Ref: 16-685-L3-1
Date: 9th July 2026

Neil Campbell
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RESPONSE TO CONTAMINATED LAND OFFICER HYDRO ALUMINIUM DEESIDE LTD

1. BACKGROUND

E3P were instructed by Pace Architecture on behalf of their clients, to undertake a Geoenvironmental Site Assessment for the redevelopment of a parcel of land known as Hydro Aluminium Deeside Ltd, off Bridge Road, Wrexham, LL13 9PS. The Client for the Phase I and II Geoenvironmental Site Assessments was Portal Construction with the Remediation Strategy prepared directly for Hydro Aluminium Ltd.

Hydro Aluminium Ltd intends to construct a proposed recycling materials sorting facility and covered storage bays with associated service infrastructure and external hardstanding.

A Memorandum (Ref: P/2026/0126) from Angela Roberts, Contaminated Land Officer at Wrexham Borough Council was issued in April 2026., relating to the report referenced below:

- E3P – Hydro Aluminium – Remediation Strategy (Ref: 16-685-L2-1, dated February 2026).

This letter has been written by E3P to highlight the updated sections of the report as per the comments made by Wrexham Borough Council.

2. COMMENTS FOR PLANNING SERVICES

The strategy refers to a residential development at the top of the second page; I will assume this is a typing mistake and the proposals in the strategy are for the industrial development proposed under planning permission P/2024/1554.

Page 2 of the report has been amended to reflect the proposed development plan.

On p4 it is stated under the Human Health Risk Assessment, that PCBs were encountered during the previous Gemini investigation. It is also mentioned on p7 that an elevated concentration of lead was also reported. It is stated that an exploratory hole location plan from the Genesis Environmental Ltd investigation was not provided to e3p, however this is required for me to be able to properly review the report. When I have reviewed a copy of the Genesis report, I may wish to provide further comments on this.

The Genesis report has been attached to this letter for review. This represents the fullest version of the report that E3P has been provided with and reviewed, and the client has confirmed that a complete version is not available. The report is incomplete, with several appendices missing, including the exploratory hole location plan, exploratory hole logs, and the raw chemical analysis data.

In the absence of a complete report, E3P has referred to the findings on an anecdotal basis only and cannot place reliance on the reported data. Consequently, the Remediation Strategy has been developed primarily using the findings of the E3P investigation. However, pre-emptive remediation measures have been incorporated to break potential contaminant pathways in areas of soft landscaping, should the previously reported PCB and lead contamination be present within those areas.

RE-4 – Surface Water Monitoring – it is stated: "The nearest surface watercourse is a drainage channel located 15 m NW of the site and there is also a drain present in the far north east of the site. Surface water samples should be obtained to ensure no detrimental effect during the enabling works. It is proposed to complete monitoring prior to the main earthworks commencing, during the works and at the end of the works." It appears to be a recommendation; will this work happen?

The above surface water monitoring will be undertaken throughout the remediation and enabling works. Sampling will commence prior to the commencement of site works to establish a baseline.

RE-5 – Preparation of Landscaped Areas for Cover System – it is stated: "Where Made Ground is deemed unsuitable for retention in a landscaped area, the area will be subject to a reduced-level dig to remove unsuitable material to a minimum depth of 300 mm below finished landscaped area level or verified natural stratum (whichever is the shallower). Excavated soil will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to reuse in an area of no sensitivity or, where necessary, this material will be removed from site in accordance with UK waste management legislation. The placement of certified subsoil and topsoil will be completed as part of the developer works/build phase mitigation plan. All landscaped areas where a cover system is required will be subject to independent validation." What will be deemed unsuitable? Based on item 2 above it appears there is limited contamination present (just isolated areas of lead and PCBs, but yet to be confirmed until a copy of the Genesis report is provided). The Environment Partnership (TEP) Landscape Masterplan (Drawing D9871.100, dated 03/10/2023) indicates the existing trees and vegetation will be retained where possible, this is the same as the PACE Architecture Proposed Site Plan (Drawing 2027.P.003 (F)). This implies no works are taking place in this area and I assume this will mean there is no remediation works in this location either? The TEP Landscape Masterplan indicates areas of woodland edge planting and wildflower amenity grassland – are these the areas which will be subject to any remedial works where required?

It is understood that the earth bunds immediately to the northeast of the mature trees along the southwestern boundary is to be removed and disposed of offsite as part of enabling works. The footprint of the former bund will then be excavated to a depth of 300 mm below FFL to incorporate 300 mm of clean cover/growing medium to facilitate the woodland edge planting and wildflower amenity grassland planting as per the TEP Landscape Masterplan and the Detailed Planting Plan (drawing refs: D9871.100 and D9871.101, respectively).

RE-8 – Independent Validation: Watching Brief – I agree that this is required. Please clarify what is meant by: "it is recommended that a Stage 2 Detailed Risk Assessment is undertaken prior to the commencement of groundworks".

As the site history was part of Royal Ordnance Factory (ROF) Wrexham, it is recommended that a Stage 2 Detailed UXO Risk Assessment is undertaken prior to the commencement of groundworks and that a watching brief is carried out by a specialist UXO specialist for the duration of any earthworks required at the site.

RE-9 – Waste Soils Surplus to Requirements – as mentioned under RE-5 above, based on the Landscape Masterplan and Proposed Site Plan it appears that no works will take place on the bund, however it is stated here that it is understood the bund materials will be removed as part of the enabling works prior to construction of the proposed development. Based on the comments here and in item 4. above, it will be necessary to clarify what landscaping works and changes (if any) to the bund are taking place and the locations of any areas of concern (the elevated lead and PCBs) and ensure that the Remediation Strategy accurately reflects the works that area required in those areas and in relation to the landscaping works.

As stated above, as confirmed with the client, the bund to the southwest of the site is to be removed prior to construction works commencing. The installation of 300 mm growing medium will also serve as a clean cover system to break potential pollutant pathways should elevated lead or PCBs be present in this location.

RE-10 – Validation of Materials for Potable Water Supply Infrastructure. I agree that a UKWIR Risk Assessment needs to be undertaken and if required specialist pipework used for the water supply. The assessment and any resulting actions should be detailed in the Verification Report.

No action required.

RE-11 – Remedial Verification Report. Please explain the reference to the PAH impacted materials.

This has been removed from the Remediation Strategy as PAH impacted materials have not been identified at the site.

Table 2.1 – the testing proposals should be in accordance with the Welsh Land Contamination Working Group guidance 'Requirements for the Chemical Testing of Imported Materials for Various End Uses and Validation of Cover Systems' (provided).

Table 2.1 within the Remediation Strategy has been updated to reflect the above.

Paragraph 4.1 refers to record keeping and details of locations of hydrocarbon impacted soils, records associated with works on other types of impacted soils should also be kept.

Paragraph 4.1 has been amended to reflect the lead-impacted materials on site.

I trust the information provided in this letter report is satisfactory, however, if there is anything further, please do not hesitate to contact me.

Yours sincerely,
For and on behalf of E3P Ltd

Written by:
Elizabeth Fearn
Senior Geoenvironmental Consultant
BSc (Hons), MSc, FGS

Reviewed by:
Rebecca Hodnett
Associate Director

Enclosed:

- **Genesis Environmental Ltd** – Site Report of Hydro Aluminium Deeside, Wrexham. Report Ref: ADE/178/SR, dated August 2021, Prepared for Hydro Aluminium Ltd.

