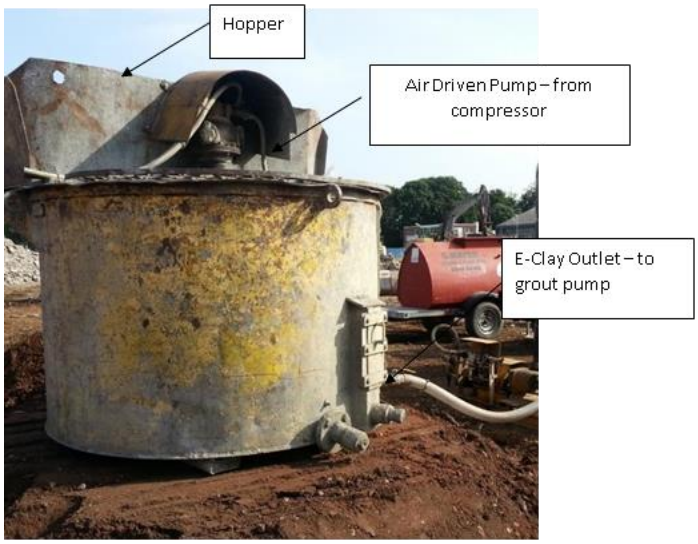
The E-Clay will be produced on site in slurry form. Generally, there will be only two different formulations used on site, one a highly pillared E-Clay for the barrier installation and a second, less pillared formulation, for the stabilisation treatment process.

The E-Clay slurry will be produced in a grout mixer (see Figure 28 below) whereby an appropriate quantity of bentonite powder will be added to a pre-determined volume of water within the grout mixer, this water can be sourced either from a mains supply or by the use of 'grey' water (absence of free product) collected as part of the excavation works. Proprietary chemical reagents are added to the bentonite solution as specified in the Site-Specific Quality Plan. This is undertaken by trained personnel only under the supervision of the Project manager.

In order to reduce the perceived risk associated with handling of the treatment materials all Envirotreat personnel involved with the remediation works will be provided with the specified Personal Protective Equipment (as detailed in Health & Safety Method Statement). Treatment reagents will be transported to the mixing zone using appropriate plant as and when required. Bentonite and cement will be supplied in 25kg bags. Liquid chemicals will be supplied in IBC and / or 205litre containers. Where regulated chemicals are utilised these will be stored on 110% containment bunds during daily usage.

All plant and machinery used in the slurry production process shall be thoroughly washed down at the end of each working day, all water collected and reused in the treatment process.

Figure 28 - Grout Mixer used for the Production of E-Clay Slurry



Engineered Containment System:

The treatment area will be located within an Engineered Containment System [ECS]. The ECS will either comprise of an existing integral slab (or similar) with appropriate bunding or an impermeable membrane and bund to prevent the migration of possible spillages / rainwater – the ECS will be inspected and approved prior to commencement of the remediation works and the inspection will be recorded in the Site Specific Quality Plan. In the event of a spillage and / or significant rainfall, the potentially contaminated water will be collected and, where possible, incorporated into the treatment process – the collection and use within the treatment process will be recorded in the Site-Specific Quality Plan. Maintenance of the overall ECS will be undertaken during the course of the remediation project through visual inspection of damage. Any damage to the ECS system will be repaired and recorded in the Site-Specific Quality Plan.

The treatment operations (and treatment area) are shown schematically in Figures 29 and 30 below.

Figure 29 – Schematic Showing Typical Treatment Area Set Up

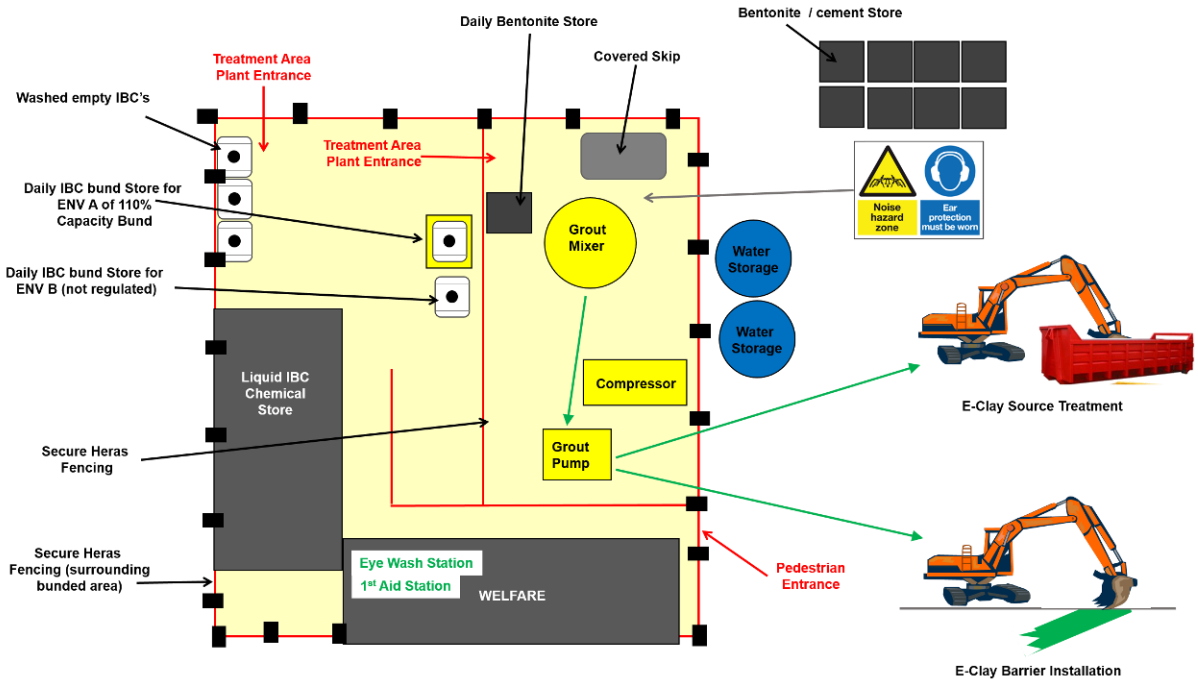
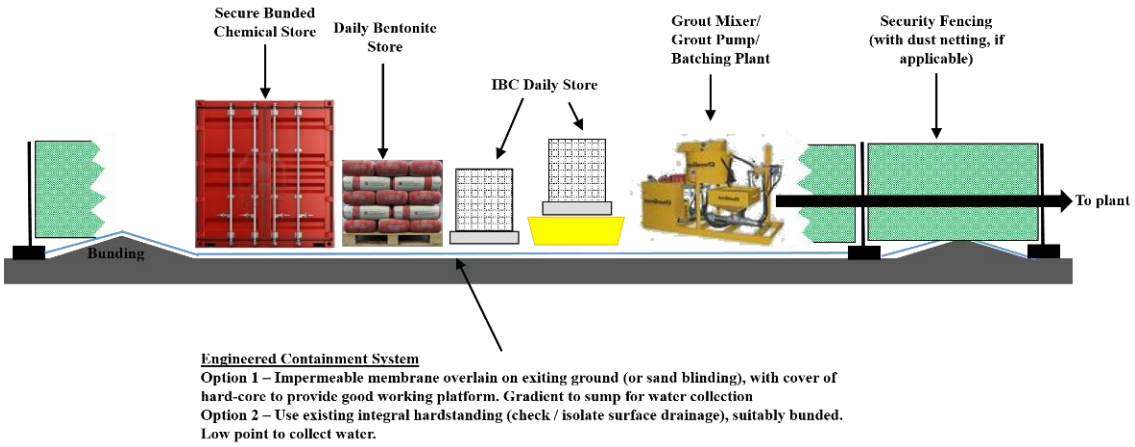


Figure 30 - Schematic Showing Typical Treatment Operation Set Up



The actual location of the treatment area is yet to be determined and will be formalised following demolition and a subsequent review of the remaining infrastructure on site.

Project Description:

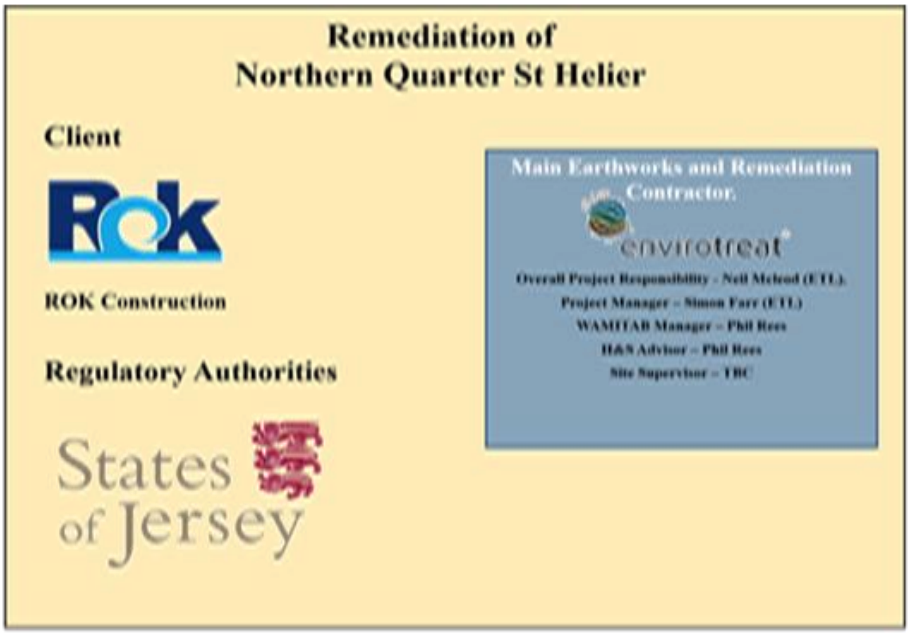
The site will be redeveloped for residential end use following soil / groundwater contamination remediation works and subsequent enabling earthworks. It is proposed that the site will be reprofiled to allow the construction of a residential blocks with associated parking. The proposed scope of works is set out below (duration approx. 30 weeks):

- Erection of suitable fencing / site security around the site
- Demolition of existing buildings (outside the scope of this document).
- Break out of all remaining hardstanding
- Trail pit investigation and delineation of source contamination
- Installation of a PRB
- Enabling works (cut and fill)
- In-situ and ex-situ E-Clay Stabilisation of soil contamination hot spots
- Offsite disposal of waste soils

Project Relationships:

The project relationships are as shown in Figure 31 below.

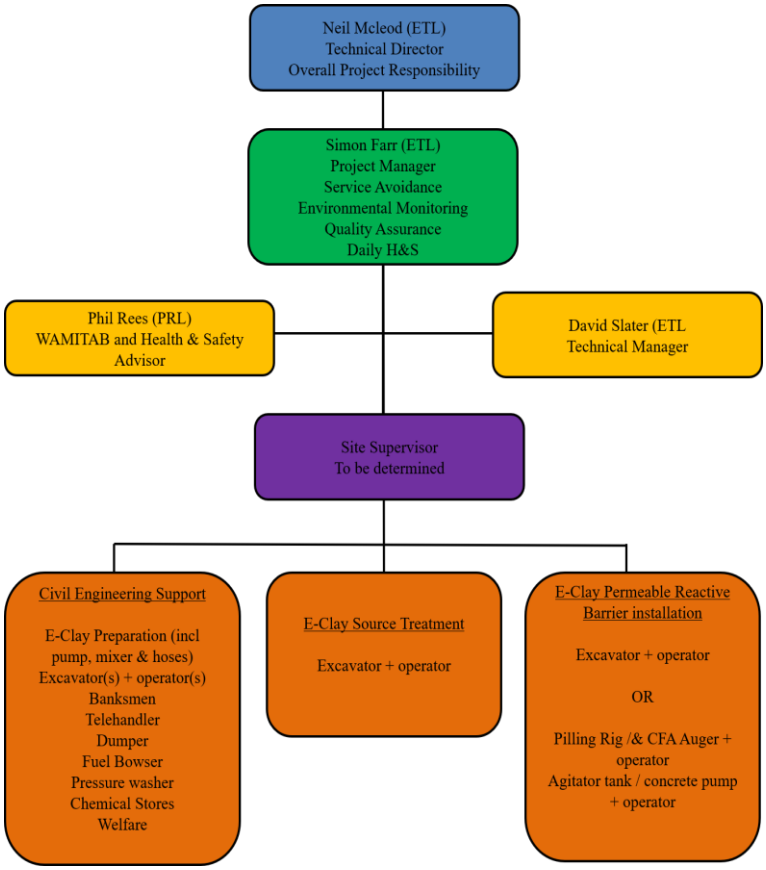
Figure 31 – Project Relationships



Project Responsibilities:

The Project Responsibilities are as Figure 32 below.

