Remediation Statement

Former Albright & Wilson Works, Whitehaven, Cumbria

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LIMITATION

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

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EXECUTIVE SUMMARY

Land at the former Albright & Wilson works, Whitehaven, Cumbria ("the site"), was determined as Statutory Contaminated Land, under Part 2A of the Environmental Protection Act 1990 ("Part 2A"), by Copeland Borough Council. The site was also designated as a Special Site, required to be regulated by the Environment Agency. The site is now owned by Rhodia UK Ltd ("Rhodia"). This document was prepared voluntarily on behalf of Rhodia by URS Corporation Ltd.

The primary purpose of this Remediation Statement is to explain and record what actions Rhodia has taken, and will take in future, to comply with Part 2A. In addition, the statement addresses how other issues will be resolved in compliance with other legislation.

The boundary of the site covered by Part 2A is very specific and excludes the landfill sites (which are covered by separate legislation) and the areas to the east of the road (assessed not to be contaminated land). It includes the part of the site at the north end now under new ownership, but the responsibility for that part has been transferred to the new owners.

The site has long industrial history, and has formerly been occupied by a coal mine, coke works and an anhydrite mine. It was developed for the manufacture of organic chemicals in the 1940's, and made a variety of products including firelighters and phosphate-based detergents. It was operational until September 2007 as a detergent manufacturing works, having been progressively closed over a number of years. During 2006 and 2007 the majority of the structures on site were demolished and removed.

It is Rhodia's intention to transfer the site to the Land Restoration Trust, with the understanding that it will become a site of local industrial heritage, and open public access will be allowed.

URS, on Rhodia's behalf, has undertaken extensive site investigation on the site, comprising the excavation of many trial pits and boreholes. Hundreds of soil and groundwater samples have been taken, and subjected to chemical analysis. The investigations have been carried out over many years, with the most intensive work being done between 2005 – 2007. Work carried out in 2006 and 2007 was agreed by the Environment Agency. Detailed reports on the investigations are included in the remediation statement as appendices.

The data from the investigations has been used to understand the nature and extent of the contamination on the site. Computer modelling has been undertaken to assess the existing risk and potential future risk from contaminants in, on or under the ground and their impact (if any) on identified environmental receptors. The models also predict how the contamination may travel in the subsurface, and predict how much contamination might be able to reach the receptors. The main receptors considered were groundwater beneath the site, the Sandwith Beck, the Byerstead Spring on Saltom Beach, and the Irish Sea. Modelling was also used to predict the potential exposure of people to the contaminants, and whether there was any risk of harm as a result. All the models used followed current Environment Agency guidance.

To simplify the assessment process, the site was subdivided into sections referred to as "Plots". Each plot represents an area considered to have the potential for significant contamination, and they were chosen after the first stage of site investigation. Each plot then had several more stages of investigation, progressively refining the understanding of the nature of the contamination and the risk

presented. At the time of completing this remediation statement, there are a number of locations where the potential for significant contamination remains. These locations require additional assessment. Rhodia will complete the additional assessments by 30th June 2008. The areas are as follows:

"Plot C": Former location of Substation Z (electricity transformer); possible oil and PCB (polychlorinated biphenyls, transformer oil additive) requires sampling and assessment.

"Plot C": North Pond; potential for stored rainwater to become contaminated by oil, naphthalene, surfactants, copper, selenium or vanadium and requires monitoring by water sampling for 1 year. The base of the pond has become eroded and requires assessment and a solution to be agreed with the Environment Agency.

"Plot C": stockpiles; a number of stockpiles of soil and rubble require sampling and assessment. It is intended that the stockpiles will be used to level the site if they are suitable.

"Plot D": hotspot 1 (fluoranthene), hotspot 2 (chloroform) and hotspot 3 (naphthalene, nickel and zinc) require further assessment to determine if contamination is significant

"Plot F": potential for oil on the groundwater surface requires assessment

"Plot G": the area under the former Ethoxylation Plant (previously inaccessible) requires sampling and assessment.

CHP Plant: the area formerly occupied by the CHP plant requires assessment

Currently, there is no identified significant contamination that requires Rhodia to undertake remedial action under Part 2A. If the assessment actions above result in the discovery of significant contamination (a "Significant Pollutant Linkage"), Rhodia will action and complete the required remediation by 31st December 2012.

1. INTRODUCTION

1.1. Background

This remediation statement has been written by URS Corporation Ltd on behalf of Rhodia UK Ltd to define the assessment actions and remedial measures proposed to resolve the pollutant linkages defined in the *Record of Determination* of *Contaminated Land*. The site (refer to Figure 1) was determined as Contaminated Land by Copeland Borough Council under the Environmental Protection Act 1990, Part 2A (as amended) and the Contaminated Land (England) Regulations 2000 (letter of 15 June 2005, reference sjm/sjm/PF). The land was determined by the Council as contaminated because pollution is being, or is likely to be, caused. A number of significant pollutant linkages were identified by the Council.

In addition, URS has highlighted a number of other potential pollutant linkages in the Phase II report (see Appendix B) in relation to the proposed land use change, with respect to human health. The site has been decommissioned and has been undergoing a programme of demolition in preparation for the transfer of the land to public open space.

This remediation statement, therefore, covers two components:

- The legally identified pollutant linkages in relation to controlled waters; and,
- The potential risks in relation to human health under the change of land use from industrial to public open space[1].

Remedial actions (including further assessment actions where required) are proposed in this document. The investigation and validation procedures for the site works are set out in Appendix A. A summary of the findings of the site investigations to date (Appendices B – J) is provided in *Section 2* and the remediation actions required to address significant pollutant linkages are explained in *Section 3*.

Currently, Rhodia plans to transfer the site to the Land Restoration Trust (LRT). The nature and timing of the investigation and remediation works set out in this document are dependent upon the agreement with LRT. In the event that the transfer does not go ahead, Rhodia will need to review and amend the proposals.

[1] It should be noted that there is no statutory requirement to investigate pollutant linkages to human health under Part 2A as the determination relates to controlled waters receptors only. The Council considered there was no significant risk to human health..

1.2. Statutory Information

ENVIRONMENTAL PROTECTION ACT 1990, SECTION 78H(7)

THE CONTAMINATED LAND (ENGLAND) REGULATIONS 2006, SI 2006/1380 OR THE CONTAMINATED LAND (WALES) REGULATIONS 2006, SI 2006/2989.

REMEDIATION STATEMENT PREPARED BY URS CORPORATION LTD

This Remediation Statement is prepared by URS Corporation Ltd in relation to contaminated land identified by Copeland Borough Council under section 78B of the Environmental Protection Act 1990 (the 1990 Act) and designated as a special site under section 78C of the 1990 Act.

The location and extent of the contaminated land to which this Remediation Statement relates (the Land) are set out in Figures 1 and 2.

The Environment Agency as enforcing authority in relation to the Land, is precluded by section 78H(5)(b) of the 1990 Act from serving a Remediation Notice and URS Corporation Ltd has therefore prepared this Remediation Statement in accordance with section 78H(7) and (8).

The components which have been and are being and are expected to be done by way of remediation and the date of completion and the period within which each of these things are being and are expected to be done are set out in Section 3.

Particulars of the substances and the pollution of controlled waters by reason of which the Land is contaminated land are set out in Section 4.

The current use of the Land is for the manufacture of detergents, in the process of being converted to public open space.

The name and address of the person who has done and is doing and is expected to do each of the things set out in Section 3 of this Remediation Statement is

Rhodia UK Ltd

Oak House, Reeds Crescent, Watford, Hertfordshire, WD24 4QP Tel: 01923 485868 Fax: 01923 211580

Signed: ……On behalf of Rhodia UK Ltd

Date:……

The enforcing authority's address for the purposes of this Remediation Statement is:

The Environment Agency, Ghyll Mount, Gillan Way, Penrith, CA11 9BP tel: 01768 215727

1.3. Environmental Setting

The site is located in a coastal setting, on the hill approximately 2km south of Whitehaven town centre. The site is broadly level with an elevation around 83m above sea level. To the northeast are residential estates (Woodhouse and Kells), and to the south is the village of Sandwith. The rest of the site is surrounded by agricultural land.

The northern and central part of the site has historically comprised a coal mining pit, coke works and alabaster works (developed between the late 1800's/early 1900's). It was developed for the manufacture of chemicals (including firelighters, detergents and other inorganic and organic chemicals) in the 1940's. Recent on-site processes have related solely to the surfactants business, divested to Huntsman in the late 1990's (Rhodia retained ownership of the land). Huntsman now have ceased operations on the site and successfully surrendered their IPPC permit. The site is closed and in the process of demolition. The "current use of the land" is best described as detergent manufacturing. Reference has been made to Department of the Environment Industry Profile "Chemical Works: Soap and Detergent Manufacturing Works", for information regarding historical use and potential contaminants.

