Meritor Heavy Vehicle Braking Systems (UK) Limited
Grange Road
Cwmbran
Gwent
NP44 3XU

Remediation Implementation Plan (LNAPL Recovery)
Grange Road
Cwmbran
Gwent
NP44 3XU
South Wales

February 2012
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ARCADIS

Executive Summary

ARCADIS (UK) Limited (ARCADIS) was commissioned by Meritor Heavy Vehicle Braking Systems (UK) Limited (Meritor) to produce a Remediation Implementation Plan (RIP) for the recovery of Light Non-Aqueous Phase Liquid (LNAPL) from the sub-surface of Zone 3 at the Meritor facility located on Grange Road, Cwmbran, Gwent NP44 3XU, South Wales (the Site).

The purpose of the RIP is to present the selected remediation strategy and define the implementation approach for recovering LNAPL from the sub-surface of Zone 3, including monitoring and validation requirements, in order to mitigate the identified risks presented by the LNAPL.

Contaminants of Concern

Contaminants identified beneath the Meritor facility include, LNAPL (oils), chlorinated volatile organic compounds (CVOCs) and total petroleum hydrocarbons in soil and groundwater. The predominant Contaminants of Concern (CoC) present in groundwater beneath the Site are CVOCs. The remediation of these compounds will be assessed and designed in a separate document.

LNAPL Assessment

The LNAPL recovery remediation works will be implemented in Zone 3 at the Meritor facility.

Given the limited nature of the dissolved phase TPH concentrations associated with the LNAPL and the low volatility of the LNAPL, human health and environmental risks associated with the presence of LNAPL are already considered to be low. Therefore, LNAPL remediation works are targeted at areas of LNAPL where the potential for recovery is considered to be greatest to reduce the future potential for LNAPL migration and provide betterment to the sub-surface conditions.

Remediation Criteria

Given the limited nature of the dissolved phase TPH concentrations associated with the LNAPL and the low volatility of the LNAPL, human health and environmental risks associated with the presence of LNAPL are already considered to be low.

However, the remediation criteria will be considered to have been met when one or more of the following criteria have been achieved:

- *LNAPL recovery rates have become low or reached asymptotic conditions and dissolved-phase concentrations of TPH compounds related to the presence of residual LNAPL are not presenting an unacceptable risk.*

- *A revision of the risk assessment, justified by changes in the plume geometry or the conceptual understanding of the Site, indicates that the reduced mass of contaminants are not presenting an unacceptable risk.*

The benefits of continued remediation should be considered against the costs throughout the works. It is anticipated that one of more of the above criteria can be achieved with the proposed design, which has been developed with relative benefits for the cost of the works in mind. If one of the above criteria is not achieved within the scope of the design, cost-benefit analysis will be considered as a justification that additional remediation works should not be undertaken considering likely improvement to the Site condition that could be achieved, versus environmental and financial costs.

Remediation Approach

The remediation strategy for LNAPL recovery will adopt the following technology:

- *Total Fluids Pumping.*

Total Fluids Pumping will be used to remove LNAPL and impacted groundwater from beneath the Site. The extraction of fluids causes drawdown of the water table at the extraction point, thereby creating a cone of depression. This effectively alters the local hydraulic gradient within the radius of the influence of the extraction well, resulting in LNAPL migration towards the extraction point, and additionally providing a hydraulic barrier minimising off-Site migration of LNAPL product and the dissolved-phase contaminant plume. Separated groundwater can be treated before discharge.

The LNAPL removal via TFP is a mass removal technology that can reduce LNAPL saturation to residual saturation. At residual saturation, LNAPL will not flow and therefore hydraulic recovery is no longer possible. Given the limited dissolved-phase TPH concentrations and low volatility of the LNAPL, the presence of residual LNAPL at or above residual saturation is considered to present a low level of risk to the identified receptors associated with the Site. The reduction of LNAPL towards the point of residual saturation is considered to manage the potential for LNAPL migration.

Remediation Design

Above-ground remediation containers should be used to house the equipment for the remediation system to enable easy access for maintenance of the system. Pipe work will connect the remediation systems to remediation wells via sub-surface ducting installed in shallow utility trenches; each remediation well will be accessed via an inspection chamber. By linking the remediation wells and containers via a network of underground ducts, the Site will be able to operate as a car parking area and production facility.

Existing extraction wells installed during previous phases of intrusive investigation works at the Site will be utilized for the TFP system in the south yard area.

Additional extraction wells will be installed across the south-western and southern central area of the main production building.

Each remediation well will be accessed via an inspection chamber and will be linked to the proposed internal and external above ground remediation containers by pipe work laid in sub-surface ducting installed in shallow utility trenches as shown on Figure 11.

Regulatory Issues

It is considered likely that an abstraction licence will be required by the EA for the remediation of Zone 3.

ARCADIS understands that Meritor holds a discharge consent, granted by Welsh Water, for the discharge of trade effluent drainage, via the effluent treatment plant to sewer. Due to the divestment of the northern portions of the Site and the likely renegotiation of the discharge consent that will be required following the redevelopment of Zones 1 & 2 and refurbishment of Zone 3; ARCADIS recommends that the discharge of treated groundwater during remediation is considered during the consent renegotiation.

It is considered likely that an Environmental Permit will be required to undertake remediation works for Zone 3.

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A Legislative Context and Regulatory Guidance
B Soil & Groundwater Site-Specific Assessment Criteria

List of Abbreviations that may be used in this report

ARCADIS	ARCADIS (UK) Limited
BGS	British Geological Survey
CCTV	Closed Circuit Television
CoC	Contaminants of Concern
CVOC	Chlorinated Volatile Organic Compounds
DEFRA	Department for Environment, Food and Rural Affairs
DPE	Dual Phase Extraction
DQRA	Detailed Quantitative Risk Assessment
EA	Environment Agency
EPR	Environmental Permitting Regulations
ESA	Environmental Site Assessment
GAC	Granular Activated Carbon
HGV	Heavy Goods Vehicle
K	Hydraulic Conductivity
LIF	Laser Induced Fluorescence
LNAPL	Light Non-Aqueous Phase Liquid
mAOD	Metres above Ordnance Datum
mbgl	Metres below ground level
Meritor	Meritor Heavy Vehicle Braking Systems (UK) Limited
MTL	Mobile Treatment Licence
O&M	Operation and Maintenance
OS	Ordnance Survey
PID	Photoionisation Detector
RIP	Remediation Implementation Plan
RoI	Radius of Influence
Sirius	Sirius Geotechnical and Environmental Limited (Sirius)
SPZ	Source Protection Zones
SSAC	Site-Specific Assessment Criteria
SSSI	Site of Special Scientific Interest
T	Transmissivity
TCBC	Torfaen County Borough Council
TFP	Total Fluids Pumping
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compounds

1 INTRODUCTION

ARCADIS (UK) Limited (ARCADIS) was commissioned by Meritor Heavy Vehicle Braking Systems (UK) Limited (Meritor) to produce a Remediation Implementation Plan (RIP) for the recovery of Light Non-Aqueous Phase Liquid (LNAPL) from the sub-surface of Zone 3 at the Meritor facility located on Grange Road, Cwmbran, Gwent NP44 3XU, South Wales (the Site).

The environmental works were conducted at the request of Meritor whom ARCADIS understands will divest the freehold ownership of the northern two thirds of the Site (Zones 1 & 2), including a parking area to the north of the main production building, for redevelopment. ARCADIS also understands that Meritor will retain the southern third of the Site and will undertake the refurbishment of the existing production building and southern yard area (Zone 3).

This report specifically focuses on the recovery of LNAPL from the sub-surface of Zone 3.

The work was conducted in accordance with the Global Master Services Agreement (2008) between ARCADIS and Meritor, Inc. The work was also performed in accordance with Welsh legislation and regulatory guidance for the assessment of contaminated land, an overview of which is presented in Appendix A.

The Site information presented in this report has been obtained during previous phases of assessment (see Section 1.3 below). This report should be read in conjunction with the previous environmental reports as the information contained in those reports forms the basis of the conceptual model for the Site.

1.1 Planning Conditions

ARCADIS has been supporting Meritor with professional and technical environmental services relating to a facility-wide environmental assessment of the Meritor facility, Cwmbran. The environmental assessment has been conducted in support of planned redevelopment of the Meritor facility, as evidenced by a joint planning application submitted to Torfaen County Borough Council (TCBC) in February 2011 by Meritor and Morrisons Supermarkets Plc.

A planning application (reference Application Number 11/P/00101) has been submitted to the Local Planning Authority, TCBC, for the redevelopment of the northern zones at the Meritor facility (Zones 1 & 2) and for the refurbishment of the southern zone (Zone 3). Detailed redevelopment plans which have been provided to ARCADIS and are presented in the planning application indicated that three main commercial developments will be carried out, as follows:

- **Zone 1** – Employee car park to the north of the main production plant, to be redeveloped with a new supermarket, associated petrol filling station and two smaller retail units (as well as a pedestrian bridge from the Site into Cwmbran town centre).

- **Zone 2** – Central portion of the Meritor Site including the Heavy Goods Vehicle (HGV) entrance, loading bay and the northern third of the existing production building to be redeveloped as commercial offices with a hotel (and associated bar/ restaurant) and car parking areas.

- **Zone 3** – The remainder of the production building (south of building column row M) and the southern yard area and visitors car park to be retained as a heavy vehicle braking systems production building with associated employee and visitor car parking areas; an engineering centre; and Meritor's offices.

TCBC has imposed environmental planning conditions for the redevelopment of Zones 1 & 2 and for the refurbishment of Zone 3. The information contained in this report can be used to assist in the discharge of the environmental planning conditions.

The general location of the Meritor facility and the physiogeographic features of the surrounding area are presented on Figure 1 at a map scale of 1:50,000. The 2010 facility layout is presented on Figure 2, the proposed redevelopment areas are presented on Figure 3.

1.2 Report Objectives

The purpose of the RIP is to present the selected remediation strategy and define the implementation approach for recovering LNAPL from the sub-surface of Zone 3, including monitoring and validation requirements.

1.3 Scope of Work

The RIP for LNAPL recovery includes the following aspects:

- Summary of Site, and specifically Zone 3, characteristics including potential constraints on remediation approach;
- Statement of remediation objectives and remediation criteria;
- Remediation technology description and specification;
- Development of implementation methodology; and,
- Development of monitoring and validation requirements.