Figure 32 – Project Responsibilities



Key Envirotreat contacts are:

Neil Mcleod (Technical Director - 07968 496927 – neil.mcleod@envirotreat.com)

Simon Farr (Project Manager - 07803 174046 – simon.farr@envirotreat.com)

David Slater (Technical Manager - 07949 205896 – david.slater@nvirotreat.com

Training, Awareness and Competency:

All aspects and requirements of the agreed Remediation Strategy / Remediation Method Statement, Environmental Risk Assessment, Site-Specific Quality Plan and Health & Safety Risk Assessment / Method will be communicated to the project team, site operators and subcontractors by the following:

- Envirotreat Site Induction
- Subcontractor Prestart meetings
- Daily Pre-start meetings
- Task Specific Toolbox talks throughout the various elements of the works
- Incident Reports / Bulletins

Continuous assessment will be carried out as part of the weekly site inspections and recorded in the Site Health and Safety File.

Site-Specific Quality Plan:

The Quality Assurance / Quality Control protocols will be contained within the Site-Specific Quality Plan, a bespoke onsite document that outlines all the procedures and checks which need to be undertaken to ensure the correct delivery of the technology (this document covers both the PRB installation and E-Clay Stabilisation elements of the remediation works).

In summary the Site-Specific Quality Plan document will include the following:

Section 1: Project Management:

Company Policy, Management Responsibilities, Verification Resources & Personnel and Management Review

Section 2: Quality System:

Structure, Composition & Contents of the Quality System, Document Control, Issue and Amendment of the Quality Plan

Section 3: Contract Review:

Contractual Documents:

Section 4: Associated Contractual Documents

Section 5: Correspondence

Section 6: Orders & Requisitions

Section 7: Waste Transfer / Imported Material

Section 8: Minutes of Meetings

Section 9: Miscellaneous

Section 10: Quality Risk Assessments & Controls

Quality Procedures:

QP001 - Production of E-Clay Slurry

QP002A – In-Situ E-Clay Stabilisation

QP001B – In-Situ E-Clay Stabilisation

QP003A – In-Situ Barrier Installation Methodology – Using Conventional Plant

QP003B – In-Situ Barrier Installation Methodology – Using CFA Rig

QP004 – Setting Out

QP005 – Collection of samples

QP006 – Validation

Quality Risk Assessment Sheets - Revision Record

QRA001 - Production of E-Clay Slurry

QRA002A – In-Situ E-Clay Stabilisation

QRA001B – In-Situ E-Clay Stabilisation

QRA003A – In-Situ Barrier Installation Methodology – Using Conventional Plant

QRA003B – In-Situ Barrier Installation Methodology – Using CFA Rig

QRA003 – Material Usage Audit

Section 11: Training Records

Section 12: General Quality Check Sheets

QCS001a/b/c/d – Delivery Record Sheet – Bentonite, Cement, Envirotreat A, Envirotreat B and Envirotreat C

QCS002 – Stock Take

QCS004a - Additive Addition Check Sheet

QCS004b – E-Clay Delivery Check Sheet

QCS005a – Weekly Record of General Inspection

QCS005b – Record of General Inspection – Comments

QCS006a – Plant / Equipment Maintenance Schedule and Procedure

QCS006c – Record of Plant Inspection – Comments

QCS007 – Validation Sampling Record Sheet

QCS008 – Weekly Record of Works

QCS009 – Summary of Envirotreat Standing Time

QCS010 - Plant & Equipment Breakdown Review

QCS011 – Complaint Form

QCS012 – Quarantine Record

QCS013 – Weather Record

QCS014a – Environmental Monitoring – Noise.

QCS014b – Environmental Monitoring – VOC

QCS014c – Environmental Monitoring – Odour

QCS014d – Environmental Monitoring – Dust

QCS015 – Spillage Record Sheet

QCS016 – Piling Logs

The Quality Assurance / Quality Control Procedures will include:

- monitoring E-Clay production (additive addition, addition order, mixing times number of batches produced, etc)
- monitoring E-Clay additions by regular process checks (thereby ensuring that the required quantities are added to the barrier installation / for E-Clay Stabilisation)
- continuous monitoring and assessment of the actual chemical usage levels in comparison to the estimated usage levels (to ensure that the PRB installation and E-Clay Stabilisation Process is carried out in accordance with the required designs)
- monitoring the soil mixing processes
- monitoring the plant / equipment being utilised for both the barrier installation and stabilisation works
- environmental performance parameters including regular checking of the ECS; prevailing weather conditions; quarantine reports; spillage records etc.
- regular material stock checks will be carried out - daily material usage will be documented and compared to recorded stock levels - daily checks will be undertaken by the Project Manager on chemical addition rates and on-site mixing
- A daily / weekly record of works (including hours operated, volumes treated, site checks, plant records, etc) will be kept and documented. The record sheets will be reviewed by the Project Manager and on approval will be signed and incorporated into the Site-Specific Quality Plan held on site.

Discovery Strategy:

A 'Discovery Strategy' will be employed throughout the remediation works – this Discovery Strategy which will incorporate suitable protocols to address the requirements of Planning Condition COMC006 as summarised above in relation to '*contamination not previously identified'*. These protocols are designed to provide an acceptable methodology for addressing contamination 'not previously identified' as and when encountered.

Protocol Flowchart 1 will be adopted for the validation of soils not previously investigated.

Protocol Flowchart 2 will be adopted for the necessary Quarantine Process.

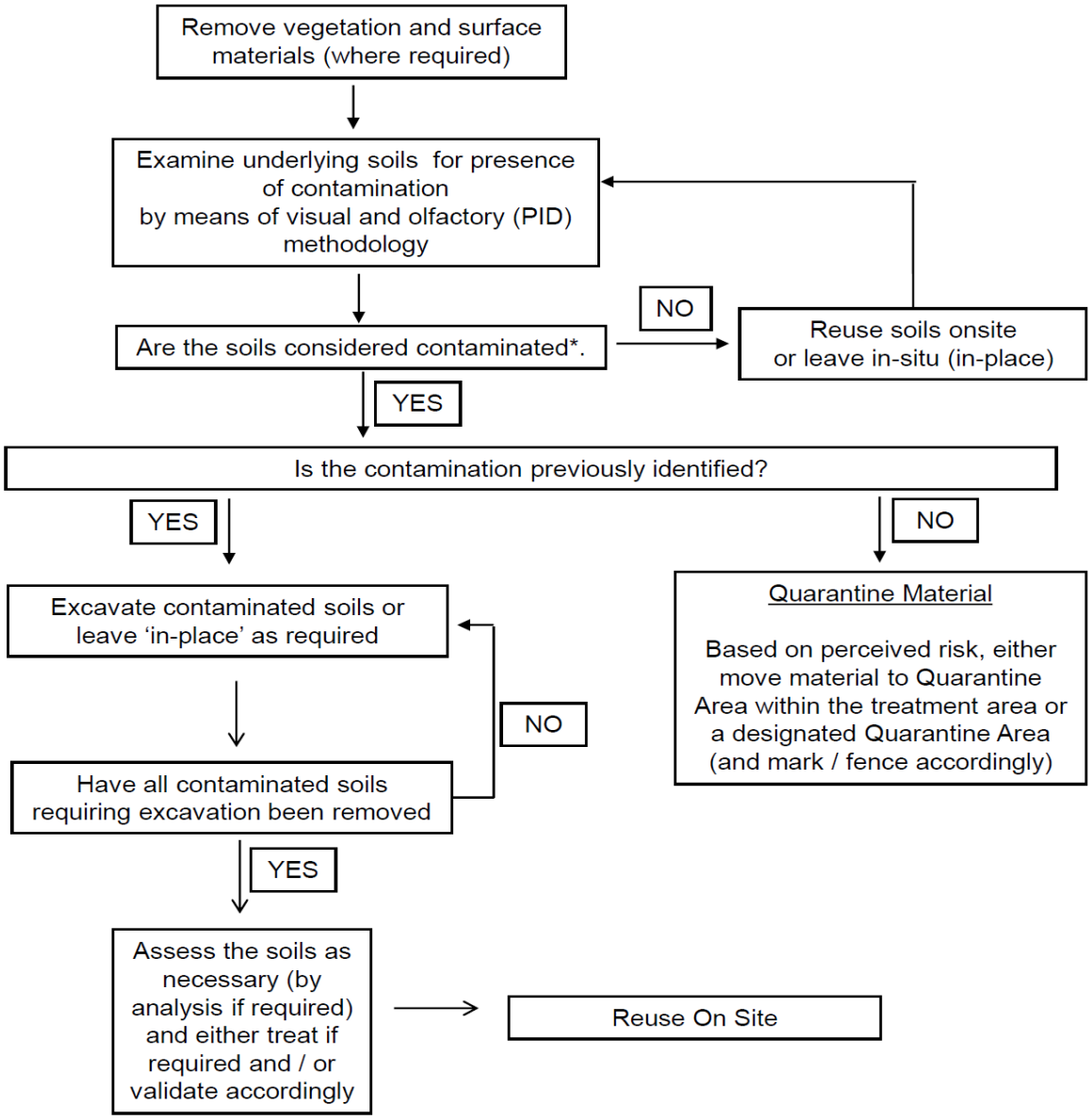
Quarantine Process:

The Quarantine Process referred to in Protocol Flowchart 1 is designed to enable Envirotreat to make a full assessment of any contamination '*not previously identified*'.

Any material designated for inclusion in the Quarantine Process will either be quarantined at the point of discovery (if movement is not considered practical or if there is a risk of cross-contamination by moving) or moved to a designated Quarantine Area.

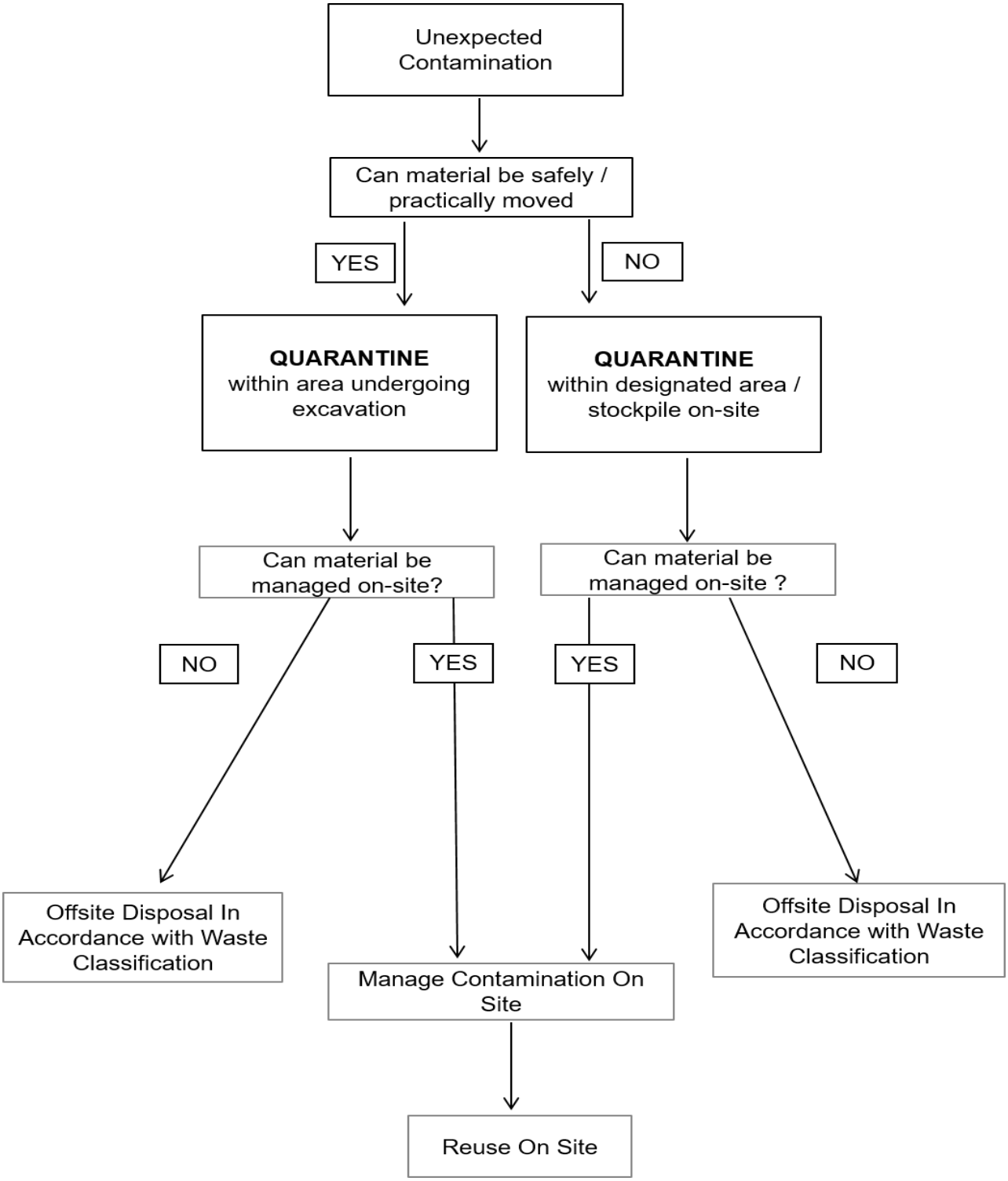
Following assessment, the material will either be managed onsite to address the identified risks associated with the material or disposed of offsite in accordance with the designated waste classification [WAC / WM3]. The regulatory bodies will be notified on the agreed course of action for each quarantined material.