GENESIS ENVIRONMENTAL LIMITED

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SITE REPORT OF HYDRO ALUMINIUM DEESIDE, WREXHAM

AUGUST 2001

Date : 27th August 2001

Our Ref. : ADE/178/SR

Prepared for :

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Appendix 10	Safety Notice 01.10 Safe Storage of Oil Drums and Other Chemicals
Appendix 11	Safety Notice 01.11 Safe Storage of Bulk Oils
Appendix 14	Drainage Drawing
Appendix 15	HES Notice 01-07 Procedures for Collection and Disposal of Waste Oils
Appendix 16	Location of European Sites
Appendix 17	Plant Layout Drawing Existing plant in Centre 1 & New plant in Centre 2
Appendix 18	New plant in Centre 2
Appendix 19	Ordnance Survey map - scale 1 : 10000
Appendix 20	Location of the sewer
Appendix 21	Location of the water supply
Appendix 22	Location of the gas supply
Appendix 23	Location of the electricity supply
Appendix 24	Pollution prosecution
Appendix 25	Ordnance Survey map dated 1938
Appendix 26	Ordnance Survey map dated 1961
Appendix 27	Ordnance Survey map dated 1983
Appendix 28	Certificates of Incorporation for : Deeside Aluminium Limited (January 1984) and Hydro Aluminium Deeside Limited (November 2000)

SR1.0 Introduction

SR1.1 Background

This report has been prepared by David O'Malley of Genesis Environmental Limited, Hoylake, Wirral on behalf of Hydro Aluminium Deeside Limited. The report relates to the factory located on Bridge Road, Wrexham Industrial Estate. Hydro Aluminium Deeside is a converter of aluminium scrap. As part of the non-ferrous metals sector it will be regulated by the Environment Agency under the Pollution Prevention and Control Regulations 2000. The Regulations have a requirement for a Site Report to be produced for the installation that proposes a baseline condition for the land quality of the site. This report was produced to fulfil the requirements of IPPC and to provide supporting information for the application for an IPPC Permit.

SR1.2 Objectives

The main objectives of the site report under IPPC are :

- To form the reference point against which later determinations for the site can be compared and will form a baseline for the eventual surrender of the Permit.
- To provide information on the physical attributes of the site and its vulnerability.
- To provide evidence of prior investigation for the purposes of complying with the Groundwater Directive.

In particular, this part of the assessment will aim to achieve the following specific objectives :

- To review the historical and current uses of the site to identify the potential for areas of contamination to exist.
- To review information with respect to the environmental setting of the site in order to aid the understanding of the nature, extent and behaviour of any contamination which may be present.
- To allow sufficient information to allow the initial development of a conceptual model for the site and its environs. The conceptual model is a term used to describe the inter-relationship between all environmental media that may exist at the site.

This report relates to the area of the installation and the area surrounding the installation which may affect or be affected by the area of the installation.

SR1.3 Scope and Approach

This report has been prepared by review of current and historical data for the site. An intrusive investigation was undertaken (by Environmental Resources Management) as part of a Due Diligence investigation prior to the purchase of Deeside Aluminium Limited (as the Company was known previously) by Hydro last year. The data from that intrusive investigation has been incorporated into this report.

The following sources of information have been consulted during the compilation of this report :

- Report by Environmental Resources Management (Ref. 3125, dated 20th February 1995) entitled "Environmental Audit of Deeside Aluminium, North Wales"
- Report by ICC Site Search (Ref. CL3421-KM, dated 13th March 1995) entitled "Search for Contaminative Uses at Deeside Aluminium Limited, Bridge Road, Wrexham Industrial Estate, Wrexham"
- Report by Royal Ordnance, Environmental Services Group (Ref. ENQ5001/2087/95/A dated 14th March 1995)
- Report by Dames & Moore (Ref. 30536.001.402 dated 15th March 1995) entitled "Phase I Environmental Assessment of Deeside Aluminium Limited, Wrexham, North Wales"
- Report by AEA Technology (Ref. AEA/RABA/25017001/R/9 dated 20th June 1996) entitled "Environmental Risk Assessment for IPC Processes undertaken at Deeside Aluminium Ltd, Wrexham"
- Report by Environmental Resources Management (Ref. 6802, dated 12th May 2000) entitled "Phase II Due Diligence Investigation: Deeside Aluminium, Wrexham, UK"
- Other documentation retained in the files of Hydro Aluminium Deeside Limited
- 1:10000 Ordnance Survey map with the factory concerned at its centre - see Appendix 19

The report is divided into several sections as follows :

Section 2	Site Description - describing the current uses and the site's setting.
Section 3	Site History - describing the history of the site and its historical uses.
Section 4	Intrusive Site Investigation- describing the investigation conducted by Environmental Resources Management on behalf of Hydro in 2000.
Section 5	Discussion of Results including development of a Conceptual Model
Appendices	Reference is made in this report to various maps and other documentation. These are reproduced as Appendices to the application for an IPPC Permit.

SR2.0 Site Description

SR2.1 Site Location

Hydro Aluminium Deeside Limited, hereafter referred to as the site, occupies an area of land to the north-western side of Bridge Road towards one edge of the large Wrexham Industrial Estate, and around 4 km to the East of Wrexham town centre. Based on the 1:10000 Ordnance Survey map reproduced in Appendix 19, the site is located at National Grid Reference SJ 3765 4922. The site boundary of the installation for which the application is being made is shown in red in Appendix 19.

SR2.2 Current Ownership

Hydro Aluminium Deeside Limited is a wholly owned subsidiary of Norsk Hydro, a multinational Company based in Norway. Hydro bought the Company previously known as Deeside Aluminium Limited during 2000, and it was they who commissioned the Due Diligence report from Environmental Resources Management prior to the purchase.

SR2.3 Current Site Usage

Hydro Aluminium Deeside Limited convert aluminium scrap into billet. Various grades of scrap are bought in from a number of suppliers and are first inspected and sorted manually. A charge is then made up and loaded into a melting furnace. After checking and, if necessary, adjusting the alloy composition to meet the customer's specification, the metal is cast into a cylindrical log which is sawn into billets. The operational processes of the factory can be split into a number of sequential parts as follows :

- Raw materials handling
- Scrap sorting
- Melting and Holding furnaces
- Casting
- Product Treatment - the 2 homogenising furnaces and the 2 saws

Further specific details of the process can be found in Section B2.3 of the application.

The localities of each of the above-mentioned processes in the factory are shown in the Plant Layout drawing in Appendix 17.

Associated with the process areas of the site are a number of ancillary facilities, in particular :

- The Balancing Pond (towards the northern end of the site)
- The Maintenance Workshop (between the Balancing Pond and the main factory building)
- The oil storage area (towards the northern corner of the site)
- The 3 bag filter plants and the water cooling units for the caster and the induction furnaces on the south western side of the factory building (towards the Pentre Maelor estate)

A fairly large area of made ground is located between the factory building and an earth mound which runs along the boundary of the site with Clywedog Road East. The purpose of the earth mound is to screen the noise of the factory from the local residents.

Hydro Aluminium Deeside Limited currently have an IPC Authorisation (AS4117) issued by the Environment Agency.

SR2.4 Future Site Usage

Hydro are planning to put a substantial investment of new production plant into the factory in the coming twelve months or so. This will involve the installation of a new 28-tonne capacity melting furnace feeding a new 28-tonne holding / casting furnace, which will in turn feed the existing casting machine previously known as Caster 2. This part of the operation will be known in the future as Centre 2. These new furnaces will significantly improve the control of fugitive emissions from the process, and will also lower the specific energy consumption significantly.