1.4 Previous Environmental Works

The Meritor facility has undergone a series of intrusive investigations, risk assessment and remediation pilot testing since December 2009, when ARCADIS was commissioned to undertake an updated Phase I Environmental Site Assessment (ESA) of the facility and to develop a scope of works for a subsequent Phase II ESA. The environmental works to date conducted by Meritor are detailed in the following reports:

- *Phase I Environmental Site Assessment*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909361804_02, January 2010.
- *Phase II Environmental Site Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran. ARCADIS report ref: 909361904_03, February 2010.
- *Phase IIB Environmental Site Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran. ARCADIS report reference 909362203_03, May 2010.
- *Detailed Quantitative Risk Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362002_01, May 2010.
- *Revised Detailed Quantitative Risk Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362802_01, January 2011.
- *Remediation Options Appraisal Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362302_02, August 2010.
- *Remediation Method Statement*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362819_01, January 2011.
- *Supplementary Site Investigation Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362509_01, April 2011.
- *Remediation Pilot Testing (Oil Recovery) Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362711_01, June 2011.

- *Updated Detailed Quantitative Risk Assessment*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909363202_02, June 2011.
- *LNAPL Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909363303_01, August 2011.
- *Baseline Site-Wide Groundwater Monitoring Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362902_01, July 2011.
- *Remediation Implementation Plan (LNAPL Recovery),* Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909363022_06, January 2012.
- *Location of Historic Abstraction Well Letter Report,* Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909363603_02, January 2012.

This report follows on from, and should be read in conjunction with the previous reports detailed above.

1.5 Reliability of Information/ Limitations

This report is only valid when read in its entirety. Any information or advice included in this report should not be relied on unless considered in the context of the whole report. Reference should be made to the notes on study limitations at the end of this report.

A copy of ARCADIS' study limitations are presented in Section 9.

1.6 User Reliance

There are neither third party rights nor benefits conferred under this report. Use of this report is strictly limited to Meritor and Meritor, Inc and its direct and indirect subsidiaries, which are the sole parties to whom ARCADIS intends to confer any rights. Any reliance on the contents of this report by any other party is the sole responsibility of that party.

2 SITE CHARACTERISTICS

ARCADIS used information obtained from an inspection of the property, previous environmental works at the Meritor facility, and reference materials to formulate the property description.

2.1 Site Location and Description

2.1.1 Site Location

Information from Ordnance Survey (OS) maps indicates that the facility is located at National Grid Reference ST 296951 (National Grid co-ordinates 329684 195192) on Grange Road, Cwmbran, Wales.

The Meritor facility is located in an area of mixed land use that includes residential, light industrial and commercial properties. The Site is bounded by Grange Road to the west, Edlogan Way to the north, a railway line to the east and a factory to the south. The facility lies on the flood plain of the Afon Lwyd at an elevation of 55 metres Above Ordnance Datum (mAOD). The topography of the facility is generally flat with the immediately surrounding area sloping gently to the south.

The general location of the Meritor facility and the physiogeographic features of the surrounding area are presented on Figure 1, on a map scale of 1:50,000

2.1.2 Use of the Property and Description of Structures

The majority of the buildings at the Meritor facility were constructed in the 1930s to 1940s using a steel frame structure clad with metal sheeting. The facility is currently used for the manufacture of braking systems for HGVs. The gross area of the facility is 25.73 acres. At the time of the *Phase I ESA* (909361804_02, January 2010 referenced previously), the number of staff working at the facility was reportedly approximately 600 people.

The external locations surrounding the facility comprise concrete and bituminous surfaced roads and pavements. There are small areas of open space to the west consisting of gardens and roadside verges.

The 2010 Site layout is presented on Figure 2.

2.1.3 Current Uses of the Adjoining Properties

At the time of the *Phase I ESA* (909361804_02, January 2010 referenced previously), Site walkover the land-use in the immediate vicinity of the facility comprised light industrial, residential, and commercial buildings together with sports fields and a school.

North:	A small industrial estate (approximately 300 m from facility boundary).
East:	Beyond the railway track lie sports playing fields, the (river) Afon Lwyd and a school (approximately 550 m from the facility boundary).
South:	Crane Process Flow Technologies Limited, who manufacture valves and a large car park lies beyond to the south-west. Residential properties are located beyond the units and car park.
West:	Immediately west of the Site lies the Lufthansa Resource Technical Training Limited building (the building is now redundant). Beyond Grange Road lies residential housing and flats (approximately 80 m from the facility boundary), and Cwmbran town centre.

Recent visits to the facility have confirmed that adjoining land use conditions have not changed since the *Phase I ESA* (909361804_02, January 2010).

2.2 Summary of Site History

The historic use of the Meritor facility was determined from inspection of 1:2,500, 1:10,000 and 1:10,560 scale OS map extracts contained within the Enviro*check*® Report for the facility produced by Landmark Information Group, dated December 2009, previous environmental works undertaken at the facility by ARCADIS, Information Obtained from www.Cwmbran.info and historic photographs. Reference should be made to the *Phase I ESA* (909361804_02, January 2010) referenced previously for further information on the Site use history.

2.3 Topography

The Meritor facility lies on the flood plain of the Afon Lwyd at an elevation of 55 mAOD. The topography of the facility is generally flat, although the ground level of the surrounding area is sloping gently to the south.

2.4 Geology

2.4.1 Regional

A review of the 1:50,000 scale British Geological Survey (BGS) solid geological map (Sheet Number 249, Newport, 1975) indicates that the facility is underlain by Alluvium overlying the Raglan Mudstone Formation (formerly the Raglan Mudstone Formation) which is part of the Lower Red Sandstone Group. The Raglan Mudstone Formation consists of red mudstones with calcretes and sandstones which gently dip towards the west.

2.4.2 BGS Borehole Records

Four historical borehole records for the Site and the surrounding area were obtained from the BGS as summarised in the table below:

Four historical borehole records for the Site and the surrounding area were obtained from the BGS as summarised in the table below:

BGS Borehole Record	National Grid Reference	Location	Borehole Depth	Ground Conditions
ST29NE80 (1942)	ST 2983 9526	Grange Works on Grange Road	146 m	Made Ground. Alluvium: Gravel, clay and cobbles proven to 6.0 mbgl Raglan Mudstone Formation: Bands of sandstone and sandy mudstone to a depth of 8.0 mbgl. The interbedded bands of marl and sandstone continued to a depth of 146 mbgl.

BGS Borehole Record	National Grid Reference	Location	Borehole Depth (m)	Ground Conditions
ST29NE79 (1904)	ST 2942 9530	Cwmbran's Electricity Generating Station	10.5 m	The ground conditions encountered comprised hard red marl from ground level to 1.7 mbgl into underlying red rock proven to a maximum depth of 3.48 mbgl considered to represent the Old Red Sandstone.
ST29SE85 (1976)	ST 2960 9468	Crane Process Flow Technologies Limited	29.5	Made Ground: Proven to a depth of 1 mbgl. Alluvium: Gravel proven to 6 mbgl. Raglan Mudstone Formation: Bands of marl and sandstone proven to a depth of 29.5 mbgl
ST 39SW92 (1990)	Unknown	Lane two of the Llantarnam By-Pas	10.5	Alluvium: Topsoil and clay proven to a depth of 2 mbgl Raglan Mudstone Formation: Reddish-brown mudstone (marl) to a depth of 9 mbgl. The marl was underlain by greenish grey sandstone proven to a depth of 10.5 mbgl.

Reference should be made to the *Phase I ESA* (909361804_02, January 2010) referenced previously for further information on the borehole logs supplied by the BGS.

2.4.3 Site Condition

Several phases of intrusive investigation have been undertaken at the Meritor facility, including Site investigations by ARCADIS in 1998, 2010 and 2011 and an investigation undertaken by Sirius Geotechnical and Environmental Limited (Sirius) in 2009. The findings of the intrusive investigations are summarised below

:

Who	Date	Area of Investigation	Max. Borehole Depth in Investigation (m)	Findings
ARCADIS	October 1998	Facility-Wide	3.0	Concrete was encountered in seven of 13 locations resulting in shallow refusal. Ground conditions recorded comprised Made Ground, underlain by alluvium deposits consisting of soft clay and sandy gravel, and silty sandy gravel.

Who	Date	Area of Investigation	Max. Borehole Depth in Investigation (m)	Findings
Sirius	February – March 2009	Northern Employee Car Park (Zone 1)	10.0	Made Ground typically comprised bituminous surfacing, concrete or hardcore hardstanding over a mixed granular and cohesive fill. The Made Ground overlaid cohesive stratum described as soft and firm, locally very stiff, slightly sandy slightly gravelly clay. Underlying the natural cohesive deposits were deposits, typically described as locally clayey sand and gravel with a medium cobble content. Sirius encountered occasional boulders, with a maximum recorded dimension of 0.40 m x 0.70 m. Sirius reported that mudstone was encountered beneath the superficial deposits where boreholes were progressed to a sufficient depth. Sirius reported that a weathering profile was seen within the mudstone, although variable, with an upper layer of completely weathered material (recovered as sandy gravelly clay).
ARCADIS	January - February 2010	Facility-Wide	15.5	Concrete or bituminous surfacing overlying Made Ground comprising gravelly clay and clayey or gravelly sand. The Made Ground was underlain by sandy or gravelly clay and clayey or gravelly sand with occasional cobbles. This was overlying sandy gravel and cobbles of sandstone proved to a maximum depth of 5.6 mbgl. The Alluvium deposits were underlain by mudstone with bands of sandstone, proven to a maximum depth of 15.5 mbgl, considered to be representative of the Raglan Mudstone Formation.

Who	Date	Area of Investigation	Max. Borehole Depth in Investigation (m)	Findings
ARCADIS	March – April 2010	Facility-Wide	33	Concrete (or gravelly or clayey soils in certain locations) overlying Made Ground consisting of gravelly clay and clayey or gravelly sand. The Made Ground was underlain by sandy or gravelly clay and clayey or gravelly sand with occasional cobbles. This was overlying sandy cobbles and boulders proved to a maximum depth of 6.0 mbgl. The Alluvium deposits were underlain by a red mottled grey mudstone in several boreholes, proven to a maximum depth of 33 mbgl considered to be representative of the Raglan Mudstone Formation.
ARCADIS	March – April 2010	Off-Site In Adjacent Playing Fields	27	The ground conditions encountered off-Site consisted of similar conditions to those encountered on-Site.
ARCADIS	September – December 2010	Southern Yard Area (Zone 3)	10.5	Underlying concrete hardstanding Made Ground was encountered, comprising clayey sand, gravel and sandy gravelly clay with fragments of brick, concrete and clinker. Proven to a maximum depth of 2.4 mbgl. In a number of locations, including borehole EX5, concrete was proven to a notable depth >2.0 mbgl. The Made Ground was underlain by sandy or gravelly clay and clayey or gravelly sand with occasional cobbles, proven to a maximum depth of 5.7 mbgl. The Alluvium was underlain by a red mottled grey mudstone proven to a maximum depth of 10.5 mbgl considered to be representative of the Raglan Mudstone Formation.

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Reference should be made to the *Phase I ESA* (909361804_02, January 2010), the *Phase II ESA* (909361904_03, February 2010), *Phase IIB ESA* 909362203_03, May 2011) and *Supplementary Site Investigation* (909362509_01, April 2011) referenced previously for further information on the ground conditions beneath the facility.