Protocol Flowchart 1



(*) contamination will be assessed on the basis of rapid sampling techniques as necessary, such as use of PID/FID to monitor volatiles in addition identify materials displaying visual, olfactory or physical properties (including hydrocarbon sheens / staining on soils and groundwater) that may be suspected of representing a contamination risk

Protocol Flowchart 2



Validation:

Excavations:

The excavations will be validated by Envirotreat using [primarily] visual and olfactory methods. Where requested, samples will be collected from the sides and bases of the excavations to demonstrate the satisfactory removal of contaminated soils. Trial pitting investigation will be used to demonstrate suitable delineation on the in-situ source treatment process (where full excavation will not be undertaken).

E-Clay PRB Installation:

The E-Clay PRB installation will be validated by demonstrating compliance with the PRB Design document and with the requirements of the Site-Specific Quality Plan.

Ongoing monitoring of groundwater down gradient of the barrier installation may be required by the States of Jersey Government which could involve groundwater monitoring over an agreed period following the barrier installation.

Source Treatment (E-Clay Stabilisation):

The Validation Procedure will comprise of representative sampling from each treated batch producing a composite sample for leach testing – the composite sample will be representative of typically every 250m^3 of soils treated.

Following a suitable period of “curing”, samples will be leached and tested for the main contaminants of concern by an independent UKAS Accredited Laboratory. The 12457-2 leachate methodology will be utilised as this is recognised as the appropriate / preferred mechanism for demonstrating long term stability of treated material within a reasonable timescale. The Environment Agency of England and Wales and the Scottish Environmental Protection Agency both accept the BSEN (or CEN) 12457-2 (L:S 10:1) leaching protocol for demonstration of leachate characteristics for soils treated by the Envirotreat Process. This leachate testing protocol has been applied with regulatory support for over 15 years in relation to stabilisation projects undertaken by Envirotreat and is considered to be a suitable testing methodology. The Remediation Target Criteria [RTC] are to be agreed.

Sampling records will be maintained by an Envirotreat representative and held within the Site-Specific Quality Plan.

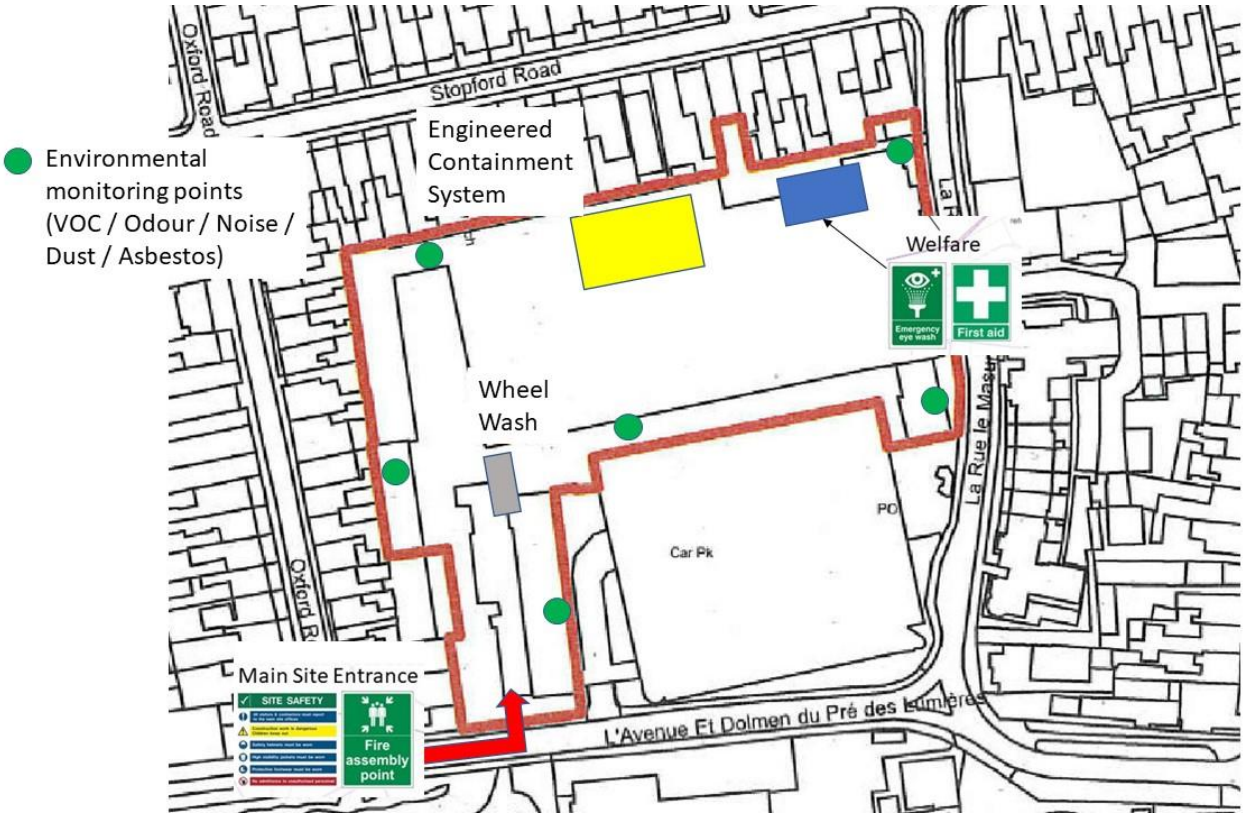
Environmental Risk Management:

The Environmental Risk Assessment relates to the contamination remediation and initial enabling works only.

Based on the identified RISKS and known RECEPTORS, Envirotreat has formulated the following risk assessment based on the proposed-on site activities.

The locality of the project area is shown in Figure 33 below – this includes the proposed locations of the welfare, wheel wash and environmental monitoring points (actual locations to be determined / agreed).

Figure 33 – Locality of Project and Total Disturbance Footprint



Site Sensitivity:

There are number of highly sensitive potential receptors around the site boundary - these have been taken into consideration in the Environmental Risk Assessment.

Former BOA Warehouse, St. Helier, Jersey – Site Specific Working Plan

Table 2 - Conceptual Site Model and Risk Assessment

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Hydrocarbons, metals and gas works waste associated with contaminated soils	Site operatives, general public & neighbours	Human health issues	Contact, ingestion and inhalation of contaminated soil, dust & vapours.	Low	High	Medium	Short & long term health effects	In-situ installation of E-Clay PRB minimises amount of arising. In-situ E-Clay stabilisation of contaminated soils, reduces the risk of exposing contaminated soils Monitoring dust (minimising by wetting soils if necessary). VOC monitoring. Ensure all operatives use specified PPE. Good hygiene Induction training. Controlled site access	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Low	Low	Effect of contamination on soils & ground water	In-situ installation of E-Clay PRB at project minimises risk of offsite migration of contaminated groundwater as a consequent of earthwork. Subsequent E-Clay chemical stabilisation significantly reduces future risk of mobile contamination.	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Hydrocarbons, metals and gas works waste associated with contaminated soils	Off-site receptors	Contamination to offsite receptors	Migration across / off site.	Low	High	High	Contamination affecting general public & neighbours. Contamination affecting soils & groundwater off-site	Clean all vehicles before leaving site, mobile plant remains on site during works, deliveries outside treatment area. Segregation of site into “clean” and “dirty”. All vehicles taking soils offsite to be cleaned and inspected prior to leaving site. Consideration or road sweep and wheel wash at site exit.	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Liquid chemical reagents associated with treatment process (spillages or leakage)	Site operative's general public & neighbours	Human health issues	Contact & ingestion of liquids and inhalation of vapours.	Medium	Medium	Medium	Short & long term health effects	Ensure all operatives use specified PPE. Ensure all operatives are fully inducted (including COSHH training). Correct labelling of products. Provision of site security and containerised storage. Suitable chemical transfer containers (with lids and less than 10litre) Controlled site access	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Medium	Medium	Effect of contamination on soils & ground water	Use of Engineered Containment System (ECS) COSHH & induction training.	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Liquid chemical reagents associated with treatment process (spillages or leakage)	Off-site receptors	Contamination to offsite receptors	Migration across / off site.	Medium	High	High	Contamination affecting general public & neighbours. Contamination affecting soils & groundwater off-site	Provision of decontamination areas for operatives. Minimal plant entering / exiting Mobile Plant Area during operational works. Clean all vehicles before leaving site, mobile plant remains on site during works, deliveries outside treatment area. Store all chemicals away and use at a safe distance from site boundary. Use of ECS. E-Clay production to undertaken away from site boundary. Ensure all operatives are fully inducted (including COSHH training). Only full / new / securely chemicals offsite on completion.	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Powder chemical reagents associated with treatment process.	Site operatives, general public & neighbours	Human health issues	Contact, ingestion and inhalation of powders / dusts	Medium	Medium	Medium	Short & long term health effects	Minimise dust (see above). Ensure all operatives use specified PPE. Correct labelling of products. Implementation of site security and containerised storage. Provision of boundary Herras fencing to incorporate dust mesh to minimise windage. Ensure all operatives are fully inducted (including COSHH training).	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Low	Low	Effect of contamination on soils & ground water	Use of ECS. COSHH & induction training. Implementation of site security measures. No soils / materials envisaged going offsite	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Powder chemical reagents associated with treatment process.	Off-site receptors	Contamination to offsite receptors	Migration across / off site.	Medium	Low	Low	Environmental risks from contamination are low – nuisance risk only	Minimise dust (see above). Provision of decontamination areas for operatives. Clean all vehicles before leaving site, mobile plant remains on site during works, deliveries outside treatment area. Store all chemicals away and use at a safe distance from site boundary. Herras fencing to incorporate dust mesh to minimise windage. Ensure all operatives are fully inducted (including COSHH training). No soils / materials envisaged going offsite	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Daughter products resulting from mixing treatment reagents	Site operatives, General public & neighbours	Human health issues	Contact, ingestion and inhalation of E-Clay slurry / vapours.	Medium	Low	Low	No daughter products produced other than E-Clay. E-Clay is non-hazardous	Ensure all operatives use specified PPE. Undertake induction training.	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Low	Low	No daughter products produced other than E-Clay. E-Clay is non-hazardous and is used to treat soils.	Use of ECS Spillage will be cleaned up. Undertake induction training.	Low
	Off-site receptors	Contamination to offsite receptors	Migration across / off site.	Medium	Low	Low	No daughter products produced other than E-Clay. Environmental risks from contamination are low.	Clean all vehicles before leaving site. In-situ treatment to be undertaken away from site boundary. Ensure all operatives are fully inducted (including COSHH training). No materials envisaged going offsite	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Products resulting from treatment process	Site operatives, general public & neighbours	Human health issues	Contact, ingestion and inhalation of treated soils & dusts.	Medium	Low	Low	Post treatment soils are wet minimising potential for dust. Treated material inert.	Dust monitoring. Ensure all operatives use specified PPE.	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Low	Low	Treated material chemically inert.	Use of ECS. Induction training.	Low
	Off-site receptors	Contamination to offsite receptors	Migration across / off site.	Medium	Low	Low	Treated material chemically inert. Nuisance risk	Clean all vehicles before leaving site. Undertake induction training. Controlled site access. No soils envisaged going offsite. All vehicles taking soils offsite to be cleaned and inspected prior to leaving site. Consideration or road sweep and wheel wash at site exit	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Refuelling machines & plant	Site operatives, general public & neighbours	Human health issues	Contact & ingestion of liquids and inhalation of vapours.	Medium	Medium	Medium	Short & long term health effects	Ensure all operatives use appropriate PPE. COSHH & induction training. Correct labelling of products. Use correct refuelling equipment.	Low
	Underlying soils & groundwater	Contamination of underlying soils / ground water	Migration through ground to underlying soils / aquifer	Medium	Medium	Medium	Effect of contamination on soils & ground water	Use of ECS. COSHH & induction training. Use drip trays. Provision of spill kits.	Low
	Off-site receptors	Contamination to offsite receptors	Migration across / off site. .	Medium	Low	Low	Contamination affecting general public & neighbours.	All fuel storage / refuelling to be undertaken in designated area away from site boundary COSHH & induction training.	Low
Refuelling machines & plant	All receptors	Environmental & health risks	FIRE	Medium	Medium	Medium	Risk of fire during storage and fuelling with flammable liquids	Use correct equipment. Safe storage of fuel. Strict no smoking policy.	Low