Until this new plant is fully commissioned - planned for March 2002 - the existing reverbatory furnaces (Melter 3 and Melter 6) will continue to be used to melt scrap, and feed molten metal to the existing holding furnace (Holder 1). This holding furnace feeds the existing casting machine known as Caster 1. This part of the operation will be known in the future as Centre 1. Appendix 17 shows the layout of both the existing plant in Centre 1 and the new plant to be installed in Centre 2. Appendix 18 shows further details of the new plant in Centre 2.

Once Centre 2 has been commissioned, all production from the existing plant in Centre 1 will cease. Centre 1 will then be re-developed over a period of about 6 months.

Further investment is planned at a later date in Centre 2 involving the installation of another homogenising furnace and modified casting moulds, in order to increase the production capacity of the factory, plus automatic sawing and handling.

SR2.5 Surrounding Land Use

Along the north-western boundary of the site there is a stream known as Redwither Brook which meanders around part of the Wrexham Industrial Estate and eventually joins the River Clywedog at a point just over 1 km to the East of the site. The River Clywedog is itself a tributary of the River Dee. Beyond Redwither Brook (in the same direction) are light industrial units including mould manufacture, plastic laminating and coating, plastic extrusion and injection moulding.

To the north / north-east of the site are several light industrial units. The ERM report (Ref. 6802) states :
"*Immediately bounding the site is a small asphalt operation. There are numerous drums stored on this property, which is slightly down-gradient from the subject site. Some minor leakage of bituminous material was noted from several of the drums.*"

To the south-west of the site (across the made ground and lorry park owned by the site) is Clywedog Road East. Across this road is a residential estate (Pentre Maelor Estate) comprising approximately 100 dwellings.

To the south-east of the site (across Bridge Road) is a vacant plot of land formerly occupied by a factory of Firestone Tyre and Rubber. This factory was demolished a few years ago.

SR2.6 Raw Materials usage

All loose scrap materials are stored under cover within the factory building. Bundles of clean extruded scrap and primary ingot are stored outside. The various types of scrap are stored together in a number of loose piles in segregated bays of the factory. Manual sorting of the incoming scrap is undertaken in order to separate out different grades. Batches of the feed materials are assayed if the experienced operators are suspicious of their content. Metal composition is measured with a spectrograph; oil/grease is checked visually. All other materials used on site are purchased solely from approved suppliers, of which an up to date list is kept. Chemical health and safety data sheets are obtained from the manufacturers and kept on file. The chemicals used on site are kept within designated areas.

SR2.7 Topography and Underground Services

Other than the specially constructed earth mound along the south-western boundary, the site is fairly flat, being located in the flood plain of the River Clywedog.

A plan of the surface water drain and sewerage system is reproduced in Appendix 14. The only uses of water in the process are recirculating water systems for the casting operations and the induction furnaces, and the cooling of bearings on the homogeniser fans. Evaporative losses are topped up with fresh water. There are no discharges to sewer other than those from toilets and washing facilities.

Periodically the casting pits are emptied for maintenance. Water drained from the casting pits passes through an oil / water separator before entering a balancing pond at the rear of the premises. From here the water passes through a chamber fitted with an orifice plate which regulates the flow into the Redwither Brook. This discharge is identified as Release Point W1 in Authorisation AS4117.

In addition, there is an old land drain which also discharges into Redwither Brook - this is identified as Release Point W2 in Authorisation AS4117. There are no connections into this drain from Hydro Aluminium Deeside Limited, but it is known to be located under the land on which the factory now stands. From historical drawings of the site, the drain appears to be one from former buildings which used to stand on the site. The Company had a survey of this old land drain undertaken, as far as this was practicable within the constraints of not having to excavate through the concrete floor of the factory. This survey did identify two previously unknown collection pits to which the drain is connected, with a side drain to one of these collection pits disappearing under the factory but showing evidence of oil. This pipe has now been separated and isolated from the old land drain by the installation of a new collection pit. This new collection pit is emptied on a regular basis whenever the oil separators are emptied. It was found that the drain had collapsed under No. 2 Saw, and so further investigation beyond that point could not be undertaken without major disruption to the normal operation of the business. Similarly the main drain had collapsed under the roadway to the side of the factory. These will be explored further at an appropriate time.

Other underground services to or from the site are shown on the drawings in Appendices as follows :

Appendix	Underground service	Number of drawings	Source
Appendix 20	Sewer from the site (under Bridge Road)	1 drawing	Welsh Water
Appendix 21	Water supply to the site (under Bridge Road)	2 drawings	Dee Valley Water plc
Appendix 22	Gas supply to the site (to a sub-station at the rear of the factory)	1 drawing	Transco
Appendix 23	Electricity to the site (to a sub-station at the rear of the factory)	3 drawings (LV, HV and EHV)	Manweb

SR2.8 Geology and Hydrogeology

The site is located over Recent Glacial Till, consisting mainly of boulder clay which is typically present to depths of 9 metres. These glacial deposits are typically non homogeneous and often contain glacial sands and gravels as well as glacial silts. The sands, gravels and silts contain shallow groundwater. Geotechnical investigations carried out on the site in 1994 indicated shallow groundwater at about 1 metre below ground level. More substantial groundwater resources are found in the sand layers which are located approximately 17 metres below ground level.

These drift deposits are underlain by rocks of the Lower Mottled Sandstone sequence of the Triassic Series. This sequence lies unconformably upon strata of the Erbistock Beds of the Upper Coal Measures of the Carboniferous Series. The conjectural boundary of the two units is indicated on mapping at approximately 1 km to the west of the site. The sandstone represents a major groundwater resource.

A database search of licensed groundwater abstractions carried out by ERM identified three abstractions within 1 km. These comprise three boreholes (144 metres deep) 680 - 770 metres to the east / south-east, operated by Calypso Soft Drinks Ltd for "General Industrial" purposes. These could potentially be used for product purposes and therefore could be highly sensitive to any contaminant impact.

SR2.9 Hydrology

The nearest surface watercourse is Redwither Brook which borders the site along its north-west boundary, flowing towards the north-east. It flows into the River Clywedog 1 km to the east of the site. The Clywedog is a tributary of the River Dee. The chemical quality of the River Clywedog is classified by the Environment Agency as Grade A (Very Good).

SR2.10 Site Environmental Sensitivity

Shallow groundwater resources can be considered as of moderate vulnerability and low to moderate sensitivity. Deeper groundwater resources in the sandstone strata are of relatively low vulnerability due to the overlying drift deposits, but of moderate to high sensitivity.

The neighbouring Redwither Brook is of high vulnerability given its proximity to the site and the potential for direct contaminant discharge via the surface drainage system. However control measures are in place at the site to prevent such contaminated discharges. There are no underground storage tanks. All fluid storage (in particular that for oils used in the process) is provided with secondary containment in the form of an impervious bund. There is no outlet from these bunds, and their condition is visually inspected on a monthly basis. The vast majority of operational areas have an impervious surface in the form of concrete. Oil separators are incorporated into the surface drainage system.

SR2.11 Current Authorisations

Authorisations for Part A and B Prescribed Processes

Hydro Aluminium Deeside Limited currently have an IPC Authorisation (AS4117) for the site issued by the Environment Agency.