2.5 Hydrogeology

2.5.1 Regional Hydrogeology

The EA formerly classified the Old Red Sandstone underlying the Meritor facility as a Minor Aquifer, as defined in their "*Policy and Practice for the Protection of Groundwater – Groundwater Vulnerability 1:100,000 Map Series* (Sheet 36 – Gwent, South and Mid Glamorgan, 1996). However, the nomenclature associated with the designation of aquifers has undergone a period of transition. The Environment Agency (EA) now refers to Principal Aquifers, Secondary Aquifers or Unproductive Strata, depending on the importance of the aquifers in terms of groundwater as a resource (supporting abstractions, ecosystems *etc*).

The EA website (www.environment–agency.gov.uk) accessed January 2012, indicates that the Alluvium and the Raglan Mudstone Formation underlying the facility are classified as Secondary Aquifers. Secondary Aquifers include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types A and B. Both the Alluvium and the Raglan Mudstone Formation are classified as Secondary Aquifer A, indicating they have permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

2.5.2 BGS Borehole Records

Four historical borehole records for the Site and the surrounding area were obtained from the BGS. The hydrogeological information obtained from the logs is summarised in the table below:

BGS Borehole Record	National Grid Reference	Location	Borehole Depth	Details
ST29NE80 (1942)	ST 2983 9526	Grange Works on Grange Road	146 m	The borehole log indicates that groundwater strikes occurred at depths of 17 mbgl and 30 mbgl and that groundwater was resting at approximately 1 mbgl following the monitoring well installation. A note added to the borehole log indicates that the borehole location was visited in August 1950 and was then "concreted over due to insufficient water".
ST29NE79 (1904)	ST 2942 9530	Cwmbran's Electricity Generating Station	10.5 m	The borehole log indicates that groundwater was resting at 1 mbgl in the installed monitoring well.
ST29SE85 (1976)	ST 2960 9468	Crane Process Flow Technologies Limited	29.5	The borehole log indicates that a groundwater strike occurred at a depth of 3.7 mbgl and that groundwater was resting at a depth of 1.3 mbgl following the monitoring well installation.
ST 39SW92 (1990)	Unknown	Lane two of the Llantarnam By-Pas	10.5	The borehole log indicates that groundwater seepage occurred at depths of 5.3 mbgl

Reference should be made to the *Phase I ESA* (909361804_02, January 2010), referenced previously for further information on the hydrogeological conditions beneath the facility.

2.5.3 Source Protection Zones

The digital groundwater Source Protection Zone (SPZ) Data Register accessed in January 2012 and the Enviro*check*® Report, indicates that Meritor faciliity is not located within a groundwater SPZ, as defined by the EA.

2.5.4 Groundwater Abstractions

The Enviro*check*® Report produced by Landmark Information Group, dated December 2009 provides no record of licensed groundwater abstractions located within a 2 km radius of the facility.

2.5.5 Site-Specific Hydrogeology 1998 – 2009

Several phases of intrusive investigation have been undertaken at the Meritor facility, including investigations by ARCADIS in 1998, 2010 and 2011 and an investigation undertaken by Sirius Geotechnical and Environmental Limited (Sirius) in 2009. The findings of the intrusive investigations are summarised below

:

Who	Area of Investigation	Findings
ARCADIS	Facility-Wide	Groundwater was encountered between 0.8 m and 1.3 mbgl resting within the Made Ground. Insufficient Site data was available to enable a definite groundwater flow direction to be inferred.
Sirius	Northern Employee Car Park (Zone 1)	Sirius reported perched groundwater within the Made Ground was encountered. In addition, that monitoring of the standpipes, installed within cable percussive boreholes, indicated groundwater levels between 1.24 m and 3.04 mbgl, indicating a hydraulic gradient to the south and east.

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Reference should be made to the *Phase I ESA* (909361804_02, January 2010), the *Phase II ESA* (909361904_03, February 2010), *Phase IIB ESA* 909362203_03, May 2011) and *Supplementary Site Investigation* (909362509_01, April 2011) referenced previously for further information on the groundwater beneath the facility.

2.5.6 Site-Specific Hydrogeology 2011

During the most recent groundwater monitoring visit conducted between 15th February 2011 and 23rd March 2011, resting groundwater levels were again recorded. During the groundwater monitoring visits, the rest groundwater levels were recorded in the monitoring wells screening the Alluvium at the Meritor facility:

Alluvium:

Date	Range in Resting Depths to Groundwater in the Alluvium (mbgl)	
	Minimum	Maximum
February – March 2011	0.65 (BH130)	4.27 (BH204AS)

Notes:

mbgl Metres below ground level

No groundwater was encountered in monitoring wells BH134 and BH908, LNAPL was encountered in and to the base of the monitoring wells. No groundwater or LNAPL was encountered in monitoring wells BH116, BH302_S, BH916 or BH931 *i.e*. the monitoring wells were dry.

During the groundwater monitoring visit, the rest groundwater levels were recorded in the monitoring wells screening the Alluvium off-Site:

Alluvium Off-Site:

Date	Range in Resting Depths to Groundwater in the Alluvium (mbgl)	
	Minimum	Maximum
February – March 2011	0.52 (BHOS409)	1.77 (BHOS 414)

Notes:

mbgl Metres below ground level

During the groundwater monitoring visit, the rest groundwater levels were recorded in the monitoring wells screening the Raglan Mudstone Formation oat the Meritor facility at the Meritor facility:

Raglan Mudstone Formation:

Date	Range in Resting Depths to Groundwater in the Raglan Mudstone Formation (mbgl)	
	Minimum	Maximum
February – March 2011	0.83 (BH202D)	4.84 (BH303D)

Notes:

mbgl Metres below ground level

The groundwater in monitoring well BH203D was overflowing on removal of the well cap.

During the groundwater monitoring visit, the rest groundwater levels were recorded in the monitoring wells screening the Raglan Mudstone Formation off-Site:

Raglan Mudstone Formation Off-Site:

Date	Range in Resting Depths to Groundwater in the Raglan Mudstone Formation (mbgl)	
	Minimum	Maximum
February – March 2011	1.90 (BHOS306S)	2.37 (BH3OS307)

Notes:

mbgl Metres below ground level

A plan showing the locations of the on- and off-Site monitoring well locations is presented on Figure 4.

2.5.7 Interpretation of Groundwater Interaction

The groundwater in the Alluvium is partially confined by the overlying clayey deposits and groundwater rest level typically rises in comparison to its strike level. This behaviour was not observed beneath the adjacent playing fields that did not have consistent overlying clayey alluvial deposits.

In the Raglan Mudstone Formation there were no obvious groundwater strikes, but resting water levels were present in the overlying Alluvium at approximately 3.0 mbgl (see table below). In comparable installations, such as BH204AS, BH204AD and BH305, there was a vertical head difference of between 0.3 m and 0.97 m between the Alluvium and the Raglan Mudstone Formation installed to medium depths (10-15 mbgl).

Within the Raglan Mudstone Formation there was a distinct head difference between the 10 m -15 m deep monitoring wells and the deeper 30 m – 33 m deep wells. The vertical head difference within the Raglan Mudstone Formation was most distinct in the east of the Site adjacent to the railway line with a head difference of 1.85 m. In all cases there was a downward vertical head difference within the Raglan Mudstone Formation.

The measured groundwater elevations suggest that the water bodies may be directly in connection with each other despite no obvious groundwater strikes noted within the mudstone deposits. As groundwater is present within the mudstone in fissures and joints there is potentially considered to be no unsaturated zone in the Raglan Mudstone Formation.

Borehole Set	Groundwater Elevation (mAOD)			
Screened Unit	BH411/ BH306	BH132/ BH301	BH204A/ BH305	BH102/ BH303
Alluvium	49.77	52.59	50.46	51.51
Raglan Mudstone Formation (15m)	49.46 (-0.31)	52.04 (-0.55)	49.49 (-0.97)	51.09 (-0.42)
Raglan Mudstone Formation (30m)	49.03 (-0.43)	51.67 (-0.37)	49.03 (-0.46)	49.24 (-1.85)

Notes
Based on groundwater elevation data from 29th April 2010
Figures in parentheses are elevation differences (m) relative to the aquifer unit above

Groundwater elevation data have been used in combination with topographic data to calculate the relative resting groundwater elevations at the Meritor facility. The groundwater elevation data has been used to infer a groundwater flow direction to the south and south-east within the Alluvium towards the Afon Lwyd.

Based on the groundwater elevations in the monitoring wells, screened at approximately 15 m within the Raglan Mudstone Formation, a groundwater flow direction to the south-south-east with a more prominent flow direction to the south-east in the southern portion of the Site was inferred. Using the groundwater elevations from the deeper installations a flow direction to the east south-east was inferred. The deeper groundwater had a more easterly component of flow than the shallower deposits. The groundwater in the Raglan Mudstone Formation is likely to be directly in continuity with the Afon Lwyd.

A plan showing the locations of the on- and off-Site monitoring well locations is presented on Figure 4.

2.6 Hydrology

Inspection of the OS map for the area (Landranger 171, Cardiff and Newport, 1997) indicates the nearest surface water feature to the Meritor facility is the Afon Lwyd, located 250 m to the east. Information obtained from the EA website (www.environment–agency.gov.uk) indicates the water quality of the river was classified by the EA as 'C', *i.e.* fair quality in 1998.

Information obtained from the EA website, accessed in November 2007, indicates that there has been a notable improvement in the river quality and between 2004 and 2006 the river was classified by the EA as 'B', *i.e.* good.

The Cwmbran Brook is located 400 m to the west of the facility and is culverted beneath Cwmbran town centre, which discharges to the Afon Lwyd located to the south of the facility.

2.6.1 Flooding Risk

The EA's 'What's In Your Backyard?' search engine indicates that the Afon Lwyd is at risk of flooding in areas without defences. The Meritor facility is indicated to be within an area classified as extent of extreme flooding. Some river defences are present to the south-east of the facility, along the Afon Lwyd.

2.6.2 Surface Water Abstractions

The Enviro*check*® Report provides one record of an active licensed surface water abstraction located within a 2 km radius of the Meritor facility. The abstraction is located approximately 986 m south-west of the facility from the Cwmbran Brook and is licensed to TCBC for intake to the boating lake.

A plan showing the surface water abstractions in the area is presented on Figure 5.