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Fire / explosion	All receptors	Environmental & human health risks	FIRE	Negligible	Medium	Medium	Risk associated with release of flammable free product	All recovered free product stored safely onsite away for other combustible materials, away for site boundary and welfare / storage facilities	Negligible
Odours and VOCs	All receptors	Environmental & human health risks	Air	Medium	Medium	Medium	Risk associated with release of odours and VOCs	Odours and VOCs to monitored during the day at key locations around the site. Trigger and Action Value will be formulated and adhered to. A significant proportion of the works will be in-situ therefore minimising the risk of release.	Negligible
Gas release	Site workers	Serious injury / death	Air	Negligible	Medium	Medium	Risk of asphyxiation due to diminished oxygen	If probability changes;- Operative to use air monitoring devices which measure LEL/O_2/CO/H_2S. No operative to enter unventilated confided spaces / excavations	Negligible

Source	Receptor	Harm	Pathway	Probability of Exposure	Consequence	Magnitude of Risk	Justification for Magnitude	Risk Management	Residual Risk
Noise generated during mobilisation, onsite works and demobilisation	Site operatives, general public & neighbours	Human health issues	Proximity exposure	Medium	Low	Low	Risk of hearing damage or nuisance due to elevated noise levels Magnitude and consequence of risk to offsite receptors low due to distances involved.	.Use specified PPE as determined on site. Ongoing noise monitoring. Consider alternative equipment. Work within agreed working hours. Consider acoustic damping to fencing	Low
Dust	All receptors	Environmental & human health risks	Air	Medium	High	High	Risk associated with release of odours and VOCs	Minimise dust through keeping stockpiles damp / covered. Damp down roads or ground where plant operating Dust monitoring around site measuring, Total dust, PM10 and Respirable levels. Trigger and Action Value will be formulated and adhered to.	Low

Environmental aspects relating to the Envirotreat Mobile Treatment Licence although not specific to the States of Jersey - it does allow / cover all the relevant / salient points associated with a typical permit application.

1. Specified Waste Management Activities - It is proposed that this document covers the installation of the E-Clay PRB (groundwater treatment) and E-Clay stabilisation (source treatment)
2. Agreement of the Site-Specific Working Plan and supporting Information - Envirotreat recognise that the works must not begin until confirmation from the States of Jersey Government has been agreed. The remediation works shall be carried out in accordance with the application submitted in support of this application, the agreed deployment form and the conditions of this licence. It is anticipated that the works will take circa 30 weeks and will be completed over TWO phases.
3. Changes to the deployment form requiring prior consent by the States of Jersey - Envirotreat will inform the States of Jersey of any changes to the remediation plan prior to implementation.
4. Permitted quantities of contaminated material, substances or products – Circa 6,000m^3.

Staffing and understanding of requirements of licence conditions

5. Minimum staffing and supervision - Simon Farr (BSc., CChem, CSCS Land Remediation) - Project Manager (or nominated alternative Project Manager in direct employment of Envirotreat) will be present on site at all times. He is suitably trained and fully conversant with the requirements of the MTL, the deployment form and MTL application regarding:
    - contaminated material, substances or products acceptance and control procedures
    - operational controls and environmental monitoring
    - maintenance
    - record-keeping
    - emergency action plans
    - notifications to the Regulators.

    He will be fully supported by

    Neil Mcleod (Envirotreat Technical Director) – overall project responsibility,

    David Slater (Envirotreat Technical Manager) and

    Philip Rees – Technically Competent Person (WAMITAB)
6. Availability of licence and deployment form - The completed approved Deployment will be kept onsite for the duration of the works.

7. Understanding of Licence / Permit and Deployment Form (Permit application submission) - All staff will work under the direct supervision of a Simon Farr (or nominated alternative Project Manager), who is fully conversant with those aspects of the Licence / Permit conditions and deployment form which are relevant to their duties.
8. Attendance of technically competent persons - A site diary will be maintained logging all site visitors and onsite actives.
9. Changes in technically competent persons - All changes to Technically Competent Person (Phil Rees) will be notified to the Environment Agency.
10. Notification of relevant convictions - Notify accordingly
11. Notifications of appeals against convictions - Notify accordingly
12. Notification of change of operator's or holder's details - Notify accordingly
13. Notification of preparatory works - At least 7 days prior notice will be given prior to commencement of preparatory works.
14. Cessation and resumption of treatment processes - In the event of unplanned treatment ceases for longer than 21 days the States of Jersey shall be informed prior to re-commencement.
15. Removal of residual contaminated material, substances or products from operating site - In the event to treatment operations on the site cease and they are not resumed within 1 month, all plant on the site will be decontaminated. In addition, all waste resulting from the decontamination process will be removed from site within 7 days.
16. Notifications and submissions to Regulators - To be undertaken accordingly
17. Provision and maintenance of containment and drainage systems - Potentially polluting materials will only be deposited, stored, treated or otherwise handled in an area of the site where an engineered containment and drainage system has been provided for that area which meets the required standards (see above for details). The engineered containment and drainage systems will be designed, constructed, inspected, validated and maintained, and shall be fully documented (site specific Quality Plan) and recorded, to be fit for purpose and meet the required standards.
18. Provision of mobile treatment plant identification board - An Identification Board will be provided at or near the operating site entrance. The board will display the following information:
    - Operating site name and address
    - Operator name (company name)
    - Licence / Permit number (if applicable)
    - Emergency contact name and telephone number
    - Statement that the remedial action is licensed by the States of Jersey
    - Regulator contact details.

- Operational hours for licensed activities.

19. Operating site security - Site security will be provided at all times to prevent access by unauthorised persons. Additional security in terms of anti-climb fencing and secure lockable storage units will be maintained by Envirotreat, all details will be recorded in Site-Specific Quality Plan. The site benefits from secure fencing and a secure controlled entrance. The Treatment Area will be suitably fenced off using 1.5m high anti-climb fencing; all liquid chemicals will be stored in a secure storage unit.
20. Prevention of mud and debris on road - See Environmental Risk Assessment.
21. Remediation of mud and debris on the road - In the event that mud or debris arising from the operating site is deposited onto public areas outside the operating site, the following remedial measures must be implemented immediately. The affected public areas outside the operating site will be cleaned. Traffic will be isolated from sources of mud and debris within the operating site to prevent further tracking of mud and debris, and measures must be taken to clear any such sources as soon as practicable.

Potentially polluting leaks and spillage of contaminated material, substances or products

22. Potentially polluting leaks and spillage from vehicles, plant and equipment - See Environmental Risk Assessment.
23. Potentially polluting leaks and spillage from skips, drums and other mobile containers - See Environmental Risk Assessment. In addition, a Lifting Plan will be followed to ensure the safe / correct loading / unloading and movement of chemicals on site.
24. Control and remediation of leaks and spillage - See Environmental Risk Assessment.
25. Prohibition of fires - No fires will be permitted on site
26. Actions to be taken in the event of a fire – Envirotreat will implement a Fire Safety Plan which will be communicated to all personnel on induction
27. Contaminated material, substances or products acceptance and control procedures - All contaminated material, substances or products must be received, inspected, accepted or rejected, handled, kept, despatched and recorded in accordance with the site-specific Quality Plan.

Process plant and equipment

28. Commissioning, operating and maintenance - All process plant and equipment used under the MTL will be commissioned, operated and maintained, and must be fully documented and recorded within the site-specific Quality Plan.
29. Means of measurement - A full record / log of will be maintained covering;
    - Volumes treated and / or length / depth of barrier installed
    - Quantity of E-Clay added.
    - Batches of E-Clay prepared.
    - Chemical Usage and daily stocktake.

- In process QA / QC checks.

30. Treatment of contaminated material substances or products with specified hazardous properties or forms - On the basis that most of the installation / remediation is in-situ, only small proportion of the identified waste streams anticipated when handled are likely to generate significant quantities of dusts, fibres, particulates and bioaerosols. Monitoring of dust will be carried out as specified.
31. Pollution abatement provisions - All vapours, gases and aerosols from the treatment process will be contained, collected and treated to minimise pollution of the environment and harm to human health in accordance with the agreed deployment form.
32. Emissions Monitoring - Groundwater, Surface Water, Soil Gas and Emissions to Air - The environmental monitoring regime is specified and covers:
    - Baseline monitoring results
    - Trigger levels for indictor parameters
    - The construction of the monitoring points
    - The location of the monitoring points
    - Monitoring protocols
    - Frequency of monitoring
    - Experience and qualifications of personnel carrying out the monitoring and the personnel responsible for interpreting and acting upon the results of monitoring.
33. Emissions action plan - In principle the **Emissions Action Plan** states that all ongoing works will be suspended until it can be ensured that the emissions will not exceed the specified trigger levels specified. All exceedances will be recorded and published accordingly.
34. Keeping and maintenance of records - A record of the emissions monitoring and sampling results will be kept and maintained in the site-specific Quality Plan
35. Submission of records - These will be included in the Validation Report.
36. Monitoring and control of aerial emissions of dusts, fibres, particulates, bioaerosols, VOCs and odours – as outlined within this document.
37. Monitoring and control of pest Infestations, scavengers and litter – as outlined within this document.
38. Control of noise– as outlined within this document.

Operating Site records

Security and availability of records

39. Security of records - All records which are required to be made under the conditions of this licence and the deployment form must be maintained and kept secure from loss, damage or deterioration for a period of 2 years.
40. Availability of records - These will be held onsite during the remediation works and in the main office following competition.
41. Recording of contaminated material, substances or products accepted, treated or removed - These will be recorded within the site-specific Quality Plan and / or Validation Report.
42. Summary records of contaminated material, substances or products accepted and removed, and materials remediated - These will be recorded within the site specific Quality Plan and / or Validation Report
43. Site diary - On site activities will either be recorded in a written site diary or the site-specific Quality Plan and will cover the following items.
    - construction work
    - maintenance
    - breakdowns
    - emergencies
    - problems with contaminated material, substances or products treated, received and action taken
    - operating site inspections and consequent actions carried out by the operator
    - technically competent management attendance on the operating site: the date and the time onto the operating site and the time left operating site
    - severe weather conditions
    - complaints about authorised operations and actions taken
    - environmental problems and remedial actions.