There is just one other IPC Authorisation on the Wrexham Industrial Estate - this is held by Owens Corning Fiberglas (GB) Limited (OCF) whose factory is around 2 km away from the site in a north-west direction. Since both of these IPC sites may emit combustion gases and fluorides, there is a potential for these emissions to interact additively. The predominant wind direction is towards the north-east, that is from the site towards OCF.

In addition, there are a number of Part B Authorisations on the Wrexham Industrial Estate under the control of the Local Authority (Wrexham County Borough Council), but none of these is likely to influence the environmental impact of the site on the surrounding area.

Waste Management Licenses

There are no current waste management activities within the area of the site. However, it is quite possible that the disposal of certain wastes occurred during the historic uses of the site (see Section 3 below for details).

The ICC Site Search report included searches (in 1995) of :

- The Institute of Geological Sciences desk study of landfill sites active in 1973-1974 [Note - this body is now the British Geological Society].
- The Aspinwall Sitefile Digest (1987-1995) of licensed landfill sites and authorised waste treatment sites.

No references to the site were found in these searches.

SR2.12 Planning Details

The ICC Site Search report (Ref. CL3421-KM) included details of the planning history for the site up to March 1995, based on a search of the Local Authority records, as follows :-

Reference	Details	Decision
12/1130	Erection of two unisec buildings for the manufacture of capacitors	Approved 5/12/1951
RD1547	Extension of dry process capacitor manufacture	Approved 23/1/1964
RD5138 - RD6993	Temporary buildings for the storage of raw materials for electronic components	Approved (no date given)
ABE/11240	Erection of aluminium ingot manufacturing plant with related offices and external works	Approved 24/9/1984
ABE/18450	Large scale extension to aluminium ingot plant	Approved 17/3/1989
ABE/19786	Gas tanks	Approved 7/11/1991

Hydro Aluminium Deeside's own records list rather more planning consents. Those which are relevant to environmental considerations are as follows :

Details	Date
Original planning consent for the factory	22/2/1984 Amended 24/9/1984
Phase I extension	16/5/1988
Phase II extension	9/1/1989
Bag Plant	17/3/1989
Maintenance Workshop	20/3/1991
Argon and Nitrogen gas tanks	7/11/1991
Dry Store for scrap aluminium and No.3 Gas filtration unit Note - the consent for the Dry Store has not been implemented as yet	10/4/1995
Removal of redundant flues and erection of new flue for new furnace	30/7/2001

SR2.13 Pollution Incidents

In the past pollution incidents have been in two forms, namely noise and uncontrolled airborne releases. There have been no incidents with respect to water releases.

Noise

The history of complaints about noise from some local residents on the Pentre Maelor estate, and the resultant noise surveys and remedial actions are considered at length in Section B2.9 of the application, and so will not be repeated here. The company registers all complaints in a Complaints Log which is available for inspection. The number of complaints received during the last three years is shown below, and it can be seen quite clearly that there has been a very substantial reduction in the numbers of complaints.

1999 135 recorded complaints
2000 42 recorded complaints
2001 4 recorded complaints to date (August).

Uncontrolled airborne releases

In a similar way, it is acknowledged that historically there have been occasions when uncontrolled airborne releases, generally in the form of black smoke, have occurred in the past. Indeed in July 1995 two Improvement Notices were issued by HMIP against the Company on the same date because of such an incident, and the Company were prosecuted when a further offence took place in September 1995. Details of this enforcement action are given in Appendix 24. Following the sealing up of the by-pass flue on Melter 3 and the improved management control of the feed materials (using scrap sorting and metal purchase contracts), such incidents are now very rare. They only occur now when baled scrap containing some undetected plastic material in the centre is charged into the melting furnace.

It is believed that the new melting furnace which is being installed in Centre 2 will eliminate such pollution incidents altogether once it becomes operational in March 2002, because the charging door will only be open for two minutes at a time, and, when the door is shut, it will seal hydraulically against the outside of the furnace. Moreover, both the pressure and the temperature inside the new furnace will be controlled. Thus fugitive emissions during the normal operation will be an order of magnitude lower than with the existing plant in Centre 1, and there will be no more pollution incidents.

SR2.14 Proximity of Protected or Sensitive Habitats or Species

The closest Sites of Special Scientific Interest (SSSI's) are the River Dee and Sontley Marsh, both about 4 km away from the site, and Vicarage Moss at 5 km. These SSSI's are therefore too far away to be affected by the operations of Hydro Aluminium Deeside.

SR2.15 Building Conditions

The buildings are considered to be in good condition.

SR2.16 Emergency Response

The management plan to control the risk of accidents having environmental consequences is outlined in Section B2.8 of the application. A record will be kept of any such accidents which do occur in the future, and will be reported to the Environment Agency.

SR3.0 Site History - historical uses of the Site and Surrounding Land

SR3.1 Prior to 1938

The ICC Site Search report includes part of the Ordnance Survey map of 1938 (the scale is believed to be around 1 : 10000), on which the outline of the site has been drawn. This map is reproduced in Appendix 25. It is clear that at that time the area was an undeveloped greenfield site. Indeed it was considered to be good grazing land by the Ministry of Agriculture.

SR3.2 1939 to 1946

Around the outbreak of the Second World War in 1939 the area was developed as the Royal Ordnance Explosives Factory, Wrexham for the production of Cordite W for use (principally) by the Royal Navy. By December 1940 there were 500 workers engaged in producing some 480 tons per week, increasing to 520 tons per week in 1942. Shortly after this the production rate was halved.

As the war progressed, and as the skilled labour force was inducted into the fighting forces, the Explosives Factory relied more and more on unskilled labour. It was reported that, as a consequence, wastage was quite high, and that environmental concerns at the time were not a priority.

Cordite traditionally involved the mixing of Nitrocellulose (NC) and Nitroglycerine (NG) with a little mineral jelly in the presence of acetone as a solvent. The extruded cords were then dried to drive off the solvent so that they became fairly hard. The Wrexham factory produced "flashless" Cordite by the inclusion of a large proportion of finely divided Nitroguanidine (Picrite) which cooled the propellant during initiation to reduce the flash. For solventless Cordite the use of Carbamite was introduced as a stabiliser. Typically the Cordite produced at Wrexham would have a composition of NC 65%, NG 29% and Carbamite 6%, giving an explosive temperature of around 3305°K. This was known as Cordite W.

Plans available for the former Explosives Factory do not indicate any particular use for the buildings on the site of interest. Although apparently dated 1961, the Ordnance Survey map in Appendix 26 is reported to show part of the Explosives Factory over which the boundary of the subject site has been drawn. The Royal Ordnance Environmental Services Group (ESG) report states :
"The shapes and layout of the buildings would suggest that they are process buildings rather than storage magazines. Two buildings which fall on the north eastern boundary of the area of interest have the appearance of incorporator houses. These were where the Cordite dough would have been mixed and extruded. Smaller buildings across the remainder of the site have the appearance of being drying houses. The remaining buildings away from the area of interest have similar apparent uses with the packing and magazine areas further afield."

The ESG report lists the following as potential contaminants on the site :

"Conventional contaminants

- *Metals (from the general site processes)*
  Any ash or clinker as a result of the boiler house operations may have been deposited across the site.