A fuller discussion of the whole site history is given in the main Phase II report, held within Appendix B of this document.

Once the site is transferred to LRT, it is proposed that the site will become a "site of local industrial heritage" with the building slabs and existing contours remaining in place, and to allow open public access.

Sandwith Beck rises at the site boundary (NGR NX967154). It flows in a generally south to south-south-east direction, through the villages of Sandwith and Rottingham, where it meets with Thorney Beck, and from there it flows towards the sea at St. Bees as Rottingham Beck. In addition to Sandwith Beck, 500m to the south-east of the site a tributary of Pow Beck drains eastwards towards a reservoir, which lies to the south of Mire House West. 500m further on lies Bell House Gill, where a second tributary issues to flow in a north-easterly direction, meeting up with Pow Beck to flow into Stanley Pond and from there south westwards along the Whitehaven-St. Bees valley towards St. Bees and the Irish Sea.

There is a watershed within the site, with approximately two thirds of the site draining southwards towards Sandwith Beck and the northern third draining to the coast to the north. The situation is complicated slightly by former site drainage system, which routed most surface water to the north, so a larger area than suggested by the topographic watershed drained northwards. The site drains are currently being decommissioned as part of the demolition works, and it is intended the drains will be allowed to silt up and collapse over time. It is anticipated the site watershed will revert to the natural topographic drainage. This remediation statement covers land that will drain to both the south (Sandwith Beck) and to the north/northwest (to the Irish Sea). It also considers water that will drain vertically from shallow ground down to deeper water-bearing rocks.

The geology and hydrogeology of the Rhodia site is complex, and a full explanation is presented in the Phase II report (the main phase site investigation) included in Appendix B. Further site investigations have been carried out in particular areas of interest within the site, and these are labelled Plots A – F (reported in Appendices C-I). There is additional detailed geological interpretation within these reports, relating to different geology in different plots. The geology is important, because it affects the movement of contamination, and therefore affects the risk of pollution to groundwater.

The geological sequence comprises:

- *Made Ground: the made ground (the man made or disturbed ground formed when the chemical works was built), overlying*
- *Glacial Boulder Clay: (absent in some parts of the site) overlying either*
- *Whitehaven Sandstone: part of the Carboniferous Coal Measures, a sandstone classified as a minor aquifer. Present in the north east part of the site; or*
- *St Bees evaporites: anhydrites, gypsum, siltstones and sandstones forming the bedrock beneath most of the site, classified as a non-aquifer; or*
- *St Bees Shales: siltstone and fine grained sandstones which form the bedrock beneath the western edge of the site, (separated from the St Bees Evaporites by a north-south trending fault which runs through the site);*

URS considers that there are two groundwater systems. The first of these (referred to as the “shallow groundwater” in previous reports) is also considered to be representative of pore water. The second (the “deep” groundwater) is considered to be the main groundwater system, although its behaviour is considered to be different in different geological units.

The “pore water” (shallow groundwater) is found within the Made Ground and the Boulder Clay, at a varying depth, up to approximately 8m below ground level. Pore water is considered to occur in isolated pockets, which are not necessarily interconnected. Consequently where contaminants are identified within pore water, it is considered in the context of a potential source within the conceptual site model rather than as a receptor.

Deep groundwater flow is complicated and poorly understood. However, it is considered that flow is broadly towards the Irish Sea (i.e. north and west). There are known to be rapid pathways through: dissolution features within the St Bees Evaporites; the Byerstead fault; and old mine workings, via which water from the site reaches the sea.

Geological faults in the area are thought to exert a strong influence on the groundwater (and, therefore, contaminant) flow regime, in particular, the Byerstead Fault and the 'North-South' Fault. In the case of the Byerstead fault, the fault is considered a pathway for the historic presence of site process waters on the beach at the Byerstead Spring, approximately 800m south west of site. It is likely to channel flow horizontally and vertically between units of significant groundwater pressure difference (i.e. different levels of groundwater). The fault is intersected by two anhydrite mine drifts, and at approximately 109m below Ordnance Datum by a service road tunnelled from Ladysmith shaft (centre of site) to workings beneath Sandwith. Dye tracer testing in 2002 proved a rapid pathway from the on-site drainage system to the Byerstead fault at the coast.

2. LOCATION AND EXTENT OF CONTAMINATED LAND TO WHICH THIS REMEDIATION STATEMENT RELATES

Section 2 aims to set out the nature of the contamination on the site and how it will potentially affect future visitors and water resources ("*The Receptors*"). The investigations and assessments made on the site have been used to look at whether there is the potential for a "*Significant Risk*"[2] to the receptors from contamination identified on site via any of the pathways by which the contamination could reach the receptors. Section 2.1 below provides an outline of how "*significant risk"* is assessed and established in the UK.

It should be noted that Copeland Borough Council's Part 2A determination of the site as Contaminated Land makes reference only to controlled waters as receptors. Future visitors to the site were not regarded as Part 2A receptors because they would only be present under a future use of the site (as open space) and the Part 2A determination dealt only with the current land use. Risks to the future visitors to the open space are considered here for completeness, however regulatory control of this aspect would be by means of the Town and Country Planning regime.

[2] A "Significant Risk" is where a source of contamination is demonstrated to have the potential to cause harm to an identified receptor.

2.1. Background to the Assessment of Contaminated Land

Part 2A of the Environmental Protection Act 1990 provides the regulatory basis for the identification and remediation of statutory designated Contaminated Land.

The Act defines Contaminated Land as:

"Any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of the substances in, on, or under the land, that:

1 Significant harm is being caused or there is a significant possibility of such harm being caused: or

2 Pollution of controlled waters is being or is likely to be caused."

The application of the Part 2A regime is subject to the statutory guidance in the DEFRA Circular 01/2006, further supported by a number of other key guidance documents, which have been developed to assist local authorities and the Environment Agency. As the Site has been determined as contaminated land, Copeland Borough Council were required to make an assessment of the hazard and subsequent risk and demonstrate a significant possibility of significant harm, or that significant harm has already occurred with regard to a number of statutory receptors. These are identified in Chapter A of Annex 3 of Circular 01/2006 and include:

- *Human Beings;*
- *Ecological Systems consisting largely of designated sites;*
- *Controlled waters;*
- *Property in the form of livestock, crops and produce grown for consumption, domestic animals and wild animals subject to shooting or fishing rights; and*
- *Property in the form of Buildings.*

In the case of the Rhodia site the potential for pollution was identified to controlled waters. Where controlled waters receptors are identified as the receptor at risk it must be determined that substances are continuing to enter controlled waters and/or are likely to enter controlled waters. This implies that substances in, on, or under the land must be present. Furthermore substances must be entering controlled waters in concentrations, which are considered to be poisonous, noxious or polluting and/or comprise solid waste matter.

Guidance for the management and remediation of land contamination in England and Wales is set out in the CLR11 documentation[3] issued by the Environment Agency. This document provides a framework for addressing land contamination identified under Part 2A of the Environmental Protection Act 1990.

This document provides a framework for the investigation and assessment of contaminated land. This framework has been followed to provide the assessment reports for the site, which are provided as appendices B-J to this document. The investigation and assessment was undertaken as a phased process, which focused initially on the site as a whole, and then subsequently targeted "Plots" of land where the initial investigation had identified contamination, which required more detailed assessment.

2.2. Designated Area

Figure 1 shows the location of the site. Figure 2 shows the site characterisation zones, the area to which this Remediation Statement applies (the area determined as contaminated land under Part 2A), and the boundaries of Plots A-F where additional investigation was undertaken.

2.3. Receptors

Surface water receptors

- Sandwith Beck: which rises at the southwestern site boundary. Under the new drainage regime it will be extended into the site in two connected drainage ponds in order to attenuate runoff from the site to reduce the risk of flooding;
- Bell House Gill: a river approximately 1.25km to the south east of the site; and
- Coastal waters: 400-500m to the west/northwest of the site.

Groundwater Receptors

Based on the existing wells on site, deep groundwater is found within the solid rock strata and is generally encountered at depths of between 10m and 23m below ground level (bgl) within the St. Bees Evaporites, 9m - 40mbgl within the Whitehaven Sandstone, and 50mbgl within the St. Bees Shale.

Pore water within the Boulder Clay is not considered to be a receptor because it is present only sporadically, and occurs in unconnected pockets across the site.