Envirotreat Environmental Risk Assessment:

Section 1 - The Envirotreat Technology and Process, Characterisation of Risk Source

A site-specific risk assessment has been completed for the Northern Quarter site to determine the potential environmental hazards and risks associated with application of the proposed remediation technology. The risk assessment has been completed in accordance with the requirements set out in "Standard rules SR2008No27 - mobile plant for the treatment of soils and contaminated material, substances or products" and Schedule 1 of the Conditions relating to our Mobile Treatment Permit.

The hazards have been identified as those associated with application of the Envirotreat Technology / Process at the Site. The risks are those of pollution to the environment, including harm to human health or serious detriment to local amenities outside the boundary of the site and its containment.

The site-specific risk assessment has been undertaken to identify and prioritise the measures that need to be taken to comply with the relevant statutory provisions. The mitigating measures applied are those that need to be implemented in order to comply with the required legislation.

Table 3 is an indication of the potential hazards that should be taken into consideration during application of the technology at the Site. The potential sources, pathway and target receptors have also been identified.

Table 4 shows the allocation of a scoring system determining the environmental risks identified during and after application of the technology.

The likelihood or frequency of occurrence of each hazard is indicated in Column 1.1 and 2.1. The magnitude or seriousness of the consequences of the hazard occurring has been given a similar score and is illustrated in Columns 1.2 and 2.2. The previous two scores are combined to give a measure of the potential risks posed and illustrated in Columns 1.3 and 2.3. Finally, the risks identified require certain controls and therefore management. Columns 1.4 and 2.4 illustrate reduced scores as a result of the management controls in place. Scores are provided during the treatment operation and on completion. The scoring system as indicated in Table 2 has been modelled on remediation projects carried out to-date and re-evaluated in light of site-specific issues at the Site.

The scoring system is as follows: -

- **N** **Negligible Risk**
- **L** **Low Risk**
- **M** **Medium Risk**
- **H** **High Risk**

Table 5 identifies the risks to human receptors (on-site and off-ite) from gaseous emissions to air from chemical reagents used during application of the Envirotreat Technology / Process.

Table 6 identifies the risks to human receptors (on-site and off-site) from emissions to air from dry materials used during application of the Envirotreat Technology / Process.

Table 7 identifies the risks to human receptors (on-site and off-site) from gaseous emissions to air from the contaminants of concern identified from the Site Investigation data and Quantitative Risk Assessment.

Table 8 allocates a scoring system determining the risks to human health (site operatives) from emissions to air identified during and after application of the Envirotreat Technology / Process before and after implementation of controls.

Table 9 allocates a scoring system determining the risks to human health (visitors and general public) from emissions to air identified during and after application of the Envirotreat Technology / Process before and after implementation of controls.

Table 10 allocates a Scoring System Determining the Risks to Human Health (Site Operatives and General Public) from Emissions to Air Identified During and After Application of the Envirotreat Technology Process Before and After Implementation of Controls.

The scoring system is as follows: -

- **N** **Negligible Risk**
- **L** **Low Risk**
- **M** **Medium Risk**
- **H** **High Risk**

The scoring system has been carried out by suitably qualified and experienced personnel including representatives from management and supervisory staff and based on an assessment of each operation carried out during the remedial works. When determining the levels of risk, decisions have taken into account the potential source, pathway and receptor for each operation and process reagent / material. In particular we have considered levels of volatility (chemical reagents & contaminants of concern), likely levels of dust production (dry materials), potential spillages, distance from the treatment zone to the receptor etc.

The risks to site operatives have been deemed worst case in comparison to the effects to site visitors and the general public etc.

Table 3 - Identification of Potential Hazards: Pathways and Receptors

Source and Hazard	Pathway	Receptor
Mud & debris	Overland	Site operatives General public / neighbours Off-site receptors Site visitors
Plant & equipment – Noise	Direct to	Site operatives General public / neighbours Off-site receptors Site visitors
Potentially polluting leaks, spillages & aerial emissions. Waste & general spillages	Migration to underlying soils / waters. Migration via groundwater.	Groundwater / underlying matrix Surface waters Off-site receptors
Remediation chemical reagents – potential spillages	Migration to underlying soils / waters Migration via groundwater	Groundwater / underlying matrix Surface waters Off-site receptors
Migration of contaminated ground & surface water / leachate	Migration to underlying soils / waters Migration via groundwater	Groundwater / underlying matrix Surface waters Off-site receptors
Remediation reagents – dry materials	Airborne Migration to underlying soils / waters Migration via groundwater	Groundwater / underlying matrix Surface waters Site operatives General public / neighbours Off-site receptors Site visitors
Remediation reagents – leakage or accidental release (E-Clay slurry)	Overland Migration to underlying soils / waters Migration via groundwater	Groundwater / underlying matrix Surface waters Off-site receptors

Source and Hazard	Pathway	Receptor
Waste –Volatile Organic Compound (VOC) emissions	Airborne	Site operatives General public / neighbours Off-site receptors Site visitors
Plant or Waste – fire / explosion	Overland	Site operatives General public / neighbours Offsite receptors Site visitors
Waste – Generation of dust	Airborne	Site operatives General public / neighbours Offsite receptors Site visitors
Waste – Generation of odours	Airborne	Site operatives General public / neighbours Offsite receptors Site visitors
Asbestos containing materials	Direct to	On site soils
Asbestos fibres	Airborne	Site Operatives General Public / Neighbours Site Visitors Off site receptors
Pests / birds & other scavengers / litter	Overland	Site operatives General public / neighbours Off-site receptors Site visitors

Table 4 - Allocation of a Scoring System Determining the Environmental Risks Identified During and After Application of the Envirotreat Technology for Remediation Purposes

	During Treatment				***After Treatment***			
	1.1 Probability of occurrence	*1.2 Magnitude of consequence*	*1.3 Level of risk before controls*	*1.4 Level of risk with controls in place*	*2.1 Probability of occurrence*	*2.2 Magnitude of Consequence*	*2.3 Level of risk before controls*	*2.4 Level of risk with controls in place*
Mud & debris	***M***	***M***	***M***	***N***	***L***	***M***	***M***	***N***
Plant & equipment – noise	***M***	***M***	***L to M***	***L***	***N***	***N***	***N***	***N***
Potentially polluting leaks, spillages & aerial emissions – Waste & General Spillages	***M***	***M***	***M***	***L***	***N***	***N***	***N***	***N***
Chemical reagents – potential spillages	***M***	***M***	***M***	***L***	***N***	***N***	***N***	***N***
Migration of contaminated groundwater / leachate	***M***	***M***	***M***	***L***	***N***	***N***	***N***	***N***
Remediation reagents – dry materials	***M***	***L***	***L***	***L***	***N***	***N***	***N***	***N***
Remediation reagents – leakage or accidental release	***M***	***M***	***M***	***L***	***N***	***N***	***N***	***N***

	During Treatment				***After Treatment***			
	1.1 Probability of occurrence	*1.2 Magnitude of consequence*	*1.3 Level of risk before controls*	*1.4 Level of risk with controls in place*	*2.1 Probability of occurrence*	*2.2 Magnitude of Consequence*	*2.3 Level of risk before controls*	*2.4 Level of risk with controls in place*
Waste - VOC emissions	***L***	***M***	***L***	***L to N***	***N***	***N***	***N***	***N***
Plant & Waste – Fire / Explosion	***L***	***H***	***L***	***N***	***N***	***N***	***N***	***N***
Waste – generation of dust	***M***	***M***	***M***	***N to M***	***N***	***N***	***N***	***N***
Waste – generation of odours	***L***	***H***	***L***	***L***	***N***	***N***	***N***	***N***
Asbestos containing materials	***L***	***H***	***M***	***L***	***N***	***N***	***N***	***N***
Asbestos fibres	***L***	***H***	***H***	***L***	***N***	***N***	***N***	***N***
Pests / birds & other scavengers / litter	***M***	***M***	***L***	***N***	***N***	***N***	***N***	***N***

Table 5 - Identification of Risks to Human Receptors (on-Site and off-Site) from Gaseous Emissions to Air from Chemical Reagents used during Application of the Envirotreat Technology

Parameters	*Envirotreat 'A'*	*Envirotreat 'B'*	*Envirotreat 'C'*
Relative Volatility	*Medium*	*Low*	*Low*
Occupational Exposure Limit	*10mg/m³ over an 8 hour period*	*2mg/m³ over an 8 hour period*	*1mg/ m³ over an 8 hour period*
Storage	*Intermediate Bulk Containers (IBC's) (1000L capacity) Unopened containers securely locked up, open containers over 110% containment bund*	*205litre drums Unopened containers securely locked up*	*25litre pails Unopened containers securely locked up*
Transportation on-site	*Forklift / telehandler*		
Dispensing into measuring receptacle	*Controlled tap to closed transfer container at ground level*	*Manual dispenser pump to closed transfer container*	*Controlled tap to closed transfer container at ground level*
Carriage	*< 3m from storage to mixer unit in closed container*		
Dispensing into mixer units	*Controlled pouring into grout (paddle) mixer*		
Slurry mixing operation	*Water soluble*		
Pumping to application area	*Slurry is contained within pipe and reagents are absorbed within E-clay slurry matrix*		
In-situ mixing	*In situ applications require addition of E-Clay slurry direct to barrier installation location and mixing in-situ (without excavation). Liquid chemicals once incorporated into the bentonite, associated risk with odour production is negligible. Following treatment, the risk associated with odour production is negligible.*		
Post remediation	*No further disturbance of soils*		

Table 6 - Identification of Risks to Human Receptors (On-Site and Off-Site) from Emissions to Air from Dry Materials used during Application of the Envirotreat Technology

Parameters	*Cement*	*Bentonite*
Volatility		*N/A*
Occupational Exposure Limit	*10mg/m³ total inhalable dust over an 8-hour period; 4mg/m³ respirable dust over an 8-hour period*	*10mg/m³ total inhalable dust over an 8-hour period; 4mg/m³ respirable dust over an 8-hour period*
Storage	*25kg paper bag with waterproof lining, pallets covered with plastic sheeting.*	*25kg paper bag with waterproof lining, pallets covered with plastic sheeting.*
Transportation on-site	*Forklift to treatment area*	*Forklift to treatment area*
Dispensing into measuring receptacle	*N/A*	*N/A*
Carriage	*< 1m from storage to mixer unit unopened*	*< 1m from storage to mixer unit unopened*
Dispensing into mixer units	*Bags opened with knife, controlled dispensing into mixer unit / mixer skip / treatment area*	*Bags opened with knife, controlled dispensing into mixer unit or mixer skip*
Slurry mixing operation	*N/A*	*Water suspension*
Pumping to mixing zone	*Slurry is pumped to agitator tank*	*Slurry is contained within pipe and materials are absorbed within E-clay slurry matrix*
In-situ mixing	*In situ applications require addition of slurry direct to barrier installation area and mixing in-situ (without excavation). Cement bags will be added direct to treatment area / skip. Operative will be wearing appropriate PPE. associated with odour production is negligible.*	*In situ applications require addition of E-Clay slurry direct to barrier installation area and mixing in-situ (without excavation). Bentonite bags split and content added to grout mixer, possibility of localised dust (inert), operative will be wearing appropriate PPE. Treatment (Mobile Plant Area) to benefit from dust mesh affixed to security fencing. Following treatment, the risk associated with odour production is negligible.*
Post remediation		*No further disturbance of soils*

Table 7 - Identification of Risks to Human Receptors (on-Site and off-Site) from Gaseous Emissions to Air from the Contaminants of Concern Identified from the Site Investigation Data

Parameters	*Heavy Metals*	*VOC*	*PAH*	*TPH*	*Asbestos*
Relative volatility or dust	***Low to Nil***	***Low to Nil***	***Low to Nil***	***Low to Nil***	***Low***
In-situ mixing	*Predominately in-situ application - No excavation.* *Risk from odours is low.* *Risk of dust is low.* *All suspect asbestos containing material to be quarantined pending screening.* *Any arising to be buried.* *Following treatment, the risk associated with odour production is negligible.* *All operations to be monitored via handheld VOC monitor / dust scanner, action to be implemented in the event of exceedances.*				
Post installation	*No further disturbance of soil*				