- *Hydrocarbons (used for lubrication purposes)*
  The potential for significant hydrocarbon contamination is probably low.
- *Polycyclic Aromatic Hydrocarbons (PAH's) (from ash or clinker)*
- *Polychlorinated Biphenyls (PCB's) (from leaks from substations or switchgear)*
  Although localised, such contamination has a high potential in the area of interest.
  [Note - Manweb (as the electricity supplier) were contacted regarding the historical substations but did not have any information].
- *Asbestos (from lagging on seam pipelines)*

Unconventional contaminants (explosives)

- *Nitroglycerine (NG)*
  NG is readily absorbed into porous materials such as plaster, wood and masonry materials and normally through the paint coverings. Where spillages occurred ..... NG is likely to have been absorbed into such materials. Any demolition arisings from the former explosive buildings may contain some concentrations of NG. Considering that demolition has already been conducted, it is unlikely that an explosive risk is present, but a significant toxicological hazard may still be present. Where NG has entered any site drainage system, it is unlikely to have travelled any distance within the system. In general it becomes absorbed by the sediments and fragments within the drainage system. Only a small amount is dissolved by the passing water.
- *Nitrocellulose (NC)*
  NC would have been handled in a damp state in large volumes on the Wrexham site. NC is an extremely stable product in environmental terms. Over considerable periods it may degrade to very similar nitro compounds which ..... are more likely to detonate spontaneously. Such materials are commonly found within the ground due to localised spillages. However it is more likely that NC will be found in large quantities within the drainage system (including interceptors) of the site. Process waste from the NC plants were known to contain explosives. These were allowed to settle into a lagoon. It was common practice for these lagoons to become silted up and they may even be capped in some way. Over a period of time records of their location are often lost.
- *Nitroguanidine (Picrite)*
  In many ways Picrite will behave similarly to NG, although its slightly increased solubility in water does make it more mobile. Picrite is 100% soluble in boiling water. Picrite would have been used in large quantities at the Wrexham site in the form of a whitish powder. If in solution it may be absorbed by porous materials such as building fabric or the surrounding soils when spilt on the ground. Picrite may have been spilt resulting in accretions of explosive powder into the cracks of the building and under fittings within the buildings. It is unlikely that such contamination was addressed as part of the decommissioning process. Demolition arisings that form part of the made ground across the site could still contain Picrite contamination. Within the drainage system Picrite is unlikely to have travelled a considerable distance. If found at a distance from the source it is likely to be diluted to such an extent that concentrations will be at trace levels. Within the soil Picrite is likely to be found in a similar manner to NG with concentrations in voids."

SR3.3 1946 to 1983

Shortly after the War (in 1946) the area was taken over by the Welsh Industrial Estates Corporation, who created a large industrial complex now known as the Wrexham Industrial Estate. British Celanese and Firestone Tyre were two of the larger Companies attracted to the area. The Firestone factory was located on the opposite side of Bridge Road from the subject site.

In 1951 the Wrexham Maelor Borough Council approved the construction of "two unisec buildings for the manufacture of capacitors" on the site. Little is currently known about the Company which owned the property during this period, but in 1964 they received approval for an extension for dry capacitor manufacture and to construct temporary buildings for the storage of raw materials for electrical components. At some later date these buildings must have been demolished. In Appendix 27 the Ordnance Survey map of 1983 is reproduced. The site has been cleared of development except for a small electrical sub-station at the eastern corner.

Although no record of any details of the capacitor manufacturing process has been found, given the dates concerned it is very likely to have involved the use of Polychlorinated Biphenyls (PCB's). At the very least therefore there is clearly a potential for significant ground contamination by PCB's to have occurred on parts of the site.

SR3.4 1984 to 2001

The site was vacant until September 1984 when the construction of the initial factory for the "manufacture of aluminium ingots" by Deeside Aluminium Limited was approved. This building was extended in two Phases - in May 1988 and January 1989 - and the first bag plant was installed in March 1989. A Maintenance Workshop and gas tanks (for argon and nitrogen) were added in 1991, and the offices were extended in 1992. Production outputs have been increased over the lifetime of the factory by the installation of new furnaces and two more bag plants. The capacity in 2001 is around 43,000 tonnes of product per annum.

The Company was sold to Access Industries in 1995 but continued to trade under the name Deeside Aluminium Limited [Note - the 1995 reports by Dames & Moore and ERM were produced in connection with this sale]. As detailed earlier in this report and elsewhere in the application, Norsk Hydro purchased the Company in 2000 and changed the Company name to Hydro Aluminium Deeside Limited - a copy of each of the two Certificates of Incorporation is given in Appendix 28.

SR4.0 Intrusive Site Investigation

As part of a Due Diligence Investigation on behalf of Norsk Hydro prior to the purchase of Deeside Aluminium Limited, Environmental Resources Management (ERM) undertook an intrusive investigation between 13th and 19th April 2000. Since there have been no material changes in the intervening period, it is believed that the results of that investigation represent the condition of the land that would still prevail.

SR4.1 Near Surface Soil Sampling

A targeted near-surface soil investigation was carried out to determine the soil quality in the vicinity of potential sources identified during a Phase I site visit. This involved the advancement of a total of 4 soil bores (SB1 to SB4). These were located as close to the identified sources as possible, but boring locations were restricted by underground services, limited access or disruption to site operations. The soil bore locations are shown on the drawing in Appendix 14. The rationale for their selection was :

- SB1 - adjacent to the dross storage area
- SB2 - adjacent to the diesel above-ground storage tanks and the vehicle filling point
- SB3 - scrap storage area
- SB4 - bag filter waste skip and potential historical activities in the lorry park area [Note - On the 1961 drawing in Appendix 26 there appears to be a mound which could be a waste tip - possibly for ash and clinker?].

The locations were first concrete cored by diamond drilling where necessary. The soil bores were then advanced using ERM's Geoprobe soil boring system which comprises a Land Rover mounted dynamic soil probing rig. A hollow steel sampling probe was advanced to an initial depth of 1.2 metres below ground level using the rig, and a relatively undisturbed soil sample collected within an integral and dedicated acetate liner. The sampling tube was then advanced at successive intervals of 1.2 metres each.

Once the sampling tube had been advanced to the required depth, it was returned to the surface and the acetate liner with soil core was extracted and cut open to expose the soil within. The soil bore was then geologically logged taking particular note of any visual evidence of impact. Soil samples were taken for laboratory analysis. Soil bores were advanced until natural ground was encountered to a minimum of 2.0 metres below ground level.

Once soil sampling was completed at each location the soil bores SB1, SB2 and SB4 were back-filled. All soil bores were re-instated to ground level using bentonite, hydrated, and then capped with concrete to prevent the soil bores acting as potential future contamination pathways.

In addition to the soil sampling, one soil bore, SB3, was installed to enable groundwater monitoring. The installation consisted of 2.0 metres of slotted screen with 0.2 metre of plain riser. Backfill consisted of 2 metres of washed sand with 0.2 metre of bentonite. Unfortunately, however, this preparation for possible monitoring in the future proved to be in vain as the soil bore got covered over during further work and its exact location is no longer known.

SR4.2 Trial Pit Excavation Methodology

A total of eight trial pits (TP1 to TP8) were excavated in the area of made ground to the north-west of the main building using a JCB mechanical excavator fitted with a backactor. All locations were checked for the presence of underground services prior to excavation. Each pit was excavated using the backactor to a depth of 2.1 to 3.0 metres below ground level. The trial pit dimensions were generally 2.0 metres by 0.75 metre. The locations of the 8 trial pits are shown on the drawing in Appendix 14.

The trial pit excavations were supervised by an ERM Geologist and logs of each location were recorded. These logs include geological descriptions and notes of any visual evidence of potential contamination and fill materials.