[3] Model Procedures for the Management of Land Contamination: Contaminated Land Report 11. Environment Agency. September 2004.

Human Receptors

Human receptors are not considered at risk under the current site use for detergent manufacturing. URS has considered risks to the public under the future proposals for opening the site up to public access. The relevant receptors are people visiting the site when it is opened up, and they are expected to use the site for leisure activities such as walking and exercising dogs.

2.4. Location of Significant Sources of Contamination

The significance of sources of contamination identified during the Phase II investigation was tested through a staged risk assessment process during the investigation and assessment of each of the Plots identified as requiring further action. The details of the risk assessment process are provided in the reports for each Plot in Appendices C to I and for phosphate on the site as a whole in Appendix J. A summary of the identified potential significant pollutant linkages is presented in the sections below.

The creation of the "Plots" marked on Figure 2 was driven by the following:

- *Potential areas for remediation* - the land highlighted on Figures 12 and 13 of the Phase II report (held in Appendix B of this document) where contaminant concentrations were found to exceed site specific risk-based criteria and further investigation was required to better understand potential remedial requirements.

- *Areas yet to be investigated* - areas which were not investigated in the main Phase II investigation (normally due to the presence of structures), but were considered likely to contain elevated concentrations of contamination, given the historic land use.

Each of these plots is situated within one or more of the 11 "Zones" described in the Phase II report (which are also presented on Figure 2). The "Zones" are defined by the processes undertaken within them, with the intention that the type of contamination expected should be similar within a Zone.

2.4.1. Plot A

The Plot A area is located in the north of the site and contained the "Cathedral" (used to collect effluent prior to discharge), and areas where contaminated soils and groundwater had been identified during the Phase II investigation[4]. No samples had previously been collected from the soils beneath the Cathedral as it remained in operation during previous investigations.

The areas of contamination, which defined the extent of Plot A, were: to the northeast of the Cathedral (chloromethane); an area immediately to the south of the Cathedral (naphthalene) and an area adjacent to the Cathedral (surfactants). These areas are shown in Figures 12 and 13 of the Phase II report.

The subsequent Plot A investigations and assessments[5] (Appendix C and Appendix C2) identified a potentially significant risk to controlled waters (specifically, water quality in the Byerstead Spring) in the area to the northeast of the Cathedral, based on concentrations of cyanide, naphthalene and total petroleum hydrocarbons (TPH). These risks differ to those identified in the Phase II report because the data set has expanded and the risk assessment modelling has been changed due to a better understanding of the site setting, in particular the scenario of rapid transport to the sea. Pertinent investigation observations and data relating to the investigation locations in this area are provided in detail in Appendices C and C2 and are summarised below:

TP631A

- Soil sample at 0.5m gave 15mg/kg naphthalene.
- Soil sample at 2.0m gave 3.8mg/kg naphthalene, 2500 mg/kg TPH and 120mg/kg total cyanide, and was visibly oily.

WS115

- Soil samples collected from 4m gave a concentration of 748mg/kg TPH and a sample submitted from 0.3-0.6m reported 13mg/kg naphthalene. These soil samples were not tested for cyanide.
- Pore water samples contained cyanide, naphthalene, and 700µg/l TPH, with majority in heavy bands and considered likely to be diesel.

[4] Phase II Investigations and Environmental Assessments at the Former Albright & Wilson Works, Whitehaven (REF: 44319623, 23 June 2005). Appendix B.

[5] Appendix C. Plot A Soil and Groundwater Investigation former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320221 / MARP0004, dated 17th January 2007) and Appendix C2. Former Albright and Wilson Facility, Whitehaven, Cumbria. Plot A Assessment Actions (REF: 44320215/ MARP0002_C2, dated 17th May 2007)

The potential source area identified in the Plot A assessments is located around WS115 and TP631A and is based on risks identified at Stage 3B controlled waters modelling (see Appendix C for explanation) from naphthalene 49μg/l and cyanide 1670μg/l in pore water samples. These samples were taken in 2002 and 2003 respectively[6] and water has not been observed in this area since (it has proved impossible to install another borehole near this location, and no water has been encountered in trial pits). Concentrations of naphthalene and cyanide in soil samples collected from the surrounding area do not lead to predicted risks (*i.e.* the groundwater modelling undertaken predicts that leaching from these soil samples would lead to concentrations lower than the groundwater that we have tested).

WS115 was drilled in 2001 and has subsequently been damaged and destroyed. The pore water was observed to be black with a slight diesel odour at 3.1m bgl. Sandstone was encountered at 4.3m bgl, and therefore the water table is in clay.

Soil samples collected from TP631 did show concentrations of contamination which modelling would predict could result in pore water similar to the water sample collected from WS115[7]. The soil at 2m was observed to be oily, and contained TPH and cyanide.

It is not certain that the soil contamination observed in this region caused the water contamination measured, although it is considered that this is likely to be the case. In addition the risk assessment concludes that it is the water that poses a risk to the Byerstead Spring water quality, not the soil and therefore if there is little or no water, then there is little or no risk.

It is considered likely that there is a perched water table here to some extent but that there is not much water, as the pore water is in clay. It is in contact with sandstone beneath, but the conceptual model that this water is rapidly travelling to the coast is not really fulfilled here as evidence from the site investigations suggest there is about 2m of clay in which the water sits. It is also predicted that a monitoring well installed into the evaporites would not encounter a water table. Therefore it is considered that the clay is wet to the base, occasionally wet enough to fill a borehole if one is installed within the clay, and that the pore water may be contaminated enough to generate exceedence of EQS if it was possible to get sufficient quantity of water to the coast.

[6] Phase II Soil and Groundwater Investigation Interpretive Report the Former Albright & Wilson Works, Whitehaven (REF: 44557-021, 4 February 2002), Table 14 and; Additional Investigation at the Former Albright and Wilson Works, Whitehaven (REF: R1550-CO1/44557-033, 3rd August 2003), Table 9.

[7] Remediation Statement Appendix C. Plot A Soil and Groundwater Investigation former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320221 / MARP0004, dated 17th January 2007). Appendix G.

However, if the migration of pore waters is slowed up by the 2m or so of clay, which has been, identified here then the scenario that the pore waters may be rapidly transported to the coast is over conservative. In reality we would expect the clay to provide at least a measure of attenuation and perhaps even significantly prevent the contaminated pore water from reaching the evaporites void system. If this was the case, then our model would overestimate the concentrations of contamination reaching the coast. If we adapted the model to account for retardation, the model would not predict a risk; however the uncertainty on the attenuation provided by the pathway is very large. URS considers that the modelling undertaken is the best approximation to the conceptual model that can be reasonably achieved, but it cannot accurately replicate the complex hydrogeology of the pathway. Modelling is a tool to assist the assessment of a pollutant linkage, and is not intended to be used as the primary justification for the existence of a significant pollutant linkage. It is therefore appropriate to consider the field evidence and the detail of the qualitative conceptual model when making a judgement about the significance of the pollutant linkage.

The above assessment of the relationship of the model to reality is supported by the results of the monitoring programme at the Byerstead Spring on Saltom Beach, which has been tested quarterly since 2002. Cyanide and naphthalene have been tested between February 2004 and July 2006. Cyanide has never been detected at concentrations above the laboratory method detection limit (MDL) in any of the deep groundwater monitoring boreholes on site, or at the Byerstead Spring. Monitoring for cyanide was discontinued after July 2006 because it was not detected. Naphthalene has been detected at the Byerstead Spring, but never at the concentrations predicted by modelling, and only rarely in exceedance of the EQS.

It is therefore considered that although the contamination identified here represents a source, it is not a significant source as the pathway is less rapid than modelled. Monitoring of the receptor has confirmed that the predicted effect does not occur in reality. In conclusion, it is our view that there is no significant pollutant linkage in Plot A.

2.4.2. Plot B

Plot B is located on the northern boundary of the site, immediately to the east of Plot A. It comprises the former coking works and imidazoline plant, which had not been investigated during the Phase II works. Given the historical uses, Plot B was considered likely to contain contaminated soils and pore water. Typically, coking works contamination comprises elevated concentrations of phenols, thiocyanate, cyanide, sulphate, sulphide, sulphur, and heavy metals. The products associated with the imidazoline works include ethoxylated alcohol, Kathod CG (a chemical separation medium), monochloroacetate, sodium chloroactetate, and tertiary amine.

The soil and pore water quality[8] encountered during the investigation was not considered to represent a significant risk to controlled waters based on the risk assessments undertaken[9]. This is primarily because Plot B is underlain by Whitehaven Sandstone which is not thought to be connected to the rapid pathway to the coast via the St Bees Evaporites. Because the water table is deep (around 18m bgl) the attenuation provided by the pathway is significant.