2.7 Ecologically Sensitive Sites

The Countryside Council for Wales 'Interactive Maps' on-line facility, indicates that there are a number of ecological receptors surrounding the Site, as defined by Table A of Annex 3 of the Department for Environment, Food and Rural Affairs (DEFRA) Circular 01/2006 '*Contaminated Land: Implementation of Part 2A of the Environmental Protection Act 1990*'. The ecological receptors are summarised below:

Site	Type	Managed By	National Grid Reference	Approx. Distance from Site (Miles)
Coed Meyric Moel	Wildlife Trust Centre	Gwent Wildlife Trust	ST 272 940	1.7 south-west
Henllys Bog	Site of Special Scientific Interest (SSSI)		ST 263 926	2.6 south-west
Allt-yr-yn	Local Nature Reserve		ST 296 886	4.3 south
Craig Y Wenallt	Woodland Trust Centre	Woodland Trust	ST 260 910	3.5 south-west
Dan-y-graig	Wildlife Trust Centre	Gwent Wildlife Trust	ST 234 903	4.9 south-west

3 SUMMARY OF CONTAMINANT DISTRIBUTION

3.1 Contaminants of Concern

Contaminants identified beneath the Meritor facility include, LNAPL (oils), chlorinated volatile organic compounds (CVOCs) and total petroleum hydrocarbons in soil and groundwater. The predominant Contaminants of Concern (CoC) present in groundwater beneath the Site are CVOCs. The remediation of these compounds will be assessed and designed in a separate document.

3.2 LNAPL Extent and Assessment

3.2.1 LNAPL Extent

Multiple phases of intrusive investigation works have been undertaken to define the presence, extent and type of LNAPL in the sub-surface beneath the Site. The extent of the LNAPL beneath the Site has been delineated through investigation with the Laser Induced Fluorescence (LIF) probe and conventional boreholes, as detailed in the following reports:

- *Phase IIB Environmental Site Assessment Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran. ARCADIS report reference 909362203_03, May 2010.
- *Supplementary Site Investigation Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362509_01, April 2011.
- *Baseline Site-Wide Groundwater Monitoring Report*, Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909362902_01, July 2011.

The investigation and subsequent *Baseline Groundwater Monitoring* (909362902_01, July 2011) has indicated that distribution of LNAPL or heavily saturated soil is as illustrated on Figure 6.

During previous assessment works at the facility, the measured concentrations of CoC in soil and groundwater samples collected from Zone 1 were not considered to present a significant risk to human health or water resource receptors associated with the future end use of the Site. No measurable LNAPL has been encountered in the sub-surface of Zones 1 or 2. Therefore, no LNAPL recovery remediation works are proposed for Zones 1 and 2.

The LNAPL recovery remediation works will be implemented in Zone 3 at the Meritor facility.

3.2.2 LNAPL Assessment

An additional assessment was undertaken to evaluate the likely recoverability of the identified LNAPL, as detailed in the following report:

- *LNAPL Assessment Report,* Meritor Heavy Vehicle Braking Systems (UK) Limited, Cwmbran, ARCADIS report reference 909363303_01, July 2011.

This report concluded that LNAPL at the Site is functionally immobile at the pore-scale but that it has the potential for plume-scale migration. These findings are supported by multiple LNAPL mobility and migration potential analyses. The results of these analyses are summarised as follows.

- LNAPL accumulations show temporal variability in LNAPL thicknesses in the wells, but no increasing LNAPL thickness trends have been observed on-Site. This indicates that changing Site conditions may redistribute the LNAPL at the pore-scale immediately adjacent to wells, but Site-wide migration is not occurring.

- The LNAPL velocities calculated at all possible conditions (Site-specific and conservative, fully-saturated conditions) are below the ASTM International criterion for LNAPL mobility of $1x10^{6}$ cm/s. These pore velocity calculations demonstrate that LNAPL is functionally immobile.

- The LNAPL pore-entry pressure calculations demonstrate that there is sufficient LNAPL head pressure (represented by critical thickness) for migration into pristine soils to potentially occur.

- The recovery time of LNAPL into wells during baildown testing show that LNAPL at the Site has very limited recoverability. Also, LNAPL is less recoverable in the southeast area of Zone 3 and along the eastern property boundary as compared to the south-central area of the building based on the recovery rates during baildown testing.

Comparison of the LNAPL total and recoverable specific volume data provides a theoretical understanding of the proportion of LNAPL volume that exceeds residual saturation near a well of any given thickness. Actual field recoverability may be much less than projected by this volume analysis, as indicated by the limited LNAPL recoverability during bail-down testing and the functionally immobile outcome of the LNAPL velocity calculation.

The data collected during LNAPL recovery pilot testing indicated a limited transmissivity beneath the Site, and hence a limited yield during groundwater pumping. Although a measurable volume of LNAPL removal was observed during the pilot testing (<300 L), it was considered that the volume of LNAPL extracted was not high taking into account the apparent LNAPL thickness measured within the monitoring wells. This is considered to be due to the combination of LNAPL type and the sub-surface ground conditions beneath the Site. The volume of LNAPL recovered during the pilot test is also likely to be affected by the initial accumulation of LNAPL within the monitoring well and in the filter pack. Therefore, sustaining this recovery rate in continuous application is unlikely.

The LNAPL recovered during the LNAPL recovery pilot testing was viscous and due to the agitation and mixing during the total fluids pumping process, underwent some ‘emulsification’. Thus accurate volume measurement was not possible. 300 L was the maximum volume that could be assigned to the recovered LNAPL however, actual volume recovered (considering the poor oil-water separation and absence of discrete LNAPL and aqueous phases associated with emulsification) is likely to have been notably lower.

Given the LNAPL type (heavy oil) and the limited solubility of its constituent compounds, an extensive dissolved-phase hydrocarbon plume has not been observed. Additionally, near source soil gas data indicates that risks to the occupiers of the main production building (commercial workers) presented by the current LNAPL condition are low.

Additional data collected over a longer period of time is desirable to draw definitive conclusions of dissolved-phase plume stability based on Total Petroleum Hydrocarbons (TPH) concentrations in groundwater. Nevertheless, the limited TPH data collected and assessed to-date show that concentrations have decreased over a period of slightly more than a year. A stable dissolved-phase plume indicates a stable LNAPL plume. Thus the observations to date on groundwater quality provide an indication that the LNAPL is in a stable or improving condition.

This suggests that the removal of LNAPL is not required for risk management purposes; although it is acknowledged that recovery of LNAPL would be desirable.

3.2.3 Areas of Greatest Estimated Volumes of LNAPL

The LNAPL assessment indicates that the recovery of a significant percentage of the LNAPL from the sub-surface of the Site may not be possible and is likely to take a considerable timescale. The LNAPL distribution, based on the LNAPL thickness measured within monitoring well network across Zone 3 area, has been evaluated and is presented in Figure 6.

It is considered that the LIF data gives the best resolution of LNAPL vertical distribution. Therefore the LNAPL distribution beneath Zone 3 was further refined using LIF data collected by ARCAIS between September and December 2010 (Supplementary Site Investigation Report, ARCADIS Ref: 909362509_01, April 2011) in order to identify site areas (in Zone 3) where it is considered that the most efficient recovery of LNAPL will be possible.

The LIF is calibrated before each run using a standard oil sample to ensure that the laser is optimised to the same power output for each LIF location. This step aims to ensure that the same level of in-ground impacts produce a similar fluorescence response in the LIF. The response (%RE) is reported relative to the standard oil referred to as a reference emitter (RE). The locations where a LIF response of near or greater than 100 %RE over at least 100 mm thickness were considered as notable impacts and the potential presence of recoverable LNAPL within the soil matrix. These locations were identified across Zone 3 as the most recoverable LNAPL area in order to implement a LNAPL recovery system at the Site.

Accordingly, The area identified where effort to extend LNAPL are considered to be most effective are presented on Figure 7.

3.3 Summary

ARCADIS propose that the Conceptual Site Model (CSM) is continually reviewed, and if necessary refined, following the collection of additional data and/or commissioning of the full-scale LNAPL recovery system.

Given the distribution of measurable LNAPL, remediation works associated with LNAPL recovery will be focused on Zone 3 only. Given the limited nature of the dissolved phase TPH concentrations associated with the LNAPL and the low volatility of the LNAPL, human health and environmental risks associated with the presence of LNAPL are considered to be low. Therefore, LNAPL remediation works are targeted at areas of LNAPL where the potential for recovery is considered to be greatest to reduce the future potential for LNAPL migration and provide betterment to the sub-surface conditions.

4 SUMMARY OF REMEDIATION OPTIONS APPRAISAL

4.1 Remediation Options Appraisal

The purpose of the Remediation Options Appraisal (ROA) report is to present a review of previous environmental works, identify and evaluate feasible remediation technologies and define specifications of further investigative works that may be needed in order to develop the final remediation technology selection and design.

For further information, see the ARCADIS *Remediation Options Appraisal Report* (909362302_02, August 2010) referenced previously in this report.

4.1.1 Methodology for Selecting Remediation Technologies

The selection procedure for the appropriate remediation options broadly follows the decision making process outlined by Contaminated Land Report 11 (DEFRA and EA 2004) and the Construction Industry Research and Information Association (CIRIA), incorporating the issues raised by the EA for the selection of remediation strategies. The Site specific objectives are broken down into the following areas:

- Technical Parameters;
- Operational Parameters; and,
- Commercial Parameters.

The objectives and Site-specific constraints are prioritised in order to reconcile potential conflicts, and a ranking procedure is used to identify and evaluate potential remediation options. The remediation design selection procedure involves the following stages:

Stage 1: Review of the available technologies and a preliminary assessment of their suitability, based on **technical** feasibility;

Stage 2: Identification/assessment of appropriate technologies based on **operational** practicability; and,

Stage 3: Evaluation of appropriate technologies based on **commercial** feasibility.

Following the identification and evaluation of the appropriate technologies, professional judgement is applied to the final design of remediation strategies. This involves incorporating the design decisions along with principles such as practicability, effectiveness, durability and efficiency in order to determine the most appropriate strategy for tackling the pollutant linkages identified.

4.1.2 Selected Remediation Technologies

The following technologies were identified as suitable for addressing impacts to soil and groundwater in the southern area of the Site (Zone 3) by managing or breaking the source-pathway-receptor linkages:

South-East Corner of Site

- Excavation and disposal of impacted shallow soil;
- LNAPL Removal *via* Total Fluids Pumping (TFP) or LNAPL skimming;
- Potential DNAPL Removal (if identified); and,
- Groundwater Treatment *via* Enhanced Reductive Dechlorination (ERD) or *In Situ* Chemical Oxidation (ISCO).

As discussed in Section 3, the predominant CoC present in groundwater beneath the Site are CVOCs. The remediation of these compounds will be assessed and designed in a separate document. This document specifically addresses the recovery of LNAPL from the sub-surface of Zone 3.

4.2 Remediation Method Statement

The objective of Remediation Method Statement (RMS) was to outline the environmental works to be undertaken during and beyond the proposed refurbishment of Zone 3.

For further information, see the ARCADIS *Remediation Method Statement* (909362819_01, January 2011) referenced previously in this report.