SR4.3 Installation of Groundwater Monitoring Boreholes

Three boreholes (MW1 to MW3) were advanced to determine the nature of the underlying soil to a depth of up to 10 metres below ground level, and to allow the installation of groundwater monitoring wells across the site area to facilitate an initial characterisation of groundwater conditions and groundwater quality across the site. The borehole locations are shown on the drawing in Appendix 14. The rationale for their selection was :

- MW1 - to provide triangulation of monitoring wells for coverage of the site and characterisation of potential groundwater flow
- MW2 - adjacent to the balancing pond
- MW3 - possible historic activities in the lorry park
  [Note - On the 1961 drawing in Appendix 26 there appears to be a mound which could be a waste tip - possibly for ash and clinker?].

The 200 mm diameter boreholes were advanced using cable percussive techniques. The boreholes were advanced to a maximum depth of 10 metres below ground level. The boreholes were geologically logged taking particular note of any visual evidence of impact. Soil samples were taken for laboratory analysis.

On completion of the drilling, a monitoring well was installed to sample groundwater. The well installations were designed to minimise the possibility of creating a pathway by which deeper soil layers and groundwater could be impacted. Each borehole contained a screw threaded HDPE screened section wrapped with 'geowrap' to minimise the ingress of fine suspended solids during well development and sampling. A plain riser was then fitted to complete the well to level with the ground surface. Graded gravel filter packs were installed across the screened interval, and the remainder was backfilled with bentonite granules to provide a seal. Following borehole completion, each location was fitted with flush, lockable headworks.

After the installation of monitoring well MW2, artesian conditions developed whereby groundwater occurring under pressure in the ground upwelled to the surface. To prevent flooding of the site, following sampling of the groundwater, the well was backfilled with a betonite-cement grout from the bottom of the well using a tremie pipe, and the surface was re-instated with concrete.

Between each location all downhole drilling equipment and well installation materials were thoroughly steam cleaned.

Following the completion of each borehole, depth to rest groundwater level was measured using a hand-held depth to water meter. Ground elevations at each borehole location were surveyed to a Temporary Bench Mark located on the water meter inspection cover to the south-east of the main building. This enabled the elevations of the groundwater to be cross-referenced.

SR4.4 Soil Sampling

Soil samples collected from the soil bores and monitoring well boreholes were submitted to Scientific Analysis Laboratories for analysis. The analytical suite was selected on the basis of field screening in the Phase I assessment. The analysis suites included :

- Volatile Organic Compounds (VOC's)
- Semi-Volatile Organic Compounds (SVOC's)
- Metals and pH
- Total cyanide
- Sulphate
- Total Petroleum Hydrocarbons (TPH)
- Polychlorinated Biphenyls (PCB's), and
- Explosives suite consisting of nitrocellulose, nitroglycerine, DNT isomers, TNT, RDX, HMX, RGDN, Tetryl, PETN, HNS, Picric acid and Picrite.

Two samples were also submitted for Total Organic Carbon (TOC) and particle size distribution to assist in the risk asssessment.

Soil sampling analytical schedule

Determinand	MW1 1.5m	MW2 1.0 - 1.7m	MW3 0.3 - 0.6m	SB1 1.4 - 2.0m	SB2 0.6 - 1.0m	SB3 0.4 - 1.1m	SB4 0.6 - 1.1m	TP1 1.0m	TP2 0.4m	TP4 0.5m	TP5 2.0m	TP6 1.5m
VOC	✓	✓	✓		✓	✓					✓	✓
SVOC	✓	✓	✓			✓			✓		✓	✓
Total PCB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TPH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitroaromatics	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Metals *	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cyanide (total)	✓	✓	✓			✓		✓	✓		✓	✓
pH	✓	✓	✓	✓			✓				✓	✓
Sulphate	✓			✓			✓				✓	✓
Particle size	✓							✓				
TOC	✓							✓				

* The metals suite - Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc

SR4.5 Groundwater Sampling

Since MW3 was dry following installation, groundwater samples were only taken from MW1 and MW2. Prior to sampling, monitoring well MW1 was thoroughly purged by submersible pump to remove a minimum of three well volumes of groundwater. The sample was collected using a disposable bailer. As MW2 was giving artesian conditions, the sample was taken directly from the upwelling water. The soil bore SB3 was purged using a peristaltic pump, but there was insufficient recovery to allow sampling.

Groundwater sampling analytical schedule

Determinand	MW1	MW2
PCB's	✓	✓
Metals	✓	✓
TPH	✓	✓
VOC	✓	
SVOC	✓	✓
Cyanide	✓	✓
Ammonia	✓	✓
Nitrate	✓	✓
pH	✓	✓

SR4.6 Ground conditions - Made ground

In the made ground area between the factory building and the earth mound near Clywedog Road East, the vegetated surface was generally underlain by 0.4 to 0.8 metres below ground level of fill materials consisting of brick, concrete and wood fragments with occasional plastic, fabric and metallic materials. At two locations the made ground extended to 1.7 metres below ground level (TP6) and 2.4 metres below ground level (TP5), and contained a layer of dark grey ash and slag 0.4 metres in thickness at the base. At TP2 an obstruction, possibly a concrete slab was encountered at 2.1 metres below ground level and no further penetration was possible. A concrete slab was also encountered in TP5 at 1.9 metres below ground level. It seems likely that these two trial pits happened to be dug at the locations where the concrete floors of previous buildings on the site are still in place, and that they were covered over by around 2 metres of waste material after buildings of the former Explosives Factory were demolished. Further evidence of this theory is obtained by comparing the drawing showing the trial pit locations in Appendix 14 with the 1961 map of the site in Appendix 26.

In the lorry park area, 0.4 to 0.6 metres of hardcore was present at the two locations (MW3 and SB4) directly overlying the natural ground.

On the main site, concrete was present at three of the five soil bore and borehole locations (MW2, SB1 and SB2). The concrete was found to be between 0.25 and 0.30 metre thick. Hardcore was present beneath the concrete to a depth of up to 1.4 metres below ground level at SB1. A hardcore surface was present at the other two locations (MW1 and SB3). Underlying the surface materials were fill materials consisting of organic clay mixed with gravel with occasional pockets of ash and brick rubble to a depth of 0.6 to 1.9 metres below ground level.

SR4.7 Ground conditions - Natural ground

The natural ground consisted of Glacial Till generally comprising a stiff, reddish-brown clay which was encountered in all locations below the made ground. Grey mottling was widely observed, particularly on fissure faces in the top 3 metres of the soil profile. A narrow band of of brown fine sand was present at 9.2 to 9.3 metres below ground level in MW1, and soft, damp sandy silt was found at a depth of 7.3 to 8.4 metres below ground level, and 7.6 to 7.8 metres below ground level in MW2 and MW3 respectively.

SR4.8 Groundwater conditions

The trial pits, boreholes and soil bores were generally dry during drilling works. Water was present in near-surface hardcore material at SB3, but, following installation of a piezometer, there was insufficient water present to enable sampling to take place. Slight water ingress was associated with the ash and slag layers at TP5 and TP6 in the made ground area.

Slight seepage also occurred from the sand lens within the Glacial Till encountered during the drilling of MW1. Following the installation of the wells, which were initially dry, groundwater appeared overnight at MW1 (depth to water 2.92 metres below ground level). MW3 remained dry while MW2 had developed artesian conditions with an upwelling of water to less than 1 metre above ground level. Following pumping of MW1 during purging, recovery of the well was very slow.