With respect to human health, exposure to contaminants is prevented by the presence of thick concrete slabs over most of the area. It is important that these slabs are retained in the site's future use as public open space.

It was concluded that there were no significant contamination sources and remediation is therefore not necessary.

2.4.3. Plot C

Plot C is located in the centre of the southern part of the site. The Phase II investigation identified Total Petroleum Hydrocarbons (TPH) and naphthalene as potentially significant sources. Insufficient characterisation of the groundwater was possible at the time of the site investigation in 2005, due to the presence of concrete slabs. Further investigation of the Plot C area was carried out in 2006[10] (Appendix E). This additional investigation concluded that the TPH and naphthalene source did not present a significant risk to controlled waters or human health.

A possible significant pollutant linkage was identified from the soils at the base of the North Pond. The potential risk is from leaching of soils (TPH, surfactant, Cu, V and Se) into water in North Pond, which could subsequently move to South Pond and Sandwith Beck.

[8] Observations and site investigation data from the Plot B investigation can be found in Remediation Statement Appendix D. Plot B Soil and Groundwater Investigation former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320221 / MARP0004, dated 18th January 2007)

[9] Details of the Risk Assessments, the assumptions, methodology and justification are provided in Appendices E, F and G of the Plot B Report

[10] Remediation Statement Appendix E. Plot C Soil and Groundwater Investigation; Former Albright and Wilson Facility, Whitehaven, Cumbria (REF: 44319943/MARP0001, dated 16th October 2006)

It also identified that arsenic could present a risk to human health, and this was investigated further during 2007 (Appendix E2)[11].

The source area identified in the Plot C assessment is based on risks identified to human health from concentrations of arsenic exceeding a site-specific threshold value of 104 mg/kg (designed to protect child under 6 years old regularly visiting the site to play) in the following samples:

TP111 0.5m 431 mg/kg

TP 118C 0.5m 270 mg/kg

TP 118C 1m 370 mg/kg

Based on the investigation data to date it is considered the extent of the source area is approximately 5m long x 5m wide x and 1m deep[12]

Located in Plot C is a base from a former substation "Sub Z", to which access has not been possible for investigation. The transformers were removed in August 2007, and the bund was observed to contain some oil, thought to have been spilled when the transformers were removed. The oil and contaminated material in the Sub Z bund was removed by a contractor working for Huntsman on 26th September 2007. It is understood that the excavation removed all visibly contaminated material. The bund is understood to have had a bentonite floor at about 0.5m bgl, and some of this floor was removed by the excavation. The bund was then demolished, and the excavation backfilled with clean gravel. URS was not present during the works. There is potential for contamination to remain in this location, and validation of the excavation is required. Details of the validation to be undertaken are given under "Assessment Actions".

Plot C also contains stockpiles of material from the excavation of the North Pond. Risk assessment indicated no risks for the use of the material within Plot C, however it may be needed on other parts of the site. It will be necessary to demonstrate to the Environment Agency that the material is suitable for use elsewhere on site if this is desired.

[11] Remediation Statement Appendix E. Plot C Soil and Groundwater Investigation; Former Albright and Wilson Facility, Whitehaven, Cumbria (REF: 44319943/MARP0001, dated 16th October 2006), Section 9.

[12] Remediation Statement Appendix E2. Former Albright and Wilson Facility, Whitehaven, Cumbria. Plot C Assessment Actions (REF: 44320215 / MARP0002_E2, dated 17th May 2007). Section 6.

2.4.4. Plot D

Plot D is situated in the northwest corner of the site and comprises parts of the former alabaster works, the fatty alcohol plant and parts of the MMO, MOS, MO (surfactant manufacture) and UFEX (phosphoric acid purification) plants. The boundary of Plot D was defined on the basis of an area of naphthalene contamination of soils as identified during the Phase II investigation[13] in 2005. The Plot D investigation and assessment identified three potentially significant contamination sources. These are described individually in the sections below:

2.4.4.1. Hotspot 1 Fluoranthene

A soil leachate sample collected from TP706D at 2m failed the controlled waters risk assessment at Stage 3b with a modelled concentration at the receptor of 0.4μg/l compared to Environmental Quality Standards (EQS) for pollution in surface waters of 0.2μg/l. The 2m sample had no total soil SVOC or PAH analysis (it is therefore unknown what the total fluoranthene concentration in this sample was) and gave a leachable fluoranthene concentration of 5µg/l (which leads to the predicted concentration at the Byerstead Spring of 0.4µg/l). Field observations indicated that contamination may be more widespread at this location, and there is insufficient data to be sure that this area does not contain significant contamination. The additional observations leading to this conclusion are described below.

The same sample (TP706D @ 2m) had a concentration of 5,800 mg/kg total TPH which is significantly more than was reported for other samples submitted for analysis from Plot D. The sample was collected from ashy made ground with clinker, with a slight kerosene odour noted some 0.5m below it and consequently the sample matrix is not dissimilar from other samples collected from made ground in Plot D. No other sample analysed from Plot D had detectable leachable concentrations of PAHs.

A further soil sample was collected from TP706D at 4.2m (natural clay). This had a concentration of 0.3 mg/kg fluoranthene. It also contained detectable benzo(a)pyrere and benz(a)anthracene, indicating that a source of these could be present nearby (above, probably).

The nearby borehole WS402 also has clay underlying the made ground. It is therefore likely that in this location there is some attenuation provided by the clay. This means that the model assumption of a direct discharge to the St Bees Evaporites void system (rapid pathway to the coast) is probably over conservative.

This area should be investigated further to confirm whether there is more extensive contamination than detected to date. The additional locations will also provide more evidence of the nature of the pathway, and help decide whether an element of attenuation should be accounted for in the risk assessment.

[13] Phase II Investigations and Environmental Assessments at the Former Albright & Wilson Works, Whitehaven (REF: 44319623, 23 June 2005). Section 8 and Figure 12.

2.4.4.2. Hotspot 2 Chloroform

A chloroform concentration of 0.079mg/kg was detected in a soil sample at 0.5m in TP708D. This was considered to represent a risk to controlled waters after stage 3B modelling of a concentration of 4.4µg/l at the receptor compared to the EQS of 12µg/l, based on a potential source area of 30m long x 25m wide.

The trial pit at TP708D refused at 1m on concrete, with the presence of oily water above. There is therefore no data on soils below 1m at this location. VOC data in the surrounding locations is sparse: there was no analysis for chloroform in WS121. VOCs were tested in TP703D, and chloroform was not detected in made ground at 0.5m and natural ground at 2.5m. Chloroform was also not detected in TP709D at 3.9m (natural ground), but there was no analysis of the overlying made ground.

The size of this hotspot is a function of the frequency of surrounding data and it is generated by only one detection of chloroform. This means that although the risk modelling identifies a source, it is unlikely that it is significant.

2.4.4.3. Hotspot 3 Naphthalene/Zinc/Nickel

A hotspot where significant risks to controlled waters were identified through the investigation and modelling process was identified in the vicinity of WS123, WS416 and WS717D. Pertinent investigation observations and data relating to the investigation locations in this area are provided in detail in the Plot D Report[14] and are summarised below:

WS123 (investigation data dates from 2001):

- Soil sample collected from 0.2 – 0.5m reported a concentration of naphthalene of 3.9mg/kg.
- Other PAHs methylated naphthalenes (with a total concentration <10mg/kg) were also identified in this sample but not considered a significant risk.
- No metals analysis was undertaken and no water sample was collected.

WS717D

- A soil sample collected from clayey made ground at 2.7m reported concentrations of nickel at 28mg/kg, zinc at 99mg/kg; concentration from a soil leachate sample at 2.7m of nickel at 4µg/l, zinc at 16µg/l.
- A soil sample comprising gravelly made ground from 2.9m reported naphthalene concentrations below the laboratory MDL in both soil and leach test.

[14] Remediation Statement Appendix F. Plot D Soil and Groundwater Investigation at the Former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320215 / MARP0002_Plot D, dated 17th May 2007). Section 4 and Appendix D.

- A soil sample from 7m weathered bedrock and submitted for leach testing only reported nickel at 1μg/l. Zinc was not detected.
- The pore water table was measured at 6.5m below ground level.
- A pore water sample reported concentrations of naphthalene at 72μg/l; metals were not included in the analytical suite.