Table 8 - Allocation of a Scoring System Determining the Risks to Human Health (Site Operatives) from Emissions to Air - Identified During and After Application of the Envirotreat Technology Before and After Implementation of Controls

Parameters	*Envirotreat 'A'*		*Envirotreat 'B'*		*Envirotreat 'C'*		*Cement*		*Bentonite*	
	Before controls	*After controls*	*Before controls*	*After controls*	*Before controls*	*After controls*	*Before controls*	*After controls*	*Before controls*	*After controls*
Relative volatility	***M***		***L***		***L***		***N/A***		***N/A***	
Occupational Exposure Limit	*M*	***N***	***L***	***N***	***M***	***N***	***M***	***N***	***M***	***N***
Storage	***N***		***N***		***N***		***N***		***N***	
Transportation on-site	***N***		***N***		***N***		***N***		***N***	
Dispensing into measuring receptacle	*M*	***N***	***L***	***N***	***M***	***N***	***N***		***N***	
Carriage	*M*	***N***	***L***	***N***	***M***	***N***	***N***	***N***	***N***	***N***
Dispensing into mixer units	*M*	***N***	***L***	***N***	***M***	***N***	***N***	***N***	***N***	***N***
Slurry mixing operation	***N***		***N***		***N***		***N***		***N***	
Pumping to mixing zone	***N***		***N***		***N***		***N***		***N***	
In-situ mixing	***N***		***N***		***N***		***N***		***N***	
Post installation	***N***		***N***		***N***		***N***		***N***	

N/A – not applicable

Table 9 - Allocation of a Scoring System Determining the Risks to Human Health (*Visitors, General Public*) from Emissions to Air Identified During and After Application of the Envirotreat Technology Before and After Implementation of Controls

Parameters	*Envirotreat 'A'*		*Envirotreat 'B'*		*Envirotreat 'C'*		*OPC*		*Bentonite*	
	Before Control	*After Control*	*Before Control*	*After Control*	*Before Control*	*After Control*	*Before Control*	*After Control*	*Before Control*	*After Control*
Relative Volatility	***N***		***N***		***N***		***N/A***		***N/A***	
Occupational Exposure Limit	***N***	***N***	***N***	***N***	***N***	***N***	***L***	***N***	***L***	***N***
Storage	***N***		***N***		***N***		***N***		***N***	
Transportation on-site	***N***		***N***		***N***		***N***		***N***	
Dispensing into measuring receptacle	***N***		***N***		***N***		***N***		***N***	
Carriage	***N***		***N***		***N***		***N***		***N***	
Dispensing into mixer units	***N***		***N***		***N***		***N***		***N***	
Slurry mixing operation	***N***		***N***		***N***		***N***		***N***	
Pumping to mixing zone	***N***		***N***		***N***		***N***		***N***	
In-situ mixing	***N***		***N***		***N***		***N***		***N***	
Post installation	***N***		***N***		***N***		***N***		***N***	

Table 10 - Allocation of a Scoring System Determining the Risks to Human Health (*Site Operatives and General Public*) from Emissions to Air Identified During and After Application of the Envirotreat Technology Before and After Implementation of Controls

	Inhalation		*Ingestion*		*Skin Contact*		*Eye Contact*		*Controls / PPE Req.*	
	Site Operatives	*General Public*	*Site Operatives*	*General Public*	*Site Operatives*	*General Public*	*Site Operatives*	*General Public*	*Site Operatives*	*General Public*
Bentonite	***M***	***L***	***L***	***N***	***N***	***N***	***L***	***N***	***YES***	***NO***
Cement	***M***	***L***	***L***	***N***	***N***	***N***	***L***	***N***	***YES***	***NO***
Env 'A'	***L***	***N***	***L***	***N***	***M***	***N***	***M***	***N***	***YES***	***NO***
Env 'B'	***N/A***	***N/A***	***L***	***N***	***L***	***N***	***M***	***N***	***YES***	***NO***
Env 'C'	***N/A***	***N/A***	***L***	***N***	***M***	***N***	***M***	***N***	***YES***	***NO***

N.B. The scoring system has been based on the hazardous nature of each of the chemicals / materials.

1.1 - Control of Mud and Debris Arising from Application of the Envirotreat Technology

The control and prevention of mud and debris from being transported off-site during application of the Envirotreat Technology will be dependent upon a number of factors. These include the weather and / or the amount of traffic and personnel travelling across the site. The level of risk for movement of mud and debris off-site is **medium** during the project and **negligible** following completion for the reasons stated below: -

- The installation will be carried out mainly in-situ, this will negate the excavation of soils. The proposed duration of the remedial works on-site is relatively long, assuming the contract runs to schedule, strict housekeeping protocols will be required to minimise mud on-site, this in turn will minimise the risk of off-site contamination. All onsite plant and personnel will be required to cross a decontamination zone prior to leaving site. All plant / equipment to be cleaned prior to leaving site.
- All operations regarding the treatment process will be carried out within a designated Treatment Area. Therefore, all mud and debris arising from the treatment operation will be contained within the Treatment Area and will not be transported off-site.
- There will be little or no movement of plant or equipment off-site for the project duration.
- Imported materials including bentonite, OPC and chemical reagents will be delivered and off-loaded in the vicinity of the site entrance and moved around the site internally via an excavator or forklift. The procedure will not require import vehicles to have contact or even access to the treatment zone.

1.2 - Control and Monitoring of Noise – Plant & Equipment

Noise during application of the technology may originate from groundwork vehicles, the batching plant and / or any vehicles delivering materials to the site.

Receptors at risk are site operatives and the local community.

The impact to onsite receptors from noise will be **low** from plant and equipment operating on site with appropriate control measures in place. There will be **negligible** impact to offsite receptors due to the extended distances involved between any onsite operations and nearest receptors. In addition, there will be a **negligible** impact on receptors from noise during delivery of materials to the site for the reasons stated below: -

- The delivery process is not generally noisy and will only occur during sociable working hours (i.e. 08:00 – 16:30).
- The impact of construction site vehicles on the surrounding road network has been considered. During the installation of the piling mat there will be considerable increase in vehicular traffic. All operators will be provided with a traffic route indicating
    - hours of operation.
    - proposed traffic route.
    - appropriate speed limits.

- identified hazards.
- waiting areas.

ANY DRIVERS NOT COMPILING WITH TRAFFIC PLAN WILL BE WARNED, FURTHER INCURSIONS WILL RESULT IN A BAN.

- Deliveries will only be permitted at designated access points for operational vehicles.

Section 2 - Potentially Polluting Leaks, Spillages and Aerial Emissions from Application of the Envirotreat Technology

2.1 - Waste – Spillage

Potential receptors for spillages are the groundwater & the underlying soil matrix, site operatives & the local community. On the basis that the E-Clay preparation works will be undertaken within the confines of a suitable constructed ECS, the perceived risk to the surrounding environment is **low** during the remediation works with appropriate control measures in place and negligible. Minimal arising will be generated during the barrier installation works, it is proposed that these are loaded onto a dumper and buried within a burrow pi within the cones of the E-Clay PRB.

2.2 - General Spillages On-Site

As with the spillage of waste on-site, the identified receptors are the underlying site, operatives & the local community.

The risk to the surrounding environment is **low** during the remediation works with appropriate control measures in place for the reasons stated below:-

- All maintenance and refuelling of plant and equipment on-site will be carried out by trained personnel within a designated area using drip trays.
- All spillages will be dealt with immediately using absorbent material and incorporated with the material for treatment.
- Diesel fuel will be stored within a self-contained bowser. The spillage capacity will be 110% of the maximum volume of diesel stored within the bowser.
- Regular maintenance checks of plant and equipment will be carried out daily to prevent leaks, etc occurring.
- All storage and operation to be undertaken at a suitable distance from the site boundary.

2.3 - Chemical Reagents - Potential Spillages

There is a perceived risk to the surrounding environment from the spillage of chemical reagents during delivery, the mixing process and / or via damaged or leaking pipework.

The potential receptors identified include site operatives, underlying soil and groundwater. The associated risk to the surrounding environment is deemed to be **low** when controls are in place for the reasons stated below: -

- Delivery of reagents will generally be in the form of Intermediate Bulk Containers (IBC's), 205L drums, and 25 kg carboys. All chemical will be stored in their original containers located on-site within a lockable container.
- Any leaks or spillages will be contained within the bunded area and can be used within the slurry mixers and incorporated for the next batch of treatment slurry. Bentonite will be available to act as a spill absorbent. All leaks and spillages will be addressed as soon as practically possible but within a 24 hour period.
- The prevention of spillages during the chemical reagent addition process will be achieved by the use of closed containers, spouts for pouring and that a clear path is maintained at all times between the chemical store and the mixer units.
- The general condition of engineered containment system and general condition of chemical reagents will be inspected on a daily basis so that any damage can be identified and repaired.
- All "unopened" container will be secured.
- All "opened" regulated chemicals will be stored on a 110% containment bund.
- The authority to deal with spilt waste or chemical reagents will only be given to trained personnel.
- All storage and operation to be undertaken at a suitable distance from the site boundary.

Figure 34 – Typical Chemical Containment Bund

The potential risk from spillages during the delivery and off-loading process is deemed to be of **low** risk for the reasons stated below: -

- All deliveries will be off-loaded with a forklift operated by trained and qualified personnel only in accordance with the site-specific Lifting Plan.
- Off-loading of chemicals will be supervised by the Site Supervisor. All precautions will be taken to ensure the chemical IBC's / drums are handled carefully.
- Absorbent materials (i.e. Bentonite) will be provided should a spillage occur. This material will be contained within a waste skip for disposal at a suitable location.

2.4 - Chemical Reagents - Emissions to Air

Potential risks to human health from aerial emissions of chemical reagents from each stage of the Envirotreat Process are perceived to be **low** following implementation of control measures (to include PPE).

The surrounding environment and the general public will not be at risk from the treatment operation due to the relatively low volatility of the chemical reagents used and the relatively large distances from the Treatment Area. The security fencing around the treatment area is have anti dust mesh fitted to minimise possible windage of bentonite dust.

Should emissions to air become an issue Envirotreat personnel have the authority to cease operations until the issue is addressed.

2.5 - Migration of Contaminated Ground and Surface Water / Leachate

The potential pathway for migration of contaminated ground and surface-water, and / or leachate off-site is through the underlying base and across land to the site boundary. The migration of contaminants off-site as a result of the treatment process via the above pathways is perceived to be **low** with controls in place for the reasons stated below: -

- Where groundwater is encountered it will be contained / collected / stored an used during the treatment operation as a substitute for mains water.
- Any arising from the barrier installation will be dealt with daily. Once the contaminated soils come into contact with the treatment slurry the contaminants are bound within the treated matrix preventing leaching to the groundwater bodies.

2.6 - Remediation Reagents – Dry Materials

Possible receptors from dust production include site operatives and members of the local community (refer to Table 1). The risk of pollution from dust production to off-site receptors during the delivery and use of dry materials is perceived to be **low** (refer to Table 2) following implementation of control measures for the reasons stated below: -

- Bentonite is delivered in 25kg bags. The bentonite bags are split and emptied carefully in the mixer units; the cement bags are split and emptied direct into the mixing bin / skip.
- PPE in the form of dust masks will be worn by site personnel working in the vicinity of the treatment zone.
- The security fencing around the Treatment Area is have anti dust mesh fitted to minimise possible windage of bentonite dust.
- Dust monitoring will be undertaken and if deemed necessary dust suppression in the form of screens and / or misting units will be utilised if dust becomes a problem on-site.

During treatment, the risk from dust production is perceived to be of **medium** risk to site operatives but **negligible** to members of the local community due to the distance from the treatment zone and other control measures.