Given the results of the fieldwork programme, the site lies over low permeability strata which appears to contain a discontinuous groundwater body probably associated with sand and silt lenses. The strata generally have a low groundwater yield. However, the conditions at MW2 show that, in places, groundwater may be present under sufficient volume and pressure within the silt and lenses to cause an upwelling to the surface. It is not clear whether the groundwater encountered is in continuity with Redwither Brook on the north-west boundary of the site.

SR4.9 Analytical results - Soil Samples

The analysis results from the soil samples were as follows :

Determinand	Units	MW1 1.5m	MW2 1.0 - 1.7m	MW3 0.3 - 0.6m	SB1 1.4 - 2.0m	SB2 0.6 - 1.0m	SB3 0.4 - 1.1m	SB4 0.6 - 1.1m	TP1 1.0m	TP2 0.4m	TP4 0.5m	TP5 2.0m	TP6 1.5m
Chromium	mg/kg	54	54	50	69	60	48	56	73	139	60	48	44
Arsenic	mg/kg	8	21	22	10	9	9	7	10	20	12	9	32
Cadmium	mg/kg	<1	<1	<1	1	<1	3	<1	<1	3	1	1	72
Copper	mg/kg	13	17	23	23	21	432	19	25	200	21	31	1,093
Mercury	mg/kg	1	1	1	<1	1	1	1	2	<1	1	1	1
Nickel	mg/kg	18	21	27	36	29	20	29	39	62	27	23	71
Lead	mg/kg	34	40	21	14	47	128	16	35	1,188	54	207	25,900
Zinc	mg/kg	72	79	61	64	65	2,308	53	88	868	456	487	45,510
Selenium	mg/kg	1	2	1	1	1	1	2	2	1	3	2	2
Water sol. Boron	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate as SO4	%	0.35	0.14	0.39	0.21			0.08				0.31	0.91
Total Cyanide	mg/kg	<1	<1	<1			<1			<1		<1	<1
pH		7.8	7.9	8.2	8.5			8.5				7.8	7
TOC	%	0.8							0.4				
Ammonia as N	mg/kg		28	<1									
Nitrate	mg/kg		4.5	8.2									
TPH	mg/kg	9	46	27	8	4	ND	ND	ND	17	ND	46	ND
Aluminium	mg/kg		34	48									
Total PCB	µg/kg	58	2.6	0.95	40	28	20	18	9.1	41	23	63	33
VOC	µg/kg	ND	ND	ND		ND	ND					850	ND
SVOC	mg/kg	0.6	1	10.3			9.1			35		11.2	1.5
Nitroaromatics	mg/kg	ND			ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not Detected

SR4.10 Analytical results - Groundwater Samples

The analysis results from the samples of groundwater, and relevant screening levels, were as follows :

Determinand	Units	MW1	MW2	Screening levels *	
				Groundwater Ingestion (mg/l)	EQS (mg/l)
Chromium	mg/l	0.03	<0.01	220 - 44000	0.005 - 0.25
Arsenic	mg/l	0.1	<0.02	0.01	0.05
Cadmium	mg/l	<0.01	<0.01	0.05	0
Copper	mg/l	0.03	0.02	3.8	0.001 - 0.028
Mercury	mg/l	0.06	<0.01		0
Nickel	mg/l	0.06	<0.01	2	0.05 - 0.2
Lead	mg/l	0.04	<0.03		0.004 - 0.25
Zinc	mg/l	0.63	0.03	31	0.008 - 0.5
Selenium	mg/l	<0.04	<0.04	0.51	
Boron	mg/l	0.4	0.1		2
Sulphate as SO4	mg/l	1,150	60		400
Total Cyanide	mg/l	<0.05	<0.05		
pH		7	7.5		
Ammonia as N	mg/l	<0.05	<0.05		0.01
Nitrate	mg/l	4.6	<0.05		
TPH	mg/l	<0.1	<0.1		
Aluminium	mg/l	0.24	0.43		
Total PCB	µg/l	ND	ND		
VOC	µg/l	ND			
SVOC	mg/l	ND	ND		

ND = Not Detected

* See SR5.2 below regarding these screening levels

5.0 Discussion of the Results, and a Conceptual Model

SR5.1 Soil Sampling Results

Twelve locations were sampled during the intrusive investigation; a soil sample was analysed from each location. Additionally three monitoring wells were installed from which two samples were analysed. From the site history it was determined that the majority of the contaminants which may be present on the site would be associated with either the current or the historical operations that have taken place from 1939 to the present day. It was presumed that the contaminants present would be composed primarily of inorganic materials (mainly metals), and that organic contamination, if present, would be minimal. Analysis of the laboratory data confirmed this hypothesis. Metal concentrations were detected in all soil samples analysed; two specific metals - lead and zinc - were detected at elevated concentrations at TP2 and TP6 in the made ground area.

Seven of the twelve samples were analysed for organic contaminants. The volatile analysis showed only methylene chloride was detected in one sample. However, methylene chloride is used as a laboratory solvent and its presence at low concentrations can result from the analytical process. The other organic contaminants detected in the soil samples were semi-volatiles. The composition of the semi-volatiles consisted primarily of low levels of polycyclic aromatic hydrocarbons (PAH's). Polychlorinated biphenyls (PCB's) were detected in all soil samples tested, but only at low concentrations. These PCB's are probably the result of spillages when there was a factory on the site making capacitors - that is, some time between 1951 and 1983. Tests for explosives in soils were also carried out, but none were detected in any of the samples.

The ERM report on the intrusive investigation concluded :
"The only contaminants which exceeded their respective screening levels were lead and zinc. These two contaminants were only exceeded in TP2 (zinc) and TP6 (lead and zinc) which are likely to be associated with historic operations on the site. All other contaminants were below their respective risk screening criteria."

SR5.2 Groundwater Sampling Results

Groundwater analysis showed low levels of some heavy metals in water, but no detection of any of the organic parameters tested.

The ERM report on the intrusive investigation concluded :
"Groundwater samples were screened against two separate criteria [Note - see the table in SR4.10 above]. *The first was based on the potential exposure of a human receptor via groundwater ingestion. This is a very conservative assumption since it is known that the groundwater on-site is not used for potable use; however, the groundwater in the local area is used by a soft drinks manufacturer approximately 700 metres from the site. The RBSL's for this pathway are provided for illustrative purposes only because the contaminant levels found on-site are not necessarily those found off-site. If contaminants were migrating off-site they could potentially be found at considerably lower concentrations. Therefore the evaluation of this exposure pathway is considered extremely conservative. Nevertheless the contaminant concentrations did not exceed their respective screening criteria for this exposure pathway.*

The second type of screening was conducted against the Environment Agency published Environmental Quality Standard (EQS) for the protection of aquatic organisms. Exceedances of the EQS were only detected in the sample collected from monitoring well MW1 which is located approximately 100 metres from the stream. The EQS's for arsenic, copper, mercury, zinc and sulphate were all exceeded at MW1. The majority of the exceedances were minor except for the exceedance detected in this well for mercury. The origin of these metals is unclear as they have not been detected at elevated concentrations in the soil in this area.

None of the EQS's were exceeded at MW2. This well is immediately adjacent to the stream. It does not appear, from the current data set, that identified contaminants are migrating towards the stream, and, if they are, then they are being attenuated by the time they reach the closest monitoring point to the stream. In addition, given the absence of a continuous groundwater and the presence of low permeability strata, the risk posed by the concentrations observed at MW1 to the stream is considered to be low."