WS416

- Made ground was observed to 4m, and comprised mainly ashy gravel. Pore water was encountered at 1.2m below ground level.
- A soil sample collected from 0.45m reported concentrations of 47mg/kg of nickel, 130mg/kg of zinc, with naphthalene not detected.
- A pore water sample reported concentrations of nickel at 206μg/l, 375μg/l of zinc, with naphthalene not detected.

Modelling (Stage 3b) predicted the following concentrations at the receptor: zinc (97µg/l against an EQS of 40 µg/l) nickel (53µg/l against an EQS of 30µg/l) and naphthalene (19µg/l against an EQS of 5µg/l).

Based on the information collected from the samples described above it is considered that this is actually two different hotspots, in unconnected water bodies (zinc and nickel in WS416 at an elevation of 84.7mAOD; and naphthalene in WS717D at an elevation of 79.1 m AOD). WS123 is only included because metals were not scheduled as part of the analytical suite, and therefore we do not know whether there is contamination there or not.

The naphthalene identified in WS717D pore water cannot be readily connected to the surrounding soils, which contain insufficient naphthalene to account for the pore water concentration. Therefore, there may be a contaminant source nearby which has not been detected.

The metals in WS416 pore water are also not obviously a direct result of the surrounding soils, which leach metals at lower concentrations than observed in the pore water. Total metal concentrations within the soils collected at these locations were similar to other samples collected from made ground elsewhere on site. Metal concentrations on site are not considered to represent soil that is significantly contaminated, and there is no evidence of metal hotspots that might indicate the presence of waste from site processes.

It is concluded from these data that in Hotspot 3 there are a few pockets of water, which are unlikely to be connected to each other. The water is more contaminated than the soil thus far analysed, and therefore additional investigation to check for an undiscovered more significant soil source is appropriate.

2.4.5. Plot E

Plot E is located in the south east corner of the site and comprises an area formerly occupied by areas of ancillary services known to include offices, engineering workshops, research buildings, garages, and an area of acid storage tanks and drums.

The Phase II investigation undertaken in 2005 identified areas of TPH and PAH contaminated soils where potential risks to Human Health and Controlled Waters were identified[15]. Given the sampling density in this area during the 2005 site investigation it was also considered that additional sampling should be undertaken in this area in order to more fully understand the potential risks associated with shallow soil and pore water quality in the Plot E area.

The soil and pore water quality[16] encountered during the Plot E investigation was not considered to represent a significant risk based on the risk assessments undertaken[17]. Therefore it was concluded that there were no significant contamination sources and remediation is not necessary.

2.4.6. Plot F

The Plot F investigation area is located in the northeastern corner of the site. It has most recently formed part of a plot of land operated by Huntsman as part of their surfactant manufacturing business, but has also historically been used for the storage of fuels, dyes and perfumes.

Previous investigations in this area (the 2005 Phase II investigation[18] and the IPPC Application[19]) identified contamination of pore water with mercury[20] and surfactants. In addition, some remediation works were undertaken in 2003[21] to address historic spillages from the fuel oil tanks previously located within the boundary of Plot F.

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[15] Phase II Investigations and Environmental Assessments at the Former Albright & Wilson Works, Whitehaven (REF: 44319623, 23 June 2005). Appendix B.

[16] Observations and site investigation data from the Plot E investigation can be found in Section 4 of Remediation Statement Appendix G. Plot E Soil and Groundwater Investigation former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320215 / MARP0002, dated 17th May 2007)

[17] Details of the Risk Assessments, the assumptions, methodology and justification are provided in Appendix E, F, G and H of Remediation Statement Appendix G. Plot E Soil and Groundwater Investigation

[18] Phase II Investigations and Environmental Assessments at the Former Albright & Wilson Works, Whitehaven (REF: 44319623, 23 June 2005)

[19] ERM Reports for Huntsman Surface Sciences entitled PPC Phase 1a Site Condition Report, 25th June 2003, and PPC Phase 1B/2 Site Condition Report 30th June 2003.

[20] Phase II Soil and Groundwater Investigation Interpretive Report the Former Albright & Wilson Works, Whitehaven (REF: 44557-021, 4 February 2002). Table 4.

[21] For further details of the remediation works, see Remediation Statement Appendix H. Plot F Soil and Groundwater Investigation former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320215 / MARP0002_Plot F, dated 17th May 2007), Section1.4.2

The Plot F investigation and controlled waters modelling identified potential risks associated with concentrations of TPH (aromatic C10-12) in soil samples subjected to leachate testing and with concentrations of TPH (aromatic C12-16 and C16-21) in pore water samples. These risks are considered to be marginal and theoretical, and remediation to reduce these risks further is considered to be not practical and acheivable given the low concentrations of TPH measured in soil and groundwater. However, observations made during the site investigation suggested the potential presence of free phase oil product in the shallow perched groundwater horizons, which lie directly on top of the bedrock in Plot F. It was not possible to confirm this by sampling from trial pits.

Currently a source has not been identified, however there is the potential for a significant source if free phase oil is present.

2.4.7. Plot G

Plot G is situated in the middle of the western part of the site, in an area formerly occupied by the firewater basin, cooling towers, and part of the Fatty Alcohol and Ethoxylation Plant.

Data collected during previous investigations (Phase II[22] and the IPPC Application[23]) identified an area of naphthalene and TPH contaminated soils in the central part of Plot G (adjacent to and underneath the Ethoxylation Plant), where there were potentially significant risks to controlled waters. These investigations concluded that further investigation was necessary in order to understand the potential requirement for remediation.

The subsequent Plot G investigation (along with historical data) and the risk assessment identified a potential source of contamination of TPH in the pore waters adjacent to and underlying the former Ethoxylation Plant based on the data collected from soil and pore-water samples collected from: WS130; TP758G; TP761G; TP762; and, ERMSB15. Pertinent data are summarised in full below and can be found in detail in the Plot G Report[24].

[22] Phase II Investigations and Environmental Assessments at the Former Albright & Wilson Works, Whitehaven (REF: 44319623, 23 June 2005)

[23] Huntsman Surface Sciences IPPC Application, submitted to the Environment Agency between 1st June and 31st August 2003.

[24] Remediation Statement Appendix I. Plot G Soil and Groundwater Investigation, Former Albright and Wilson Works, Whitehaven, Cumbria (REF: 44320215 / MARP0002_Plot G, dated 17th May 2007).

WS130:

- A pore water sample (based on a shallow well screen shallow within the made ground top 1m) returned concentrations of TPH (C21-C35) at 933µg/l and TPH DRO at 5366 µg/l.
- No soil samples were scheduled for TPH analysis.
- A soil sample from 0.5-0.8m was submitted for PAH analysis and naphthalene was not detected above the laboratory MDL: It is therefore considered that the soils in this location are probably not very contaminated.

SB15:

- A pore water sample returned concentrations of total TPH at 61500µg/l; no PAH analysis was scheduled.
- A soil sample from 0.4-0.5m retuned concentrations of TPH (C12-16) at 50mg/kg; TPH (C16-21) at 136mg/kg; and TPH (C21-35) at 168mg/kg; no PAH scheduled.

TP761G:

- No contamination was observed, and laboratory chemical analysis did not return results considered to be above typical values for most of the Rhodia site.

TP762G:

- No TPH was scheduled from samples collected at this investigation location.

Due to the presence of plant buildings in this area at the time of the Plot G investigation it has not been possible to collect sufficient data to determine whether there is a significant source present. Further work is required to clarify this. The buildings and plant have now been removed.

2.4.8. Phosphate – Site Wide

Phosphate was not assessed within each of the identified plots as it was considered that it was more appropriate to assess the risks relating to phosphate from the site as a whole. This is because phosphate ores, products and wastes have been widely used, processed and handled on the site, and the detection of phosphate in soils is ubiquitous. Therefore, the distribution of phosphate across the entire site has been considered.

A detailed assessment has been undertaken, and this is presented as Appendix J.

The assessment was based on all the laboratory data collected during previous investigations and from data collected from monitoring of groundwater within the deep aquifers and the Byerstead Spring using a combination of a mass balance approach and dispersion modelling.

Tom Hurd Rock (located just off shore) was chosen as the compliance point for phosphate for the assessment because it has been agreed with the Environment Agency for a previous assessment for Rhodia's application for a discharge consent. The location is regularly monitored by the Environment Agency for water quality, although not for phosphate.

The assessment predicted that phosphate derived from site soils would not cause a significant impact on water quality at Ton Hurd rock. Phosphate is therefore not considered to be a significant source, and therefore there is considered to be no significant pollutant linkage from phosphate.