2.7 - Remediation Reagents - Leakage or Accidental Release

The potential pathway and receptor from the leakage or accidental release of treatment slurry is through the base into any underlying aquifer. The risk to environmental receptors off-site is perceived to be **low** with the control measures outlined for the reasons stated below:

- All remediation reagents will be stored within a lockable container unit to protect the surrounding environment from the spillage of chemicals.
- All locally used chemical reagents will be within the confines of the ECS.
- The batching plant will be in the completely bunded Treatment Area again preventing any spillages coming into contact with the surrounding environment.
- Any leaks or spillages will be scraped up and incorporated within the next batch of treatment slurry.
- E-Clay production will be operated at a safe distance from the site boundary.

2.8 - Waste – Volatile Organic Compound Emissions

The generation of VOC's and their toxicity to life is dependent upon the type and quantity of contamination on-site. In this case some very low-level hydrocarbons are anticipated, any are expected to be long chain aliphatic / aromatic or polycyclic aromatic in nature and of low volatility. The pathway for the release and transport of VOC's during the remediation works is airborne, and receptors include site operatives, members of the public, neighbours and site visitors.

The risk to potential receptors from the treatment operation is perceived to be **low** to site workers with appropriate control measure in place.

VOC's will be monitored throughout the treatment by means of handheld gas monitoring equipment (PID). STEL and TWA values for respective VOC's will be used as trigger values. In the event of unacceptable VOC levels, works will stop until the situation can be resolved.

The risk posed to off-site receptors is deemed to be **negligible** due to the relatively large distances between the working area and the site boundary.

Section 3 - Fires on the Operating Site

3.1 - Waste – Fire / Explosion

The potential risk of fire from application of the Technology is negligible for the reasons stated below: -

- The nature of the technology and the method and location of application.
- Wastes that are classified as explosive (Special Waste Hazard code H1), may be present onsite due to the nature of the contamination (landfill household waste) in the form of methane. All operatives will have monitoring equipment for measuring Lower Explosive Limit (LEL).
- Wastes that are classified as highly flammable (Special Waste Hazard codes H3-A and H3-B) are expected to be unlikely at concentrations which may result in a fire on-site within the area designated for the excavation of soils.
- Smoking and the use of naked flames will be prohibited within the treatment zone.

- The emergency procedures for a fire or explosion on-site are detailed in the Fire and Emergency Plan.

Emergency Procedure – Fires On-Site

The following procedure will be adhered to if a fire or explosion occurs on-site: -

- ALL fires on-site will be regarded as an emergency and dealt with as such;
- The surrounding area will be vacated immediately.

If the fire can be tackled SAFELY, then it will be extinguished using the on-site portable extinguisher and / or water from the site. The extinguishers will be stored in the Site Office for easy access. ALL personnel will be made aware of the firefighting equipment available and where they are stored. Equipment stored will include at least one of each of the following; a fire extinguisher, a fire blanket and a first aid kit.

Should the fire be successfully extinguished, a constant vigil should be maintained to ensure the fire does not re-ignite. The area should remain vacated until there is no further danger of the fire re-starting.

If the fire cannot be doused, summon the Fire Brigade immediately on determining extent of fire. Clearly state site details as follows: -

SITE NAME

ROK Construction Site

SITE ADDRESS

L' Avenue et Dolmen du Pres des lumieres, Saint-Helier, Jersey JE2 4YE, Jersey

EMERGENCY TEL. NO.

999

ALTNATIVE CONTACT NUMBERS.

Simon Farr 07803 174046

EMERGENCY CONTACT NAME.

Simon Farr

Where possible move all plant and equipment to a safe distance away from the vicinity of the fire.

Emergency Assembly Point is located on L' Avenue et Dolmen du Pres des lumieres, (see plan).

It is the responsibility of Envirotreat to ensure that relevant training will be given to all personnel on-site on what to do in the event of a fire or explosion and in the use of the firefighting equipment stored onsite.

The States of jersey will be notified as soon as practically possibly if fire occurs on site.

3.2 - Plant – Fire / Explosion

Both light and heavy plant and equipment are used to carry out the requisite remediation works. Consequently, there will be a requirement to store fuel on-site, which may pose a fire risk to site personnel and the local community etc. The following control measures will be in place during the works: -

- Fuel will be stored on-site within a self-contained bowser. Smoking or the use of naked flames will not be permitted within the storage area.
- Only suitably trained personnel, in accordance with the manufacturer's specifications, will carry out maintenance of plant and equipment.
- The emergency procedures for a fire or explosion on-site are detailed in the Fire and Emergency Plan.

Section 4 - Control, Monitoring and Reporting of Dusts, Fibres and Particulates during the Mixing / Treatment Process

The generation of dust and particulates on-site and the risk to the surrounding environment will be dependent upon the following parameters: the wind, which will erode and act as a transport mechanism and the general day to day disturbances and whether the soils are damp.

Possible receptors include site operatives, the local community, surface water and local properties. The potential risk is **medium** for site operative particularly those handling cement and bentonite; this will be controlled through handling procedures and use of appropriate dust masks. The potential risk is **negligible** for offsite operative particularly for the reasons stated below:

- On-site vehicle traffic will be kept to a minimum and water will be used to dampen down exposed soils should dust become a problem from the movement of plant and equipment.
- Monitoring of the concentration of airborne dust and particulates will be assessed throughout the day using a real-time dust monitor.
- Site will benefit from hoarding or screens constructed from anti dust mess sheeting covering 2m high heras fencing will be located around the mixing area. This will prevent the disturbance of the treatment reagents by wind.
- Should dust levels become problematic, dust suppression equipment in the form of misting units will be used.

Section 5 - Waste - Generation of Odours

The potential generation of odours on-site is related to the type of waste present. The pathway identified for the transport of odours across the site boundary is through the atmosphere, with potential receptors being site operatives, the public and site visitors. With controls in place, the likely production of odours is perceived to be **low** to site operatives for the reasons stated below: -

- The soil mixing areas will be undertaken in-situ will minimal arisings;
- Monitoring via handheld gas monitoring equipment will be utilised;
- If persistent odour problems occur, the treatment process will be stopped and appropriate measures adopted, for instance treating without stockpiling or use of odour suppression units;
- In the event of increased odour production, respirators will be worn by site personnel working in the vicinity of the treatment zone.

Section 6 - Monitoring and / or Sampling Programme

The following parameters were taken into account to determine the monitoring and sampling programmes:

- The contamination identified;
- The design of the remediation system;
- The validation standards required;
- The geology and hydrogeology of the site and surrounding land;
- The presence of local surface water bodies;
- Proximity to potable water supplies;
- Proximity to other receptors.

The remediation strategy to be applied on site is designed to ensure that the risks associated with the identified contaminants of concern are fully addressed in accordance with the quantitative risk assessment.

Section 7 - Wastes Including Pathogenic Bacteria

Previous site investigation reports have not identified a problem with the presence of pathogenic bacteria on-site.

Consequently, the potential risk to receptors associated with the application of the technology for the treatment of contaminated material as identified on the site is **negligible** for the reasons stated below;

- Comprehensive induction process for all site operative covering good personal hygiene, decontamination procedures and **Leptospirosis (Weil's Disease).**
- **Induction training for all site visitors including** good personal hygiene, decontamination procedures and **Leptospirosis (Weil's Disease).**

Section 8 - Control of Pests

Potential pests pose a **negligible** risk to site operatives and the local community from application of the Technology for the reasons stated below: -

- The nature and source of the possible wastes to be treated (i.e. organic, inorganic/ heavy metal wastes) are not regarded as foodstuffs for pests;
- Foodstuffs introduced to site by operatives will be disposed of within appropriate, covered bins;
- In the event that a pest infestation occurs, a pest control contractor will be appointed.

Section 9 - Control of Birds and Other Scavengers

Birds and other scavengers pose a **negligible** risk during application of the Technology for the reasons stated below: -

- The nature and source of the wastes to be treated on-site are not regarded as foodstuffs for birds and other scavengers.
- All food and putrescible wastes will be deposited within covered waste bins / skips, to ensure that birds and other scavengers do not become a problem on-site.
- A sealed skip will be utilised for waste generated from the welfare (all welfare waste to be placed in skip daily) and bentonite bags.

Section 10 - Control of Litter

The major source of litter from site will be from material bags and as such the risk from litter is **negligible** for the reasons stated below: -

- Litter will be deposited on-site in covered skips;
- Chemical drums and IBC's will be safely stored until arrangements can be made for their collection. Collection of empty drums / IBC's will be arranged as and when required (by a suitable carrier).

Section 11 - Documentation

At all times, an up to date Project Quality Plan and Health & Safety documentation will be kept at the site office for reference by site personnel. The site will be inspected regularly by the Site Project Supervisor to ensure license compliance.

All records will be made available for inspection by the Local Council and the Environment Agency during operational hours.

Section 12 - References

Envirotreat.

- Health and Safety Risk Assessment and Method Statement (to follow)
- Remediation Method Statement (to follow.

- Remediation Strategy (attached as part of this tender submission)

All relevant site investigation reports

Monitoring Plan

Monitoring will be carried out and results interpreted by suitably qualified and experienced Envirotreat personnel. Records of results from all monitoring will be filed in the Project Quality Plan and Site Diary, which will be on-site during hours of operation.

Envirotreat Personnel to Carry out Monitoring:

- Remediation / Project Site Manager (Simon Farr) or nominated person.
- Technically Competent Person (Phil Rees).

Baseline data for dust, noise and VOC will be established prior to the treatment. Further monitoring will be undertaken daily throughout the remedial works. The monitoring points will be detailed on the site plan. In addition, further monitoring will be undertaken should there be any concerns between routine monitoring intervals.

Air Emission Monitoring

The potential risk from aerial emissions following implementation of control measures is **low** to **negligible** for the following reasons: -

- Regular monitoring of dust (via Microdust Pro - Real Time Dust Monitor or similar) and VOC (via Mini-Rea or similar), and other noxious gases.

Figure 35 – Dust Monitor - TSI Dustrak 8534

Figure 36 – VOC Monitor – MiniRea Lite

- Installation / remediation will be predominately in-situ.
- On-site vehicle traffic will be kept to a minimum and water will be used to dampen down exposed soils.
- The mixing zone will be located as close as is practically possible to the stockpiled contaminated soils. Following treatment, the potential for aerial emissions is negligible.

The following baseline monitoring is considered necessary:

- Baseline VOC's will be taken to measure VOC's and other noxious gases resulting from other local activities.
- Baseline Dust will be taken to measure dust resulting from other local activities.
- Once remediation work commences monitoring of airborne dust, particulates, VOC's and other noxious gases will be carried out at least twice daily from the area identified in the Remediation Method Statement. The monitoring regime will involve handheld PID equipment, gas monitors and dust monitors, visual assessment of the levels of airborne dust and particulates emanating from the treatment process paying particular attention to the trigger level of dust migrating off-site.

If the trigger level is surpassed then works will be halted pending the following measures to take place, for instance;

- Dust suppression equipment in the form of a water bowser and or misting units will be used.
- VOC's and other noxious gases can be reduced to acceptable levels.

Surface Water & Groundwater

The potential sources of surface / ground water contamination are the chemicals incorporated into the E-clay and leachate & surface water runoff.

Baseline monitoring of underlain soils is not considered necessary due to the control measures being implemented and the known condition of the underlying soils (landfill material).

The chemicals and slurry mixing equipment will be located in the E-clay Treatment Area, away from known sensitive receptors. Any chemical spillages will be contained and collected and incorporated into the treatment process. The whole Treatment Area will be bunded in order to protect the environment.

The objective of this ECS is to protect the surrounding environment from chemical spillages.

The chemicals required for the production of the treatment slurry, will be delivered in Intermediate Bulk Containers (IBC's), 205L drums and 25L carboys, which will be stored within a containerized unit, to contain any spillages.

Ongoing (daily) monitoring of the ECS will be undertaken with appropriate maintenance undertaken, this will be recorded in the site diary / site specific Quality Plan.

Following completion of work, the containment area will be removed and ground reinstated.

All surplus materials arising from the decommissioning of the ESC will be disposed of accordingly.

Leachate and surface water will be collected in depression areas created within the landfill area away from known sensitive receptors. Collected water will be utilised within the treatment process as a substitute for mains water.

Installation and Commissioning

The commissioning of the Treatment Area ECS will be carried out by a suitably qualified Technically Competent Manager.