SR5.3 Exposure Pathways and Receptor Analysis

Possible human exposure pathways within the site include the ingestion and dermal contact with soil derived from unpaved areas and the inhalation of compounds attached to the entrained dust particles.

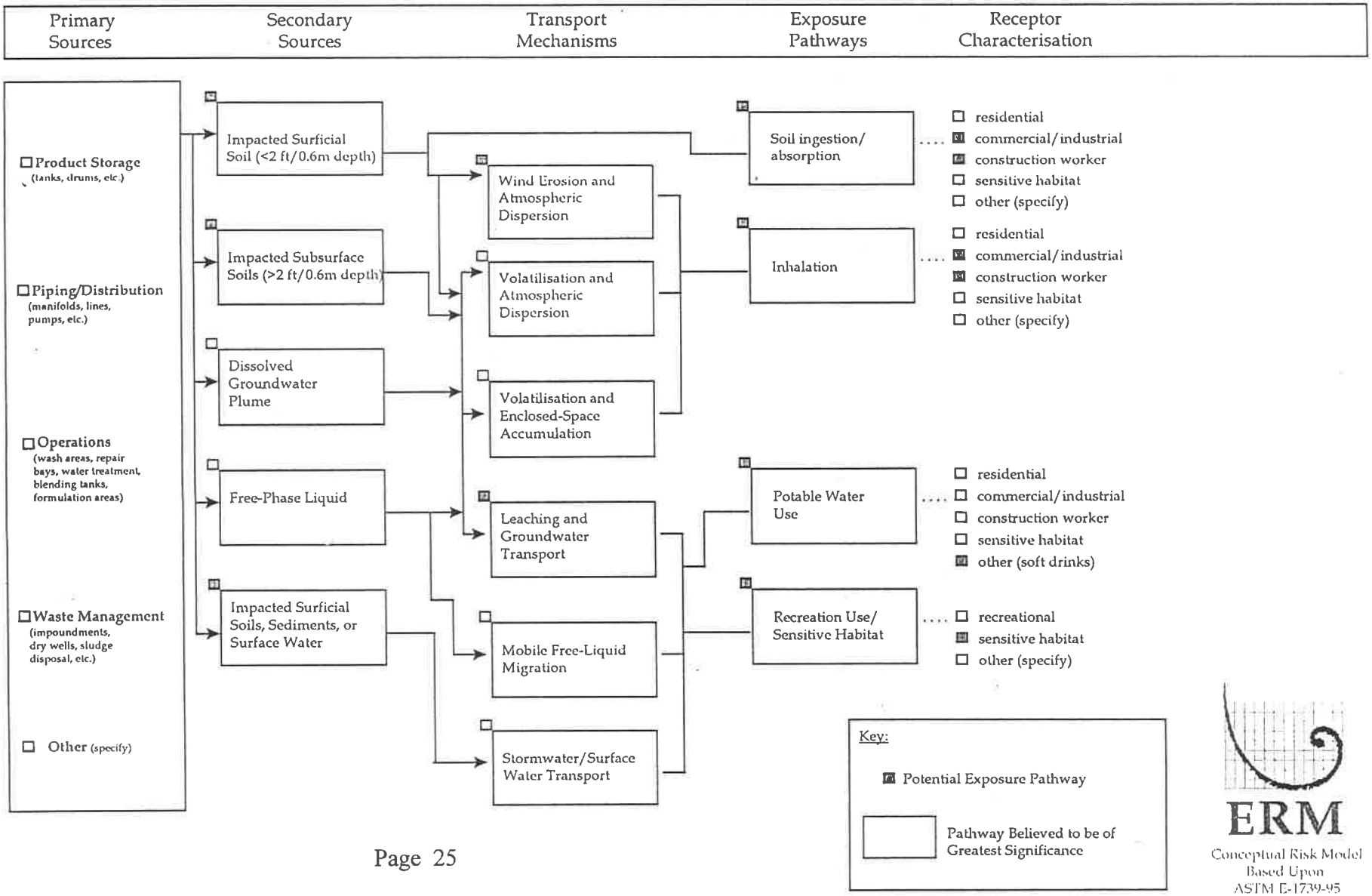
In respect of off-site migration, the potentially operative pathways include the wind blown movement of dust and particles, the surface run-off of water and entrained soils during rainfall events, and the migration of dissolved phase contamination in groundwater.

SR5.4 Conceptual Model

A conceptual model of the site has been formulated summarising contaminant sources, potential exposure pathways and possible receptors. On the basis of current information, the key exposure pathways are therefore considered to be :-

- ingestion, inhalation (dust) and dermal contact with surface and sub-surface soils of the on-site human receptor
- soils leaching to groundwater and the subsequent migration of contaminants to nearby surface waters
- ingestion of groundwater (included for illustrative purposes only)

The Figure overleaf giving further details of possible exposure pathways has been extracted from ERM's report.



ERM

Conceptual Risk Model Based Upon ASTM E-1739-95

6.0 Conclusions

The following conclusions can be drawn about the current quality of the land on the site :

1. The top 2 metres or so of soil on the made ground area to the north-west of the main factory building includes what is probably waste material from the former Royal Ordnance Explosives Factory which occupied most of what is now Wrexham Industrial Estate during the years of the Second World War. In addition to building rubble (possibly arising from the demolition of the former buildings), the waste material appears to include ash and slag from the wartime period. This ash resulted in elevated concentrations of lead and zinc at two of the six locations that were sampled in the made ground area. It would also appear that the concrete floors from the former buildings of the Explosives Factory are still in place, around 2 metres below the current ground level. Occasional pockets of ash and brick were also found in other parts of the site at depths of 0.6 to 1.9 metres.

2. In 1995 Royal Ordnance ESG expressed their view that it was likely that the land on the site would have been contaminated by both "conventional contaminants" - namely metals, hydrocarbons, PAH's, PCB's and asbestos - and by "unconventional contaminants" - that is, the explosives nitroglycerine, nitrocellulose and Picrite - during the period when it was part of the Explosives Factory. The results from the intrusive site investigation undertaken last year by ERM verify that opinion with regard to the "conventional contaminants" (although there is no mention of any samples being examined for any asbestos content). Although no evidence of contamination by explosives was found, it is possible that such contamination only occurred in pockets, and that none of these pockets happened to be included in the samples which were analysed during the investigation. Thus the potential that the site could be contaminated by one or more of these explosives cannot be excluded.

3. The polychlorinated biphenyls (PCB's) that were found in all of the soil samples that were collected and analysed during the intrusive site investigation suggests that contamination from spillages of PCB's probably occurred during the period between 1951 and 1983 when there was a factory on the site making capacitors. Some of this contamination could also have occurred during the earlier period as an Explosives Factory.

4. On the basis of currently available information, near-surface soil contamination with heavy metals does not appear to present unacceptable levels of risk to human receptors.

5. The groundwater concentrations of arsenic, copper, mercury, zinc and sulphate that were detected at one location on site (near the car park) exceeded the relevant EQS's published by the Environmental Agency. Taking into account (a) the distance from Redwither Brook (of around 100 metres), (b) the absence of continuous groundwater, and (c) the low permeability strata, the risk posed by the site to surface waters is considered to be low. The groundwater concentrations at the other sampled location close to Redwither Brook were all within the relevant criteria.