3. REMEDIATION REQUIREMENTS AND PERIODS

3.1. Introduction

The second stage in the process of management of contaminated land where the risk assessment has demonstrated significant and unacceptable risks is an Options Appraisal. The role of the Options Appraisal is to establish which options offer the best overall approach to remediation for the site as a whole, and comprises three main stages:

1 Identifying feasible remediation options.

2 Carrying out a detailed evaluation of feasible remediation options to identify the most appropriate option for any particular pollutant linkage (source-pathway-receptor).

3 Producing a remediation strategy (this document) that addresses all pollutant linkages by combining remediation options.

An important task within the development of the remediation strategy is to define the boundary within which remediation options are considered so that potential conflicts can be addressed. This is normally achieved by specifying a series of objectives that the proposed remediation must achieve. Current UK Guidance[25] advises the following are considered:

- *The degree to which risks need to be reduced or controlled;*
- *The time within which the remediation strategy is required to take effect;*
- *The practicality of implementing and maintaining the strategy*
- *Technical effectiveness of the proposed remediation in controlling risks*
- *The durability of the remediation once undertaken;*
- *The sustainability of meeting the remediation strategy goals, with respect to the use of energy and other material resources, and avoidance of adverse impacts to offsite locations such as landfills, air or water;*
- *The cost of implementing and achieving the goals set out in the remediation strategy;*
- *The benefits of undertaking the remediation. Direct benefits should be delivered.*
- *The legal, financial and commercial context within which the site is being handled.*

3.2. Options Appraisal

At this stage the remediation actions proposed are very simple, and options appraisal has also been very simple. The alternatives considered, and reasoning behind the options

[25] Model Procedures for the Management of Land Contamination: Contaminated Land Report 11. Environment Agency. 2004

selected are discussed below in Section 3.3. Some further general discussion of the likely applicability of various techniques to the areas still being assessed is given in Section 3.4.

3.3. Remediation Actions

3.3.1. Scope and Extent of Works

Remediation and assessment actions resulting from the options appraisal are presented in the sections below. In some cases further assessment is required in order to more completely define the source.

3.3.1.1. Plot A

The source identified in Plot A was considered not significant. Therefore no remediation actions are proposed.

3.3.1.2. Plot B

No significant sources were identified during the investigation and assessment process, therefore no remediation actions are proposed.

3.3.1.3. Plot C

The identified “significant source” is a volume of soils estimated to be approximately 5m by 5m in area by 1m in depth, which contain concentrations of arsenic, which may represent a significant risk to human health. This risk is based on approximately 3-4 times the concentration of arsenic in soils which would be a risk in the circumstance that a girl under the age of six chooses to come and play on precisely this area for 119 days a year. The model is therefore considered to be very cautious, and the probability of harm is likely to be very low. However, attenuation of the exposure pathway (to prevent ingestion, dermal contact, or inhalation of dusts) is readily achievable and is the proposed remediation action to address this source.

It is proposed that the source area is covered with a geotextile fabric, to act as a marker, and covered with a blinding layer of soils 200-300mm in thickness. These soils will be gained from earthworks undertaken elsewhere on site, where laboratory chemical analysis has been undertaken on representative samples and they have been identified as suitable for this purpose. It should be noted that this is not required for the receptors referred to in the Council’s Part 2A determination because this pollutant linkage relates to human health. It is included here for completeness.

3.3.1.4. Plot C – Sub Z

Following the removal of the transformers and excavation of visually contaminated materials from the Sub-Z bund, further investigation is required to check whether there is any remaining source of contamination in the soils below the bund.

This check will be carried out by excavating 7 trial pits in and around the bund, with soil samples taken every 0.25m depth for screening using a photo-ionisation detector ("PID" detects volatile substances typical of hydrocarbon contamination). 10 samples will be selected for analysis on the basis of the PID readings and visual observations. Samples will be analysed for total petroleum hydrocarbons (TPHCWG method) and 5 samples will be analysed for Polychlorinated Biphenyls (PCBs). The results will be assessed by URS, and further actions undertaken if necessary. Reports will be provided to the Environment Agency.

3.3.1.5. Plot C – North Pond

The North Pond was constructed in summer 2007. It was agreed with the Environment Agency that the pond could be unlined, provided that water quality monitoring was undertaken to check that the possible significant pollutant linkage (see Appendix E for details) was not actually present. Rhodia's reason for preferring not to line the pond is technical as well as financial: the pond is designed to be an ecological feature as well as flood prevention mechanism. It is designed as a largely dry basin, damp at the base and planted with grasses and reeds. An impermeable liner will prevent natural drainage and make the establishment and maintenance of reeds difficult. If the water quality in North Pond proves unacceptable, lining the pond will have to be considered.

The monitoring proposed is for a period of 1 year after North Pond is connected through to South Pond and Sandwith Beck:

- Sandwith Beck (at the bridge in Sandwith Village) quarterly sampling for TPH (CWG method), naphthalene, surfactant, Cu, Se, V
- North Pond: at least 6 samples at minimum interval of 1 week for pH, electrical conductivity, TPH (CWG method), naphthalene, surfactant, Cu, Se, V. The average of each determinand over 6 samples shall not exceed the discharge consent criterion, or the EQS if the discharge consent does not specify a limit

North Pond sampling frequency cannot be specified, because it only has water in it shortly after rainfall.

Note that Sandwith Beck is also monitored quarterly for a very wide range of potential contaminants under the Waste Management Licence requirements for the Ufex Landfill.

The base of the North Pond became eroded during January 2008. The problem will be assessed, and a solution agreed with the Environment Agency.

3.3.1.6. Plot C Stockpiles

Rhodia wishes to make use of the stockpiles of materials currently stored on Plot C. These have arisen primarily as a result of excavating North Pond. Testing undertaken before excavation indicated that there were no risks to controlled waters or human health within Plot C.

When a proposal for reuse of the stockpiles is available it is proposed that the following be submitted to the Environment Agency for approval:

- Method statement describing the reuse proposal
- Plan showing where the material will be reused
- Comparison of chemical quality of the stockpile material with the relevant site specific criteria for the location where the material will be reused

3.3.1.7. Plot D

Three hotspots have been identified with significant risks modelled in the assessment process. Further assessment actions and potential remediation actions resulting from this are discussed for each hotspot individually in the sections below.

Hotspot 1 Fluoranthene

Hotspot 1 is defined around TP706D. Further investigation is proposed to check for the presence of PAH in excess of that already detected, because site observations showed that there could be more contaminant present than measured in the samples analysed to date.

The risk assessment will be revised to include the new data. If remediation is required, the applicable options will be disposal off-site to licensed landfill or soil stabilisation/solidification.

Hotspot 2 Chloroform

Hotspot 2 was generated by one exceedence of chloroform with a predicted concentration at the receptor 16.4µg/l compared to the EQS of 12µg/l. Further investigation is required to check the size of the chloroform hotspot.

Hotspot 3 Naphthalene/Zinc/Nickel

The source at hotspot 3 is considered to relate to contamination within several pockets of pore water around WS123, WS416 and WS717D. It is proposed that further investigation including the collection of samples from additional trial pits and monitoring wells is undertaken and that the new data acquired is used to update the risk assessment and to further characterise the nature of the source. Contaminated water has not been identified in the boreholes installed here since 2001, and the additional assessment is required to assess whether the risk remains.

It is considered doubtful that it would be possible to remove contaminated water by pumping from boreholes, due to the clayey nature of the soils and consequent low permeability. It may be possible to remove pore water using a deep trench and sump collection system but until the additional assessment is undertaken it is not possible to identify what depth these should be constructed due to inconsistencies in water levels.

It is intended to postpone providing details of the intended remediation actions until after the additional assessment has been completed and provide details as an amendment to this document at a future date[26]

3.3.1.8. Plot E

No source significant sources were identified during the investigation and assessment process, therefore no remediation actions are proposed.

3.3.1.9. Plot F

Based on the investigation and assessment undertaken in Plot F no significant risks were identified. However based on field observations of the potential presence of free phase oil, two potential source areas have been identified which requre additional assessment. These are:

- *Area 1- the area in the vicinity of TP752F; and*
- *Area 2- the area in the vicinity of TP756F.*

It is proposed that one monitoring borehole is installed in each of the areas to confirm the presence or absence of mobile free phase oil product.

It is considered that remediation is not required unless free product is observed in the wells, in which case the following actions will be proposed:

- *A report will be prepared based on this assessment action. This will include the outcomes and results of the proposed assessment action as well as the methodologies to be employed in remediation, target values and timescale.*
- *Construction of either a trench network or installation of extraction wells in each area, depending on the amount of free phase oil product encountered.*
- *Periodic extractions of the oil by pumping.*
- *Offsite disposal to suitably licensed disposal facilities.*

It is proposed the end point is when removal of product becomes impractical due to the reduction in volume and therefore impracticalities in separation and removal.