4.2.1 Remediation Approach

The following technologies were identified as potential applications for managing the impacts identified in Zone 3, by managing or breaking the source-pathway-receptor linkages:

- Excavation and Disposal of Impacted Soil
- LNAPL Removal *via*
  - TFP; or ,
  - LNAPL Skimming.
- DNAPL Removal (if encountered);
- ERD for dissolved phase CVOC treatment.

4.3 Finalised Remediation Approach for LNAPL Removal from the Sub-Surface of Zone 3

ARCADIS considered TFP or LNAPL skimming to be suitable *in situ* treatment options for the LNAPL associated with the shallow groundwater in the south-east corner of Zone 3. Reducing the mobile LNAPL will reduce the potential for plume-scale migration of residual LNAPL.

Total Fluids Pumping is the preferred technique as the installation of a TFP system along the south and south-eastern Site boundaries will enable LNAPL recovery and in addition will provide hydraulic containment and will restrict the potential for off-Site migration of LNAPL.

In developing the remediation options, excavation and disposal of soil in the south east corner was considered but was not carried forward as the preferable option for the following reasons:

- Excavation and off-Site disposal is not a sustainable approach to remediation. It also presents additional impacts to the local area (heavy vehicle movements, *etc*).
- The risk presented by the LNAPL to groundwater quality is considered low due to its composition and low solubility, hence the cost of excavation works is considered disproportionate to the achievable reduction in risk to identified receptors.
- The proximity to the railway line will mean that permission from Network Rail will need to be obtained prior to commencing the works, and geotechnical restrictions on how close the excavation can progress towards the railway line will limit the effectiveness of the technique.
- The proximity of a retaining wall with the adjacent site would require other geotechnical considerations, thus increasing costs and reducing area of contamination that can be accessed.
- The LNAPL distribution will extend below the resting groundwater table hence requiring excavation stability control measures and dewatering processes to be implemented to enable excavation works, an approach which may not be cost effective.
- Given the distribution of LNAPL across Zone 3, if excavation works were undertaken in the south-east corner, residual LNAPL would remain under the footprint of the production building hydraulically up-gradient of the south east corner, thus potentially allowing recontamination of reinstated material although the LNAPL appears to have relatively limited mobility.

- Limiting the number of technologies, *i.e.* using TFP and SVE across the Site enable synergies from a cost and sustainability perspective to be realised.

5 ENGINEERING CONSIDERATIONS

5.1 Access and Security

A planning application (reference Application Number 11/P/00101) has been submitted to the Local Planning Authority, TCBC, for the redevelopment of the northern zones at the Meritor facility (Zones 1 & 2) and for the refurbishment of the southern zone (Zone 3). Detailed redevelopment plans which have been provided to ARCADIS, and are presented in the planning application, indicated that three main commercial developments will be carried out on Site, as follows:

- **Zone 1** – Employee car park to the north of the main production plant, to be redeveloped with a new supermarket, associated petrol filling station and two smaller retail units (as well as a pedestrian bridge from the Site into Cwmbran town centre).

- **Zone 2** – Central portion of the Meritor Site including the HGV entrance, loading bay and the northern third of the existing production building to be redeveloped as commercial offices with a hotel (and associated bar/ restaurant) and car parking areas.

- **Zone 3** – The reminder of the production building (south of building column row M) and the southern yard area and visitors car park to be retained as a heavy vehicle braking systems production building with associated employee and visitor car parking areas; an engineering centre; and Meritor's offices.

The proposed redevelopment areas are presented on Figure 3. A more detailed plan of the proposed redevelopment of Zone 3 is presented on Figure 8.

Zone 3 will continue to be a braking system manufacturing/assembly facility throughout the duration of the remediation works.

5.1.1 Access

Current Access
Access to Zone 3, the land to be retained by Meritor and the focus of the remediation works, is currently *via* Security Gate 1 from Grange Road. Access to the current visitors car park is *via* a more southerly security gate from Grange Road. Access can also be gained to the Meritor facility *via* Security Gate 2 from Grange Road. Gate 2 is located to the north of Zone 3.

Current access arrangements are presented on Figure 9.

Future Access
Access can currently be gained to the Meritor facility *via* Security Gate 2 from Grange Road. Gate 2 is located to the north of Zone 3 and therefore access will be restricted and no longer possible through this route following the sale of Zones 1 and 2. Following the refurbishment of Zone 3, vehicles will enter the site via Gate 1 and will be directed around the site in a counter clockwise direction until reaching a turning head in the north of Zone 3. Vehicles will reverse direction at the turning head, retrace their route in a clockwise direction, and exit the Site *via* Gate 1.

Future access arrangements are presented on Figure 10.

Access for Remediation Engineers
The remediation strategy requires and assumes unrestricted access to the southern yard area and southern portion of the main production building by ARCADIS to enable installation of the extraction wells and in order to install and operate the remediation system.

Where structures and Site boundaries are present, factors such as stability and access may place limitations on the extent of remediation achievable in these areas.
The scope of remediation activities at the Site may be constrained by the presence of potential underground structures (building footing *etc*), and the requirement to minimise disruption to the Site.

5.1.2 Zone 3 Refurbishment

During the refurbishment of Zone 3, the current production building will be reduced in size at the northern portion of the building. The warehouse building to the immediate south of the main production building will be demolished all but the electrical sub-station present at the eastern end. The southern portion of the production building is currently undergoing clearance and decommissioning of areas such as the paint line (Recognised Environmental Condition 5, see the *Phase I ESA* [909361804_02, January 2010] previously referenced). ARCADIS understands that on completion of the clearance and decommissioning works the southern portion of the production building will be vacant for approximately 12 months, allowing access for the installation of remediation infrastructure. Although certain operations will be re-installed in the southern portion of the building as early as May 2012. However, it is understood that after 12 months the southern portion of the production building will utilised for the assembly and production of braking systems and access will be restricted in this area of the Site.

During the refurbishment of Zone 3, the current southern yard area will be redeveloped as a car parking area for Meritor employees and visitors to the Site. It is understood that employees and visitors will require access to the southern yard area throughout the duration of the proposed remediation works.

The remediation technologies selected are considered to be appropriate for the identified impacts and geology identified beneath the Site given the Site-specific constraints.

5.1.3 Security

24 hour a day security is present at the Site. The security areas will be relocated from Security Gates 1 and 2 to a central area as indicated on Figure 10. Fencing and closed circuit television (CCTV) cameras currently in place will be retained for Zone 3 following the refurbishment.

In order to prevent unauthorised access to the system and minimise the effects of potential vandalism, all critical above ground components of the system should be housed within the secure locked steel shipping container. The permanent components of the remediation infrastructure will be installed below ground with access *via* inspection chamber covers.

5.2 Ground Conditions

The remediation area of the Site is currently a yard area used for the unloading and loading of HGVs and for storage and the southern portion of the main production building. Formerly the off-highway vehicle braking systems production building, the boiler and compressor houses and a series of stores including chemical and paint stores, were located in the yard area and were subsequently demolished. There is the potential for the footings of these buildings to remain. The scope of remediation activities at the Site may be constrained by the presence of potential underground structures (building footing *etc*), and the requirement to minimise disruption to the Site, which will remain an active production facility throughout.

Following the refurbishment of Zone 3, the area will be utilised as a car park for Site employees and visitors. The selected remediation technologies must be compatible into the future Site infrastructure to ensure the continued operation of the Site.

5.2.1 External Hardstanding

The southern yard area is currently surfaced with concrete that is in adequate condition but with obvious cracks and scarring. ARCADIS understands that following the refurbishment of Zone 3, a bituminous surfacing will cover the car parking area. ARCADIS understands that the external area will be leveled off and the bituminous surfacing applied. Curbing will be utilised along sections of the main HGV route around Zone 3.

The remediation infrastructure has been installed flush with the current ground level and would be adjusted as required by the contractor undertaking car park re-surfacing during the February and March 2012. .

5.3 Utilities

The implementation of the proposed LNAPL recovery remediation scheme requires the service of utilities to the Site.

Power
Operation of the remediation equipment at the Site would require a suitable 100 Amp, three-phase, 415 V power supply to be available.

Electricity consumption would be dependant on final equipment specification and the load under which the pumps are running (dependant on Site-specific conditions).

Sewer
Abstracted groundwater once treated should be discharged. The preferred discharge route would be to trade effluent sewer under discharge consent. However, ARCADIS are also investigating the possibility of re-injecting the abstracted up-gradient of the extraction well network at the Site.

5.4 Specific Notable Items

ARCADIS understands that the southern portion of the main production building is undergoing a programme of refurbishment, including the removal of steel from the structure that supported the original roof (the roof was replaced but the original structure remained redundant but *in situ*), painting, installation of sky lighting and laying of the new flooring.

Externally, infrastructure including the warehouse to the immediate south of the main production building and buildings along the eastern Site boundary will be demolished.

During this time ARCADIS understands that Meritor will be utilising a Permit-to-Work system for these areas of the Site. A permit from Meritor may be required to access the southern yard area on a daily basis whilst the remediation infrastructure is being installed and groundwater monitoring is being undertaken.

5.5 Timescale Considerations

Meritor requires a cost-effective remediation approach to mitigate the potential risks associated with the intended industrial end-use of Zone 3.

The installation of the remediation infrastructure in the southern yard is on-going at the time of writing, and is scheduled to be completed by the end of January 2012. The implementation of active remediation works in the South yard is expected to start in March 2012.

5.6 Stakeholder Considerations

Meritor
ARCADIS understands that Meritor owns the wider Site and will retain Zone 3 and that it is to remain braking systems manufacturing plant. Therefore, remediation technologies installed on Site should be designed to minimise disruption to Site operations. Elements of the infrastructure for the proposed *in situ* remediation system will need to be installed below ground to allow continued use of the Site. Risk management options have been assessed giving an equal priority to remediation technologies that would cause significant disruption to Site operations.

Regulators
Remediation should be carried out in a manner acceptable to the Regulators. The works should be designed to minimise the potential for harm to human health and pollution of the environment. In addition, the works should not have a serious detriment to the local amenity.

Neighbouring Businesses
The Site is located in close proximity to neighbouring commercial properties; this places considerations on control of noise and prevention of vapour migration that may arise from the application of potential remediation technologies.

5.7 Health and Safety Considerations

In order to prevent unauthorised access to the remediation system and minimise the effects of potential vandalism, all critical above ground components of the system should be housed within the secure locked compounds. Additional fencing will be maintained throughout the remediation infrastructure installation works to minimise the potential for unauthorised access.

5.8 Areas of Uncertainty

The LIF and MIP probe holes, boreholes and monitoring wells have been primarily located to target Recognised Environmental Conditions at the Site and they should identify significant areas of concern with regard to soil and groundwater impacts. However, there is potential for higher concentrations of the CoC, as hotspots, to be present in areas of Zone 3 that have not been investigated due to current structures, or equipment.