The ECS will not be connected to a drainage system; there will however be a number of sumps where any chemical spillages can be pumped from and reused in future treatment slurries. All deliveries to this ECS will be made using a forklift truck.

Following commission, the integrity of the ECS will be monitored on a daily basis. The monitoring regime will consist of a visual inspection with particular attention paid to the action trigger of any loss in integrity of the bund.

If the action trigger is surpassed, the bund will be repaired immediately and recorded in the Project Quality Plan.

Following the conclusion of works, the materials used to create the ECS will be incorporated in the final batch and remediated.

Monitoring of Groundwater

No formal monitoring of groundwater is considered necessary due to the control measures proposed. As with all projects, a daily inspection of all bunds will be undertaken to ensure their integrity.

Post E-Clay PRB monitoring / validation may be required / requested.

Monitoring of Surface Water

N/A

Monitoring of Soil Gases

VOC will be regularly monitored during the works.

Indicator Parameters

Aerial Emissions

Indicator	***Justification***
Bentonite / cement particulates released to air.	*The only potential aerial emissions will originate from the addition of bentonite.* *This will be evaluated visually and via Real Time Dust Monitor.* *Tigger level of 25ug/m³, at site boundary (or background level, whichever is greatest).* *In trigger value exceeded works will STOP until reasons evaluated and alternative method of work approved*

Dust

Indicator	***Justification***
Dust released to air due to vehicle movements, etc.	*The only potential source of dust will originate from the movement of site vehicles.* *This will be evaluated visually and via Real Time Dust Monitor.* *Tigger level of XXmg/m³ (to determined form background monitoring), at site boundary (or background level, whichever is greatest).* *In trigger value exceeded works will STOP until reasons evaluated and alternative method of work approved*

Noise

Indicator	***Justification***
Noise levels rising significantly (5dBa) above the baseline levels i.e. road noise, noise from nearby industry / housing / school	*The remediation operation is not expected to generate excessive noise beyond the site boundaries, and it is not anticipated that levels will rise above the indicator levels (5dBa over baseline) for the reasons stated previously. However, should this occur it will cause nuisance to the local community and thus remedial measures will be employed.* *Where levels exceed the lower exposure action level of 80 decibels, then ear protection will be provided based on SNR and taking into consideration real world factors.* *Tigger level of 5dBa over baseline at site boundary.* *In trigger value exceedance = works will STOP until reasons evaluated and alternative method of work approved*

VOC

Indicator	***Justification***
Any emissions over STEL / TWA. *Benzene > 1ppm*	*Monitoring throughout the treatment operation by means of handheld monitor (PID).* *Tigger level of > 1ppm benzene at site boundary.* *In trigger value exceeded works will STOP until reasons evaluated and alternative method of work approved*

Surface Water

Receptor in excess of 50m from site boundary, monitoring not considered necessary

Preferential Pathways

Indicator	***Justification***
Observation of drainage runs, other ducts, etc which lead to receptors	*Use of site plans and supervision of site investigations will minimise the risks associated with these.*

Asbestos Management Plan

There is potential for asbestos containing materials (both ACMs and fibres) to be present on site.

Should asbestos containing materials be encountered during the works it will be necessary to carry out a detailed assessment of the nature and quantity of asbestos to determine the risk classification as shown in the figures below (in accordance with the CI:aire CAR-SOIL guidelines) and also to determine whether the asbestos contamination is above or below the 0.1% hazardous threshold. This will determine the course of action required for addressing the material i.e. either treatment for reuse on-site in designated areas of the site if low risk / non-notifiable or offsite disposal to a suitably licensed landfill site if considered to be notifiable and Licenced Asbestos Work.

Figure 37 – Non-Licenced Decision Flowchart

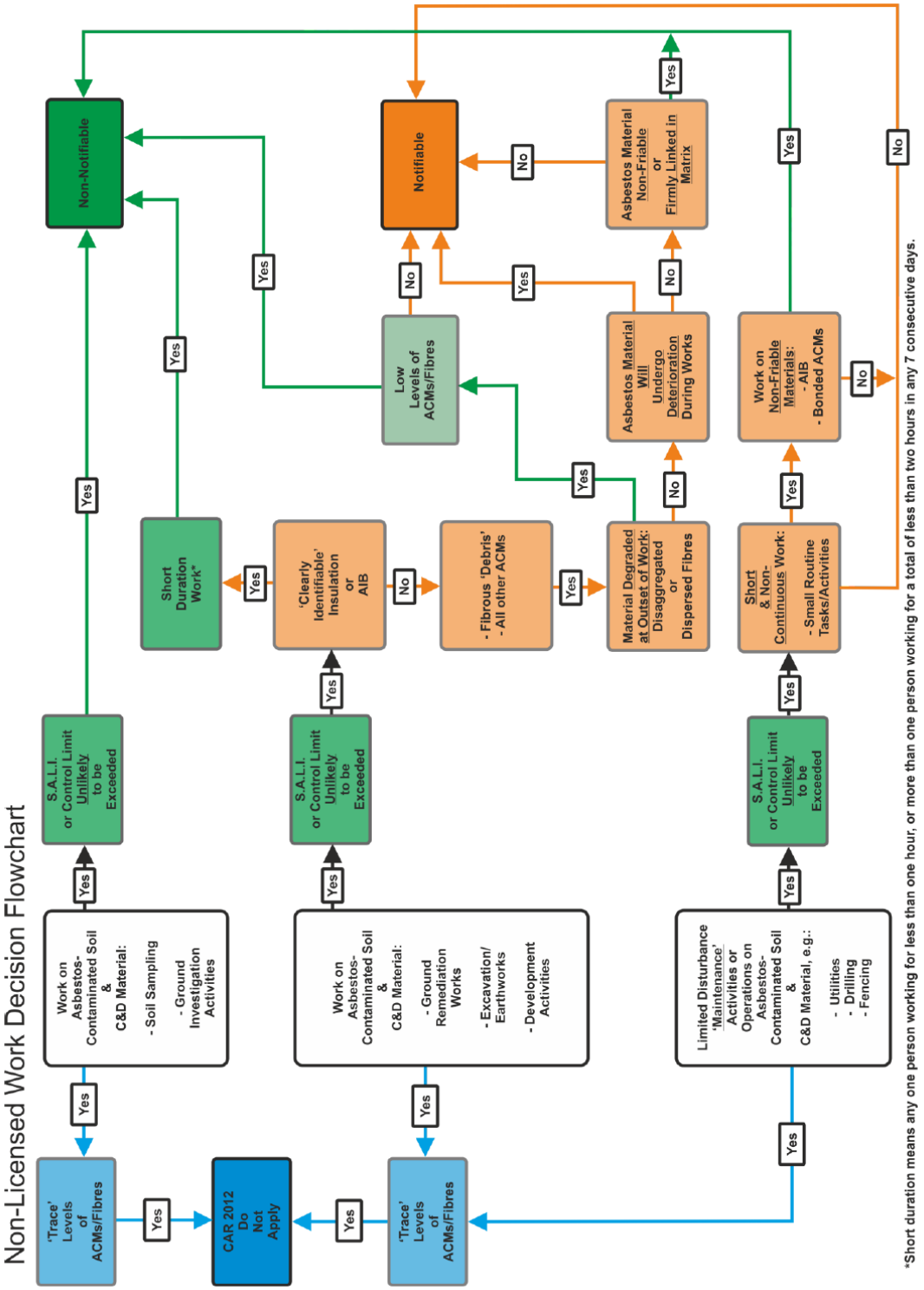
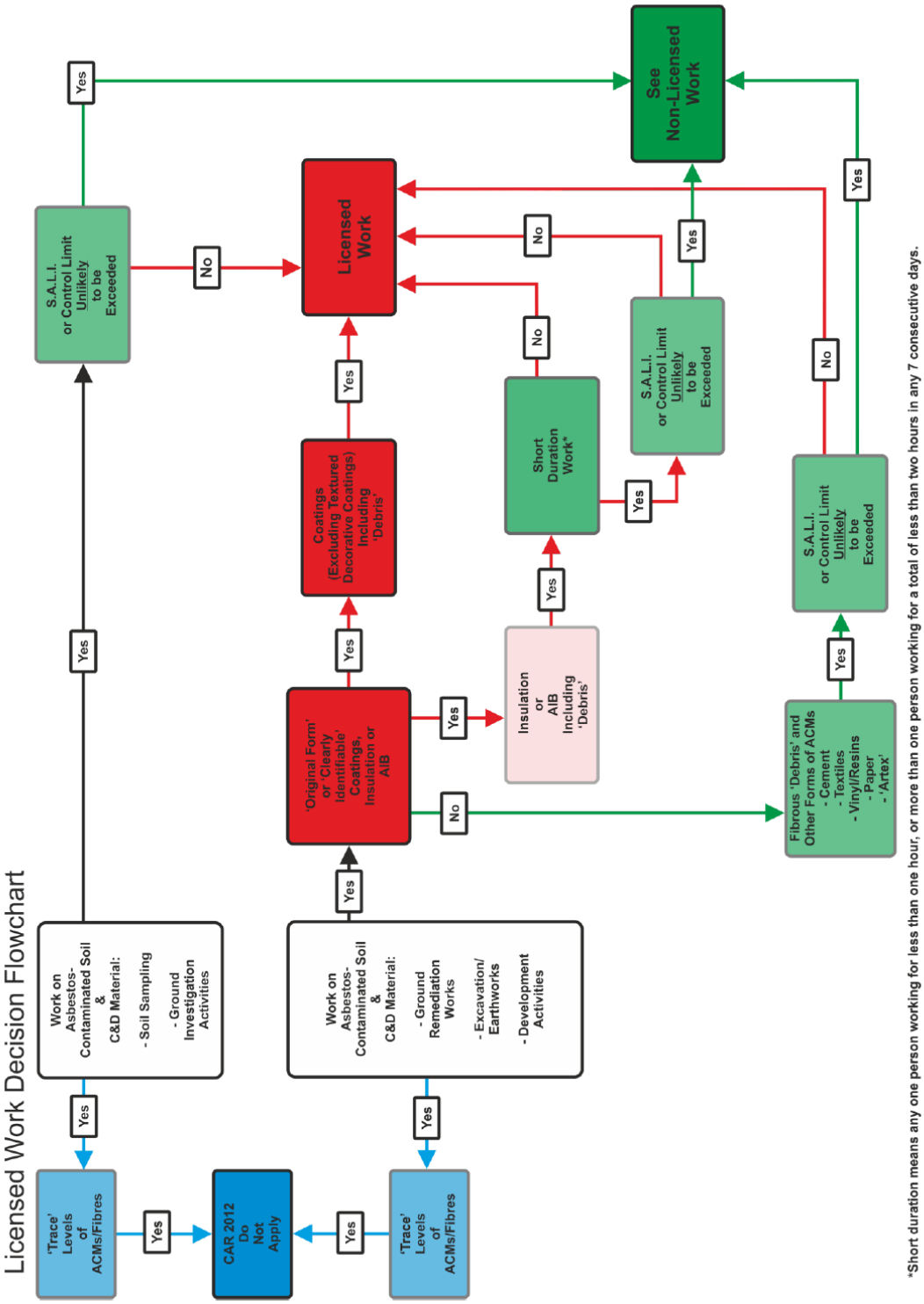


Figure 38 – Licenced Work Flowchart



Should any asbestos contaminated material be identified as part of the remediation works, then material will be quarantined pending analysis and assessment to determine appropriate course of action.

Appropriate environmental controls will be implemented to monitor and control dust emissions from the site which will also control the potential risks associated with the potential release of asbestos fibres.

These environmental controls will include (as a minimum):

- Damping down on dry days to minimise the risk of dust being generated which could potentially impact on offsite receptors. The damping down process will also control the potential release of asbestos fibres. A suitable water supply will be available at all times for this purpose
- The implementation of effective dust monitoring which will be undertaken at areas of the site deemed to pose a potential risk to offsite receptors. Should the monitoring demonstrate at any time that the potential risk is a concern then the works will cease immediately, and the methodology will be reviewed and demonstrated to be acceptable prior to remediation works recommencing on-site. The monitoring process will be fully supervised by Envirotreat and daily records will be maintained in the Quality Plan.