[26] Amendments will be provided in line with the planned timeframe set out in *Section 3.3.3* of this document.

3.3.1.10. Plot G

The area identified as a potential source of TPH contaminated pore water, located adjacent to and underneath the Ethoxylation plant requires additional assessment. This is in order to establish whether the TPH contamination in pore waters represents a significant risk to controlled waters receptors. A combination of shallow monitoring wells and trial pits will be used to collect additional data now that the Ethoxylation Plant has been demolished, and these data will be used to update the risk assessment model.

It is intended to postpone providing details of the intended remediation actions until after the additional assessment has been completed and provide details as an amendment to this document at a future date[27]. If revision of the risk assessment model identifies a significant source of contamination a remediation action will need to be agreed with the inclusion of methodology, target thresholds, and timescale.

3.3.1.11. Phosphate – Site Wide

No source significant sources were identified during the investigation and assessment process, therefore no remediation actions are proposed.

3.3.1.12. Sea Entry Points (Byerstead Spring and Others)

Water emanating on Saltom Beach at the Byerstead Spring has historically been influenced by contamination derived from operations on the Rhodia Whitehaven Site. The most prevalent of these are concentrations of surfactants, which have caused the spring water and the seawater immediately surrounding the spring to foam. However, “foaming events” are now far less common than when the site was operational, and measured concentrations of surfactants continue to decline[28]. It is very likely that there are a number of similar springs emerging along the coast, and below the water line.

Conceptually it is worth considering interception and treatment of these waters before they reach the Irish Sea to remove or reduce the concentrations of contaminants, which may be derived from the site’s shallow soils and pore water. However the springs are located either in the inter-tidal zone (*e.g.* the Byerstead Spring), and only exposed for approximately two hours at low water, or may emerge below the low water mark.

Treatment of the water emanating at the Byerstead and other springs is considered impractical, as there are no remedial technologies that could be installed on the beach within the inter-tidal zone and be used to effectively separate and treat the spring waters. In addition land or sea access to the location with machinery and materials is considered hazardous due to the cliffs above and the boulder fields on the shoreline. Furthermore, if a remedial technology could be installed, it is unlikely that it would remain in place as the spring is submerged for approximately 20hours of each day, and subject to substantial wave energy, especially during storms and high winds, which the Cumbrian coast is regularly subjected to.

[27] Amendments will be provided in line with the planned timeframe set out in *Sections 3.3.3 and 3.3.5* of this document.

[28] Rhodia, Whitehaven, Cumbria, UK. Groundwater Monitoring, Rounds 1-12 February 2004 to January 2007 (REF: 44319904/MARP0001, dated 30 March 2007)

It is not possible to intercept the waters before they emerge at the spring (e.g. by means of pumping boreholes or permeable reactive barrier). This is because the pathway is comprised of a void and fault system, which extends to several hundred metres depth and over many kilometres. There is no available technique to intercept water in deep fractured or karst systems over this kind of area.

3.3.1.13. CHP Plant

Following removal of the CHP Plant from site, an oil sheen was observed on the ground surface. This area will be assessed as a potential source.

3.3.2. Area covered by the assessment actions

Figure 3 shows the areas to which the assessment actions refer. These comprise validation of Sub-Z oil removal, validation of North Pond oily soils removals, assessment of Hotspots 1, 2, and 3 in Plot D, investigation for the presence of free phase oil in Plot F, and additional assessment under the former Ethoxylation Plant in Plot G.

3.3.3. Time period for the assessment actions

Assessment actions, described above apply to:

Plot C Sub Z

Plot C North Pond and Sandwith Beck monitoring

Plot C North Pond erosion issue

Plot C Stockpiles

Plot D

Plot F

Plot G

CHP Plant area

The above Assessment Actions shall be complete by 30th June 2008.

3.3.4. Area covered by proposed remediation actions

There are no remediation actions proposed at this stage.

3.3.5. Time period for the remediation actions

No remediation actions are proposed at this stage. If remediation actions are identified by the additional assessment actions, these will be completed by 31st December 2012.

3.4. Treatment of Contamination Sources

3.4.1. Standard of remediation

Where the identified source areas need remediation by clean up of the soil or groundwater it is necessary to define the acceptable concentration of contaminants, which may be left in the soil after remediation has been completed and the soil is returned to backfill the excavation. Remediation standards have been calculated by back calculating using the mass balance risk model from EQS standards at the Irish Sea (determined to be the point of compliance). These standards will be reviewed following completion of the additional assessment actions and should there be changes, based on the nature and extent of the source areas these will be proposed as amendments to this remediation statement.

Remedial standards in the case of risks to controlled waters are complicated because a different standard applies to different hotspots. This is because the risk is controlled by the pathway (e.g. how far to the receptor, geology) as well as by the concentration of contaminant and the size of the hotspot. It is therefore not considered helpful to list the standards here because the list is very long, but the information is contained in the Controlled Water Risk Assessment section of each Appendix[29] detailing site investigation information.

It is proposed that remediation standards for specific areas requiring remediation are provided as an amendment to this document once the remaining assessment has been done and the nature of the remediation to be undertaken is defined.

Risk management approach

In the event that circumstances not covered by this remediation statement are encountered, an action plan will be generated and agreed with the Environment Agency. This could include, for example, undertaking additional site investigation, or implementing alternative remedial methods.

Remedial technology

Soil remediation if required is likely to be undertaken ex-situ (i.e. requiring excavation of contaminated soils). Technologies currently under consideration are:

- Bioremediation
- Limited removal to landfill disposal off-site
- Soil Stabilisation

All three methods are also likely to involve an element of crushing and screening on site to enable the re-use of suitable materials to backfill excavated areas.

[29] Appendix G to each Plot Investigation Report

Areas where contamination remediation is not required will not be excavated. After demolition to ground level, the site will remain as it is. Some further groundworks may be necessary to promote good drainage, or to make the site safe for public access, however these are not part of this remediation statement.

Time periods

The remediation will take place after the assessment actions have taken place and the amended remediation actions have been agreed with the Environment Agency. The time period for remediation is specified in Section 3.3.5.

3.4.2. Groundwater treatment

Standard of remediation

Determination of groundwater standards is similar to that of soil standards, described above. The same approach will be followed.

Risk management approach

In the event that circumstances not covered by this remediation statement are encountered, an action plan will be generated and agreed with the Environment Agency. This could include, for example, undertaking additional site investigation, or implementing alternative remedial methods.

Remedial technology

At this stage it is not clear whether or not groundwater treatment is required. If remediation is necessary, a remedial action plan for groundwater will be agreed with the Environment Agency. Current expectations are that remediation will consist of:

- *Excavation of soils containing contaminated pore waters, and treatment or disposal as described above*
- *Limited pump and treat to remove free product or grossly impacted shallow groundwaters.*
- *Monitored natural attenuation*

It is clear at this stage that treatment of deep groundwater is not proposed under Part 2A. Any groundwater treated as part of the Part 2A remediation strategy will be the shallow groundwater or “pore water” contained within the made ground and drift deposits.

Time periods

Groundwater treatment, if required, will commence after the amended remediation actions have been agreed with the Environment Agency. The time period for remediation is specified in Section 3.3.5. . Monitoring will then be required, subject to review and agreement with the Environment Agency for a period of 2 years following completion. After this the strategy will be reviewed on an annual basis, and the frequency of the monitoring will be reduced when key contaminant levels show consistent, non-seasonal, decreases in concentration.

3.5. Monitoring Action

At this stage no monitoring action is proposed.

4. PARTICULARS OF SIGNIFICANT HARM AND POLLUTION OF CONTROLLED WATERS AND PARTICULARS OF SUBSTANCES

4.1. Pollutant Sources

Details of the pollutants identified as "Contaminants of Concern" within each Plot on the site (to which this remediation statement refers) during the investigations undertaken are provided within Section 5 of the Investigation and Assessment Reports (included as Appendices C to J of this document). A "Contaminant of Concern" is one which is present above levels which are considered to pose a potential risk, on the basis of quantitative risk assessment and site observations and monitoring. In their determination of the site as "contaminated land", Copeland Borough Council listed a number of other contaminants (not identified as Contaminants of Concern by the risk assessments), which they considered likely to be present on the site as a result of its previous history. These contaminants have been included in the assessments undertaken to ensure that the possibility of there being Contaminants of Concern is fully evaluated.