6 REMEDIATION OBJECTIVES

The objectives of the proposed remediation are to reduce the volume of LNAPL identified beneath Zone 3, to minimise the potential for off-Site migration of LNAPL, and to minimise the potential for remediation works to cause contamination of previously uncontaminated areas of the site.

6.1 Remediation Criteria

Although the risks to human health and the environment are low, Meritor has commissioned ARCADIS to undertake LNAPL recovery from the sub-surface of Zone 3. Therefore, the remediation criteria will be considered to have been met when either of the following criteria have been achieved:

- LNAPL recovery rates from the proposed recovery system have become low or reached asymptotic conditions and dissolved-phase concentrations of TPH compounds related to the presence of residual LNAPL are not presenting an unacceptable risk.

- A revision of the risk assessment, justified by changes in the plume geometry or the conceptual understanding of the Site, indicates that the reduced mass of contaminants are not presenting an unacceptable risk; or

The benefits of continued remediation should be considered against the costs throughout the works. It is anticipated that one of more of the above criteria can be achieved with the proposed design, which has been developed with relative benefits for the cost of the works in mind. If one of the above criteria is not achieved within the scope of the design, cost-benefit analysis will be considered as a justification that additional remediation works should not be undertaken considering likely improvement to the Site condition that could be achieved, versus environmental and financial costs.

The LNAPL recovery rates may be assessed using decline curve analysis.

7 COST-BENEFIT ANALYSIS

The proposed LNAPL remediation approach considers targeting LNAPL recovery at those areas of the Site where LIF investigation data has indicated the greatest volume of LNAPL is likely to be recoverable from the sub-surface of Zone 3.

Given the LNAPL composition, soil gas data and the results of the groundwater monitoring to date, the driver for the proposed LNAPL recovery is associated with the limited potential for plume-scale migration, as determined during the LNAPL Assessment Report (ARCADIS report reference 909363303_01, July 2011) referenced previously in this report, rather than specific human health or environmental drivers[1]. The targeted recovery of LNAPL is a pragmatic approach to provide Site betterment, whilst balancing implementation costs and the practicalities of performing remediation activities at an active manufacturing facility.

The key elements of the proposed scheme include:

- LNAPL recovery in the areas of greatest likely recovery (based on LIF data); and,
- LNAPL recovery and containment along the southern and south-eastern Site boundaries.

In order to further support the approach proposed, a limited Cost-Benefit Analysis (CBS) has been undertaken, comparing the proposed 'targeted' approach with one to provide LNAPL recovery across the entire Site areas where LNAPL has been identified. The comparison between the 'Site-Wide and targeted' approach assume the same technology (Total Fluids Pumping) is implemented.

7.1 Appropriate Guidance

The following Regulatory guidance documents have been referred to during the preparation of this section of the report:

- *Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination*. Environment Agency, Carey, M.A., Marsland, P.A. and Smith, J.W.N., 2006.

- *Cost-Benefit Analysis for Remediation of Land Contamination, R & D Technical Report P316*, Bristol: Environment Agency Postle, M., Fenn, T., Grosso, A., and Steeds, J., 1999.

- *Sustainable Remediation Assessment*, *Annex I The Sustainable Remediation Forum UK (SuRF) Indicator Set for Sustainable Remediation Assessment*: Contaminated Land: Applications in Real Environments (CL:AIRE) London, 2011.

7.2 Cost-Benefit Analysis

"*Provided that the cost-benefit analysis does not end in a decision which results in an unacceptable risk to human health or other receptors still being present, or feasibly being present in the future, it can be a useful and effective tool to guide the choice of remediation strategy and highlight whether the benefits of continues remediation can be warranted. Benefits can include environmental, social or economics, making this a powerful tool when used appropriately, allowing different stakeholders concerns to be brought into the decision-making process*".

> *Sustainable Remediation Assessment*, *Annex I The SuRF Indicator Set for Sustainable Remediation Assessment*: CL:AIRE London, 2011.

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[1] Principle 1 for Sustainable Remediation Assessment, Annex I SuRF Indicator Set for Sustainable Remediation Assessment, CL:AIRE, 2011 met, therefore appropriate to look at qualitative sustainable assessment.

In this scenario, the driver for the proposed LNAPL recovery is associated with the limited potential for plume-scale migration not a potential risk to human health or environmental receptors.

7.2.1 Comparison between the 'Site-Wide' and Targeted Remediation Approach

Consideration has been given to the costs and benefits of the 'targeted' and 'Site-wide' approach in the table on the following page. The approach involves initial qualitative assessment against the SuRF indicator set of parameters.

Table 1: Change in Costs & Benefits Associated with the 'Site-Wide' and Targeted Remediation Approach - Social Factors

Category		Cost Difference	Benefit Difference
SOC1	Human Health & Safety	Increased risk to human health through: • Requirement for additional travelling to and from Site • Requirement for additional maintenance works • Increased use of plant/ machinery to deliver increased scope	No additional benefits identified. Identified LNAPL not determined to be human health risk
SOC2	Ethics and Equality	No additional costs identified	No additional benefits identified
SOC3	Neighbourhood and Locality	Increased impacts to neighbourhood through: • Increased vibration from plant/ machinery to deliver increased scope • Increased noise from plant/ machinery to deliver increased scope and from vehicles required for additional maintenance works and additional travelling to and from Site • Increased noise from plant/ machinery to deliver increased scope and from longer-term operation of remediation system plant • Likelihood that weekend and/ or evening works will be required to deliver increased scope	No additional benefits identified. LNAPL has been present for many years and no neighbourhood effects reported
SOC4	Communities and Community Involvement	No additional costs identified	No additional benefits identified
SOC5	Uncertainty and Evidence	Greater requirements with increase in scope for validation	Uncertainty reduction

Table 1: Change in Costs & Benefits Associated with the 'Site-Wide' and Targeted Remediation Approach - Economic Factors

Category		Cost Difference	Benefit Difference
ECON1	Direct Economic Costs and Benefits	Increased cost of delivering scope estimated increase from £485,000 to £1,400,000	No financial benefit. Remediation of LNAPL does not change industrial/ manufacturing Site end -use
ECON2	Indirect Economic Costs and Benefits	No clear indirect cost increases	No clear indirect cost increases – both approaches control the identified low risk of plume-scale migration
ECON3	Employment and Employment Capital	No additional costs identified other than short-term increase in project spend	Potential short-term increase in employment due to number of staff or man hours required to complete increased scope
ECON4	Induced Economic Costs & Benefits	No additional costs identified	No additional benefits identified
ECO5	Project Lifespan and Flexibility	Potential for operation and maintenance uncertainty through project lifespan gives increased infrastructure requirements and increased operation time	Increased flexibility in remediation system

Table 1: Change in Costs & Benefits Associated with the 'Site-Wide' and Targeted Remediation Approach - Environmental Factors

Category		Cost Difference	Benefit Difference
ENV1	Air	Increase in power requirements (electricity) due to increased system size, which may result in greater emissions to air	Potentially operating timeframe resulting in reduction in power requirements. No additional benefits identified
ENV2	Soil and Ground Conditions	No additional costs identified	No additional benefits identified
ENV3	Groundwater and Surface Water	Use of local aquifer to support an abstraction – potential depletion in available water quantity/ base flow to river	Minor difference in potential for dissolved-phase contribution from residual LNAPL Given targeting of LNAPL recovery at areas of significant recoverability, incremental increase in extension of the LNAPL recovery system will not result in a linear increase in the recovered volume of LNAPL
ENV4	Ecology	Increased disturbance during implementation and specifically during installation of increased infrastructure	No additional benefits identified
ENV5	Natural Resources and Waste	Increased use of energy, materials, fuels and carbon Increased water abstraction	No additional benefits identified

7.2.2 Differences Identified

Where a large difference in cost or benefit between approaches has been identified attempts have been made to quantify the cost or benefit.

The biggest quantifiable difference, between the two remediation approaches, identified by ARCADIS is the difference in cost. ARCADIS estimate that the increased cost of implementing the 'Site-wide' approach would result in a £1,000,000 increase in costs for little environmental or land use benefits.

ECON1	Increased cost of delivering scope estimated increase from £485,000 to £1,400,000	No financial benefit Same industrial land end -use

The other important difference identified is the increased risk to human health and safety implications of the additional system installation, operations and transport requirements.

7.3 Summary

Given the LNAPL composition, soil gas data and the results of the groundwater monitoring to date, the driver for the proposed LNAPL recovery is associated with the limited potential for plume-scale migration, as determined during the *LNAPL Assessment Report* (ARCADIS report reference 909363303_01, July 2011) referenced previously in this report, rather than specific human health or environmental drivers.

The proposed LNAPL recovery approach has been compare with a 'Site-wide' approach and an evaluation of the potential costs and benefits of increasing the LNAPL recovery footprint has been made. The conclusion of this analysis is that extension of the system does not result in significant additional benefit but does incur considerable additional cost.

8 REMEDIATION DESIGN

8.1 Outline Strategy

Studies to date at the Site have illustrated that a significant thickness of LNAPL is present especially in southern and south eastern corner of the Site. Evaluation of LNAPL mobility indicates that potential for migration is relatively low but cannot be discounted. In addition, significant CVOC impacts are present beneath the Site. Treatment technologies for these contaminants may differ and may comprise engineering of *in situ* reactive zones (IRZ) through reagent injection. If such IRZ methodologies are employed, hydraulic containment may be required as the remediation technique may increase the mobility of LNAPL through hydraulic gradient change or the generation of natural surfactants.

Therefore, the approach for LNAPL recovery is targeted at recovering LNAPL from areas where the most significant thickness is present, where it can be readily targeted without causing significant disruption to on-going manufacturing activities. Additionally, LNAPL at Site boundaries (east and south) will be targeted to reduce the potential for off-Site migration, and to assist with flexibility of future remediation approaches for addressing CVOC contaminants.

The areas where LNAPL recovery will be targeted are highlighted on Figure 7.

The remediation strategy for LNAPL recovery will adopt the following technology:

- Total Fluids Pumping.

LNAPL removal *via* TFP is a mass removal technology that can reduce LNAPL saturation to residual saturation. At residual saturation, LNAPL will not flow and therefore hydraulic recovery is no longer possible. Given the limited dissolved-phase TPH concentrations and low volatility of the LNAPL, the presence of residual LNAPL at or above residual saturation is considered to present a low level of risk to the identified receptors associated with the Site. The reduction of LNAPL towards the point of residual saturation is considered to manage the potential for LNAPL migration.

The TFP system can also be configured to assist with the implementation of remediation to address dissolved-phase concentrations of CVOCs (to be addressed in a separate RIP).

8.2 Outline Design – Total Fluids Pumping

8.2.1 Pilot Test Results

Oil Recovery Remediation Pilot Testing (909362711_01, June 2011) comprised groundwater pumping tests on both the Alluvium and Raglan Mudstone Formation aquifers beneath Zone 3, and limited SVE and Dual-Phase Extraction (DPE) testing.