4.2. Pathways

Copeland Borough Council's determination of the land as contaminated land refers to only two pathways – the movement of contaminants from soil to groundwater, and the migration of contaminants to controlled waters through drains. URS has refined the understanding of the pathways, and details of the pathways identified for each Plot are provided within Section 5 of each of the Investigation and Assessment Reports (included as Appendices C to J of this document).

4.3. Receptors

The primary "controlled waters" receptors relevant to this remediation statement are the Irish Sea, and the Sandwith Beck.

In Plot B only, the deep groundwater in the Whitehaven Sandstone was considered to be the key receptor.

The critical receptor can vary because the pathway can vary. If there is no pathway to a receptor at a particular location, then it is not modelled in the risk assessment (for example all of Plot A drains to the Irish Sea and therefore Sandwith Beck is not a receptor for Plot A).

Full details of the receptors considered for each potential source are given in Appendices C to J of this document.

4.4. Significant Pollutant Linkages

For regulatory purposes it is necessary to explain how each of the pollutant linkages listed by Copeland Borough Council in their determination of the site as statutory Contaminated Land are dealt with. Table 1 below summarises the findings of the investigation and the actions applicable to each pollutant linkage. Full details of the assessment of pollutant linkages are provided for each of the investigation plots in Section 8 of the Investigation reports provided as Appendices C to J of this document.

Table 1 Summary of Remedial Actions Against Copeland Borough Council's Contaminated Land Notification

Copeland Borough Council Pollutant Linkage	Findings and Remediation Actions
Petroleum Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Potential Significant Linkages identified**
	Plot F: Potential presence of free phase product on groundwater. Further investigation required
	Plot G: Possible significant TPH source in soils and groundwater. Further investigation required.
Poly Aromatic Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Potential Significant Linkages identified**
	Plot D: Hotspot 1 fluoranthene and Hotspot 3 naphthalene require further investigation
	Plot G: Possible significant source of a number of PAHs in the vicinity of WS130. Further investigation required.
Surfactants in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no significant source).**
Phosphates in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no significant source).**
Arsenic in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Yes – Significant Linkage identified**
	Plot C Significant pathway identified from a hotspot to Human Health. Remediation proposed to break the pathway and prevent exposure.
Boron in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**

Copeland Borough Council Pollutant Linkage	Findings and Remediation Actions
Cadmium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**
Chromium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**
Copper in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (limited source, but no pathway)**
Lead in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**
Mercury in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**
Nickel in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Potential Significant Linkage identified** **Plot D:**- Hotspot 3. Further investigation required.
Selenium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**No significant pollutant linkage (no source).**
Zinc in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Potential Significant Linkage identified** **Plot D:** Hotspot 3. Further investigation required
VOCs/ SVOCs in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	**Potential Significant Linkage identified** **Plot D**: Hotspot 2 Chloroform. Further investigation required.

Note that where our comment states “no source” this means that the contaminant levels measured were not in exceedance of site-specific assessment criteria generated by the risk assessment. It does not mean that the contaminant is not present on site.

Figures

Appendix A Glossary

Conceptual model: a representation of the characteristics of the site diagrammatic or written form that shows the possible relationship between contaminants, pathways and receptors.

Contaminant: A substance that is in, on or under the land and that has the potential to cause harm or to cause pollution of controlled waters.

Contaminated land: Defined in s78A (2) of EPA 1990 as 'any land that appears to be the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that

(a) Significant harm is being caused or there is s significant possibility of such harm being caused, or;

(b) Pollution of controlled waters is being, or is likely to be caused'.

Controlled waters: defined by Water Resources Act 1991, Part 111, section 104, which includes all groundwater, inland waters, estuaries and coastal water to three nautical miles from the shore.

Detailed quantitative risk-assessment: Risk assessment carried out using detailed site-specific information to estimate risk or to develop site-specific assessment criteria.

Detailed site investigation: Main stage of intrusive site investigation, which involves the collection and analysis of soil, surface water, groundwater, soil gas and other media as a means of further informing the conceptual model and the risk assessment. This investigation may be undertaken in a single or a number of successive stages.

Durability: The extent to which a remediation treatment is likely to be effective in reducing or controlling unacceptable risks to a defined level over a period of time.

Effectiveness: The extent to which a remediation treatment successfully reduces or controls unacceptable risks to a defined level.

Environmental impact: The effect of remediation treatments on the quality of the environment during or following remediation.

Evaluation criteria: (risk assessment) Parameters used to judge whether or not particular harm or pollution is unacceptable.

Ex-situ: Where contaminated material is removed from the ground prior to above ground treatment or encapsulation and/or disposal on or off site.

Hazard: A property or situation that in particular circumstances could lead to harm or pollution.

In-situ: Where contaminated material is treated without prior excavation (of solids) or abstraction (of liquids) from the ground.

Land affected by contamination: Land that might have contamination present, which may, or may not, meet the statuary definition of contaminated land.

Monitoring: A continuous or regular periodic check to determine the ongoing nature and performance of remediation, which includes measurements undertaken for compliance purposes and those undertaken to assess performance.

Monitoring criteria: Measures (usually, but not necessary, expressed in quantitative terms) against which compliance with monitoring objectives will be assessed.

Monitoring objectives: Site-specific objectives that define the monitoring programme needed to demonstrate the short-and long-term performance of remediation or to track contaminant behaviour and movement.

Pathway: A route or means by which a receptor could be, or is exposed to, or affected by a contaminant.

Pollutant linkage: The relationship between a contaminant, pathway and receptor.

Practicability: The extent to which it is possible to implement and operate a remediation option or strategy given practical constraints, such as treatment area, access, and availability of support services.

Quality criteria: Measures of the sufficiency, relevance, reliability and transparency of the information and data used for risk management purposes.

Quality management: The systematic planning, organisation, control and documentation of projects.

Receptor: In the general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property or a water body.

Remediation: Action taken to prevent or minimise, or remedy or mitigate the effects of any identified unacceptable risks.

Remediation objective: A site-specific objective that relates solely to the reduction or control of the risks associated with one or ‘more pollutant linkages.

Remediation criteria: Measures (usually, but not necessarily, expressed in quantitative terms) against which compliance with remediation objectives will be assessed.

Remediation option: A means of reducing or controlling the risks associated with a particular pollutant linkage to a defined level.

Remediation strategy: A plan that involves one or more remediation options to reduce or control the risks from all the relevant pollutant linkages associated with the site.

Risk: A combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

Risk assessment: The formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard.

Risk estimation: Predicting the magnitude and probability of the possible consequences that may arise as a result of a hazard.

Risk evaluation: Deciding whether a risk is unacceptable.

Risk management: The processes involved in identifying, assessing and determining risks, and the implementation of actions to mitigate the consequences or probabilities of occurrence.

Site-specific assessment criteria: Values for concentrations of containments, pathways and receptors and that correspond to relevant criteria in relation to harm or pollution for deciding whether there is an unacceptable risk.

Stakeholders: Individuals or organisations with an interest in the scope, conduct and outcome of a risk management project.

Uncertainty: A lack of knowledge about specific factors in a risk or explosive assessment including parameter uncertainty, model uncertainty and scenario uncertainty.

Verification: The process of demonstrating that the risk has been reduced to meet remediation criteria and objectives based in a quantitative assessment of remediation performance.

Verification report: Provides a complete record of all remediation activities on site and the data collected as identified in the verification plan to support compliance with agreed remediation objectives and criteria.

Appendix B - Phase II Investigation and Environmental Assessments, Final Report 44319623, 23 June 2005

Appendix C - Plot A Soil and Groundwater Investigation 44320221 / MARP0004, 17th January 2007

Appendix C2 - Plot A Assessment Actions 44320215/ MARP0002_C2, 17th May 2007

Appendix D - Plot B Soil and Groundwater Investigation, 44320221 / MARP0004, 18th January 2007

Appendix E - Plot C Soil and Groundwater Investigation. 44319943/MARP0001, 16th October 2006

Appendix E2 - Plot C Assessment Actions 44320215 / MARP0002_E2, 17th May 2007

Appendix F - Plot D Soil and Groundwater Investigation 44320215 / MARP0002_Plot D, 17th May 2007

Appendix G - Plot E Soil and Groundwater Investigation 44320215 / MARP0002, 17th May 2007

Appendix H - Plot F Soil and Groundwater Investigation 44320215 / MARP0002_Plot F, 17th May 2007

Appendix I - Plot G Soil and Groundwater Investigation 44320215 / MARP0002_Plot G, 17th May 2007

Appendix J - Phosphate Contributions from the Rhodia Site to the Irish Sea 44320110/MARP0004, 23 August 2007