During the groundwater pumping pilot test on the Alluvium aquifer (EX01), a maximum abstraction flow rate of 3 L/ minute was achieved. This was sufficient to create a drawdown of 1.4 m in the abstraction well. During the groundwater pumping pilot test on the Raglan Mudstone Formation aquifer (EX05), a maximum flow rate of 3 L/ minute was achieved. This was sufficient to create a maximum drawdown of 1.4 m in the abstraction well.

An effective radius of influence is considered to be 6 - 12 m in both the Alluvium and Raglan Mudstone Formation aquifer, in order to achieve a considerable drawdown around the pumping well. It is estimated that a drawdown of about 0.2 m - 0.3 m will be achieved within this selected radius of influence.

The ranges of transmissivity and hydraulic conductivity determined during the groundwater pumping tests are summarised overleaf:

Parameters	Range
Transmissivity (T)	1.94 – 11.50 (m^2/day)
Hydraulic Conductivity (K)	0.42 – 2.49 (m/day)

8.2.2 Total Fluids Pumping Technology Description

The TFP will be used to remove LNAPL and impacted groundwater from beneath the Site. The extraction of fluids causes drawdown of the water table at the extraction point, thereby creating a cone of depression. This effectively alters the local hydraulic gradient within the radius of the influence of the extraction well, resulting in LNAPL migration towards the extraction point, and additionally providing a hydraulic barrier minimising off-Site migration of LNAPL product and the dissolved-phase contaminant plume. Separated groundwater can be treated before discharge.

It is therefore recommended that the remediation systems are configured to draw down the resting groundwater table towards the base of the zone impacted by LNAPL. This can be determined by inspection of the LIF logs and corresponds to the clayey cobble and boulder band above the underlying Raglan Mudstone Formation.

The TFP treatment systems components are listed below:

- Top Loading Pneumatic Down-Well Pumps;
- Air Compressor;
- Oil Water Separator;
- LNAPL Storage Tank;
- Transfer Pumps;
- Sand Filter; and,
- Air Stripper and Granular Activated Carbon (GAC).

8.3 Natural Surfactants

There is high interfacial tension between LNAPL molecules and water molecules which limits the recoverability of LNAPL through physical removal techniques. Based on pore velocity calculations, the LNAPL beneath the Site has been demonstrated to be functionally immobile (further reference should be made to the *LNAPL Assessment Report* 909363303_01, July 2011).

Surfactants (surface active agents) can promote the enhanced removal of LNAPL from the sub-surface through mobilisation and solubilisation. One advantage of the IRZ methodologies described above in Section 7.1, is the generation of natural surfactants. The generation of natural surfactants, through the proposed ERD groundwater treatment, may increase the mobility and recoverability of the LNAPL.

The TFP system will provide hydraulic containment along the hydraulically down-gradient southern and south-eastern boundaries of Zone 3, and enable the potential increase in the mobility of LNAPL through hydraulic gradient change or the generation of natural surfactants to be controlled, and increase contaminant mass removal potential.

8.4 Infrastructure Requirements

The provisional layout of the TFP systems are presented on Figure 11.

Above-ground remediation containers should be used to house the equipment for the remediation systems to enable easy access for maintenance of the systems. Pipe work will connect the remediation systems to remediation wells *via* sub-surface ducting installed in shallow utility trenches; each remediation well will be accessed *via* an inspection chamber. By linking the remediation wells and containers *via* a network of underground ducts, the Site will be able to operate as a car parking area and production facility.

The southern car park sub-surface infrastructure has been installed as of February 2012 to allow car park installation works to commence under Permitted Development.

The specification for the remediation infrastructure is given below.

8.4.1 Phase I – External Remediation Infrastructure Installation

Extraction Wells – South Yard Area

- Number of Existing Extraction Wells: 23
- Number of Additional Extraction Wells: 0
- Diameter of Extraction Wells: Minimum 100 mm and maximum of 125 mm
- Monitoring Well Screen: 1.0 mbgl to base of well (~ 5.0 m – 7.0 mbgl)
- Well Screen Slot Size: 0.5 mm
- Filter Pack Grain Diameter: 0.75 – 1.25 mm

The layout of the external remediation system infrastructure is presented on Figure 11 and comprises 23 extraction wells. The extraction wells are located within inspection chambers, the specification of which is presented below:

Inspection Chambers

- Minimum Depth: 750 mm
- Minimum Length: 600 mm
- Minimum Width: 450 mm
- Inspection Cover: Steel Flush to Proposed Hardstanding Level
- Inspection Cover Rating: Traffic Rated/ Heavy Duty (up to 40 tonnes)

Remediation System Ducting

Wells are connected by 150 mm diameter sub-surface ducting where required, installed in shallow trenches or running above ground.

- 150 mm diameter ducting, multiple ducts as required.
- Draw-cords are installed within all ducts.

Bund

The remediation container and storage vessels associated with the TFP system should be located on an impermeable surfaced area with adequate drainage and containment to protect against accidental spillage.

8.4.2 Phase II – Internal Remediation Infrastructure Installation

Extraction Wells – Main Production Building

- Number of Existing Extraction Wells: 0
- Number of Additional Extraction Wells: 11
- Diameter of Extraction Wells: Minimum 100 mm
- Monitoring Well Screen: 1.0 mbgl to base of well (~ 5.0 m – 7.0 mbgl)
- Well Screen Slot Size: 0.5 mm
- Filter Pack Grain Diameter: 0.75 – 1.25 mm

The provisional layout of the internal remediation system infrastructure is presented on Figure 11 and comprises 15 additional extraction wells. The extraction wells are to be located within inspection chambers, the specification of which is presented overleaf:

Inspection Chambers

- Minimum Depth: 750 mm
- Minimum Length: 600 mm
- Minimum Width: 450 mm
- Inspection Cover: Steel Flush to Proposed Floor Level
- Inspection Cover Rating: Heavy Duty

Remediation System Ducting

Wells will be connected by 150 mm diameter sub-surface ducting where required, installed in shallow trenches. The majority of the pipework, where possible, will be run above-ground.

- 150 mm diameter ducting, multiple ducts as required.
- Draw-cords should be installed within all ducts.

8.4.3 Utility Requirements

The implementation of the proposed TFP remediation scheme requires the service of utilities to the Site as detailed in Section 4.3.

9 REMEDIATION METHODOLOGY

9.1 Scope of Works

The proposed remediation for the site comprises the following tasks:

Task 1: Planning, Regulatory Interface and Power Connection
Task 2: Phase I - Installation of Remediation Infrastructure (External)
Task 3: Phase II - Installation of Remediation Infrastructure (Internal)
Task 4: Baseline Monitoring
Task 5: TFP System Commissioning
Task 6: Systems Operation and Monitoring
Task 7: Remediation Verification

The programme assumes a three month period of planning and Regulatory liaison to obtain an Environment Permit for the proposed remediation works and vary the discharge consent held by Meritor for the facility (see Section 9 of this report). Remediation infrastructure installation externally is currently on-going, and scheduled to be completed by the end of February 2012. Mobilisation and commissioning of the remediation system externally would be undertaken following completion of the infrastructure installation followed by an estimated operational period for the remediation equipment of 36 months. Six months post-remediation monitoring is proposed following the operational period.

Installation of the internal remediation infrastructure is anticipated to begin in March 2012.

9.2 Project Team

It is considered that the overall project team should comprise the following components:

ARCADIS Delivery Team	ARCADIS Peer Review	Meritor	
Project Director Project Manager Dedicated Field Staff Appointed Sub-Contractors	Account Manager Technical Health and Safety Officer Purchasing Officer	Environmental Manager	Refurbishment Programme Manager

9.3 Health and Safety Requirements

Risk assessments will be undertaken for the phases of work and, where applicable, method statements will be developed for the tasks.

9.4 Remediation Phasing and Zoning

During the groundwater monitoring visit conducted in February-March 2011, LNAPL was encountered in the monitoring well network in Zone 3 only and the greatest LNAPL thickness in the south-east concern of the Meritor facility. The proposed TFP remediation system should address the identified LNAPL. The phasing of the remediation is described in the following section.

ARCADIS understands that the southern portion of the main production building is undergoing a programme of refurbishment, including the removal of steel from the structure that supported the original roof (the roof was replaced but the original structure remained redundant but *in situ*), painting, installation of sky lighting and laying of the new flooring.

Externally, infrastructure including the warehouse to the immediate south of the main production building and buildings along the eastern Site boundary will be demolished prior to the redevelopment of the south yard into a car park.

Therefore, ARCADIS propose that the first phase of remediation infrastructure installation occurs externally in the south yard area (Phase I), prior to the commencement of the redevelopment works. Phase II of the remediation infrastructure installation inside the southern portion of the main production building should subsequently be undertaken when safe and sufficient access can be obtained following the removal of the steel from the roof.

9.4.1 Remediation Tasks

Task 1: Regulatory Interface
The programme assumes a three month period of planning and regulatory liaison. However, the lead-in period for planning and Regulatory liaison will be subject to the responses received. The following issues should be addressed during this period:

- Remediation licensing;
- Health and safety plans, method statement development *etc*; and,
- Equipment and service procurement.

Task 2: Phase I - Installation of Remediation Infrastructure (External)
The remediation infrastructure and the remediation equipment are proposed to be installed in the southern yard area at the Site with a provisional layout as presented on Figure 11.

The installation of the remediation infrastructure, including the installation sub-surface ducting, where required, and inspection chambers is currently on-going in the southern yard, and scheduled to be completed by the end of February 2012, The works are being carried out in line with the layout presented on Figure 11. An as built plan of the infrastructure will be produced following completion of the works.

Task 3: Phase II - Installation of Remediation Infrastructure (Internal)
The remediation infrastructure, including the installation sub-surface ducting, where required, and inspection chambers, and the remediation equipment are proposed to be installed in the southern portion of the main production building at the Site with a provisional layout as presented on Figure 11.

It is anticipated that the infrastructure installation works would take in the order of 5 to 8 weeks to complete. Partial closure of the southern portion of the main production building may be required during this work.

Task 4: Baseline Monitoring
In order to determine the area for treatment, obtain comprehensive and consistent groundwater quality information beneath the Site, and to provide a baseline to measure the performance of the remediation system, a groundwater monitoring visit is proposed comprising the inspection of selected on-Site monitoring and extraction wells for the presence of groundwater and LNAPL, measurement of depths to groundwater and thickness of LNAPL, if present, using an interface probe, and groundwater sampling.

Task 5: TFP System Commissioning
Delivery of the remediation systems to Site is most likely to be *via* lorry mounted crane to enable the remediation compound to be positioned in the locations indicated on Figure 11. Proposed commissioning tasks include:

- Power connection;
- GAC unit installation and connection;
- Initial system adjustments; and,
- Safety checks.

On commissioning of the TFP system, the following data should be collected to assess the initial operating parameters of the systems, evaluate the radius of influence, and enable adjustment of the initial configuration:

- Depth to groundwater across the treatment area;
- Groundwater extraction rates; and,
- Quality of discharge water post treatment plant.

Task 6: TFP System Operation and Monitoring
The systems should be operated automatically and monitored monthly in order to confirm the operation of the systems. The plant operating, monitoring and maintenance schedule is designed to meet three key requirements for the operation of the TFP remediation systems.

1. To provide data for the tracking of system performance and progress towards the remediation objectives, and allow necessary adjustments to be made to optimise the system.
2. To ensure reliable operation of the remediation system to minimise downtime, and ensure clean-up goals are achieved as swiftly as possible.
3. To meet regulatory requirements for the waste discharge streams.

The provisional plant Operation and Monitoring (O&M) schedule comprises the following tasks:

Monthly
- Visual inspection of systems;
- Systems optimization;
- Measurement of depth to LNAPL and resting groundwater in selected monitoring wells;
- Water volume discharge measurements;
- Post-treatment groundwater discharge quality monitoring (as dictated by the discharge consent);
- Volume of LNAPL abstracted and requirement for disposal; and,
- Recording of power consumption.

Biannually
- All monthly tasks;
- Equipment maintenance; and,
- Groundwater sampling from the following monitoring wells for subsequent laboratory analysis (unless LNAPL is present):

▪ BH103	▪ BH136	▪ EX15
▪ BH108	▪ BH400	▪ EX17
▪ BH109	▪ BH402	▪ EX18
▪ BH119	▪ EX08	▪ EX21
▪ BH122	▪ EX10	▪ EX23

In addition samples will be collected from four of the proposed additional internal extraction wells.

The monitoring of CoC in groundwater samples from the monitoring wells should provide information on contaminant removal and progress towards the Remediation Criteria. In addition to the CoC data, the *in situ* effectiveness of the total fluid pumping system should be evaluated using measured groundwater levels and groundwater flow rates. The CoC concentrations in untreated groundwater and treated groundwater should aid in the evaluation and operation of the performance of the remediation equipment associated with the total fluid pumping system, and provide information on contaminant removal.

Task 7: Remediation Verification
The systems should operate until the remediation objectives are achieved. This will be evaluated considering the following lines of evidence:

- Contaminant Removal Rates (LNAPL);
- LNAPL Occurrence;
- Groundwater Monitoring Results; and,
- Risk Assessment.

Compliance Monitoring
Following deactivation of each of the remediation systems, on-going assessment for the presence and thickness of LNAPL in the extraction and monitoring well network should continue.

In addition, the groundwater quality should continue to be monitored monthly for a minimum period of six months to determine whether groundwater conditions remain stable. Site monitoring should include the collection of groundwater samples for analysis for TPH in the following on-Site monitoring wells:

- BH103
- BH108
- BH109
- BH119
- BH122
- BH136
- BH400
- BH402
- EX08
- EX10
- EX15
- EX17
- EX18
- EX21
- EX23

In addition samples will be collected from four of the proposed additional internal extraction wells.

Remediation System Decommissioning
Once the remediation criteria have been achieved, the remediation system should be decommissioned and remediation equipment, electricity and system control units should be removed from Site.

Monitoring and extraction wells on the Site should be capped and if no longer required decommissioned in accordance with best practice guidance.

9.5 Pollution Prevention and Control

It is anticipated that the proposed remediation strategy will produce only limited quantities of waste. The identified potential waste streams and controls to prevent pollution are summarised below.

9.5.1 Volatile Organic Compound Monitoring

The background total Volatile Organic Compound (VOC) level will be measured during the system commissioning using a photoionisation detector (PID). The trigger level of total VOC for Site boundary is considered as the measured background total VOC plus 5 ppm. Should the operation of the remediation system exceed the trigger level, the operation of the remediation system will be ceased immediately and necessary action will be taken to reduce the VOC level as appropriate.

9.5.2 Dusts, Fibres, Particulates and Aerosols

It is considered that the proposed remediation system at the Site will not generate dust, fibres, particulates and aerosols during operation at the Site.

9.5.3 Waste

Operation of the remediation systems will produce waste streams. The relevant waste streams and proposed controls to prevent pollution are summarised below.

Solid Waste
Solid waste generated by the remediation programme should be disposed of off-Site in accordance with current Environmental Permitting and Waste Management Duty-of-Care Regulations.

Liquid Waste
Extracted LNAPL and groundwater should be passed through an oil-water separator. The groundwater would then be treated using an air stripping tower (due to the likely concentrations of CVOC in the groundwater), and polished using granular activated carbon prior to discharge to the trade effluent sewer under appropriate discharge consent. Sampling will be undertaken to ensure compliance with the consent. ARCADIS are also investigating the possibility of re-injecting the abstracted groundwater up-gradient of the extraction well network at the Site.

Separated LNAPL should be removed from the Site for disposal *via* a licensed waste contractor[2] under Duty-of-Care documentation.

9.5.4 Noise Pollution

Where necessary, noise generated during the remediation operations on-Site will be controlled to prevent excessive noise levels beyond the Site boundary. It is proposed that major works involving heavy plant movement and operation should be undertaken during typical day working hours.

9.5.5 Vehicle Movements

The proposed remediation works will generate a number of vehicle movements associated with the removal of solid waste (soil excavated from trenching *etc*) for disposal as a result of the remediation infrastructure installation as well as any delivery to Site of imported material to backfill the trenching. Consideration should be given to the route and the timing of these vehicle movements, to minimise risk and disturbance to sensitive locations (such as schools, residential areas).

Risks associated with the transport of soils that potentially contain CoC, such as dust emission, should be appropriately managed.

The works could create mud debris from vehicle movements and subsequent tracking off-Site on vehicle tyres. Wheel washing should be managed during the works to prevent off-Site mud debris transfer.

[2] Waste oil and coolants are managed on-Site by Houghtons Fluid Technology Service Worldwide (Houghtons). Recovered LNAPL disposal will be managed by ARCADIS and Houghtons.

9.5.6 Bund and High-Level Triggers

The remediation system is housed in a bunded, secure storage container. In addition, the oil-water separator will be located in a bunded area on an impermeable surfaced area with adequate drainage and containment, securely fenced off to inhibit access by unauthorised personnel.

Float valve sensors and high-level trigger alarms are installed with the remediation system container and treatment tanks, and will feedback to the system control panel and automatically switch off pumping should they be activated, therefore regulating fluid levels in the treatment tanks and minimising the potential for a spillage to occur.

System monitoring will be undertaken in accordance with the Environmental Permit for the works.

10 REGULATORY ISSUES

In developing a remediation strategy for the Site, there are a number of regulatory issues that need to be considered. These include the acceptability of a remediation technique within the UK regulatory framework, and the requirement for a remediation technique to be licensed.

10.1 Abstraction Licence and Discharge Consent

Where abstraction of groundwater or surface water is undertaken, an abstraction licence may need to be obtained from the EA. Following processing, abstracted groundwater may require disposal *via* foul sewer, which would require a discharge consent from the utility provider. A groundwater abstraction licence may be required from the EA in order to operate the groundwater pumping element of the remediation system, based on the volume of water to be extracted per day. An abstraction licence should not be required where abstraction rates are below 20 m^3 per day.

It is considered likely that an abstraction licence will be required by the EA for the remediation of Zone 3.

A discharge consent will be required to discharge treated effluent to foul sewer during the remediation works. The consent should be obtained from the local sewerage undertaker on Meritor's behalf. The need to carry out effluent treatment should be discussed with the sewerage undertaker and the remediation equipment design amended as necessary in order to achieve any consented conditions.

ARCADIS understands that Meritor holds a discharge consent, granted by Welsh Water, for the discharge of trade effluent drainage, *via* the effluent treatment plant to foul sewer. Due to the divestment of the northern portions of the Site and the likely renegotiation of the discharge consent that will be required following the redevelopment of Zones 1 & 2 and refurbishment of Zone 3; ARCADIS recommends that the discharge of treated groundwater during remediation is considered during the consent renegotiation.

10.2 Environmental Permitting

In the UK, contaminated soil and groundwater are considered to be waste. In April 2008, the Environmental Permitting Regulations (EPR) came into effect, replacing the Waste Management Licensing and Pollution Prevention Control regimes. Therefore, the need for a waste management licence, such as a Mobile Treatment Licence (MTL), is now assessed below in terms of the requirement for an Environmental Permit. Exceptions to this are soil excavation and installation of barriers, which are currently considered to lie outside the waste management regime.

At present, an EA enforcement position exists whereby, enforcement action will not normally be pursued where treatment of a volume of less than 1,000 m^3 of contaminated soil or groundwater is carried out, without an Environmental Permit in place, subject to certain criteria, as detailed in the EA Licensing/Permitting Position Statements, Licensing/Permitting Position 1.1 – Trials and small scale remediation schemes:

"Where a small scale remediation scheme or a trial is to be undertaken to determine whether or not a particular remediation technique is suitable to ensure the remediation of contaminated materials, then provided that:

(1) for any Site the total quantity of contaminated material, substances or products treated as part of the trial remediation project does not exceed 1000 m^3; and,

(2) the name, contact address (home or business), and contact telephone numbers of any landowner, developer or contractor involved in the remediation project, details of the technique and dates on Site, are supplied to the Environment Agency area office at least five working days before that project begins, then the Environment Agency will not expect a waste management licence to be obtained to cover these works."

It is considered likely that an Environmental Permit will be required to undertake remediation works for Zone 3.

11 STUDY LIMITATIONS

IMPORTANT. This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1 This report has been prepared by ARCADIS(UK) Limited (ARCADIS), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with Meritor Heavy Vehicle Braking Systems (UK) Limited (the 'Client') and Meritor, Inc. ARCADIS does not accept responsibility for any matters outside the agreed scope.

2 This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.

3 Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. ARCADIS are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.

4 All work carried out in preparing this report has used, and is based on, ARCADIS' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which ARCADIS is aware, have been considered. Following delivery of the report, ARCADIS have no obligation to advise the Client or any other party of such changes or their repercussions.

5 This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6 Whilst this report and the opinions made are correct to the best of ARCADIS' belief, ARCADIS cannot guarantee the accuracy or completeness of any information provided by third parties.

7 This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.

8 This report refers, within the limitations stated, to the condition of the Site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.

9 The content of this report represents the professional opinion of experienced environmental consultants. ARCADIS does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10 Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by Site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the Site have not been investigated.

11 If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.

12 Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.

13 Unless otherwise stated, samples from the Site (soil, groundwater, building fabric or other samples) have NOT been analysed or assessed for waste classification purposes.

12 REFERENCES

Construction Industry Research and Information Association (CIRIA), 1995. Remedial Treatment for Contaminated Land Volume 4: Classification and Selection of Remedial Methods. CIRIA, London.

Department for Environment, Food and Rural Affairs (DEFRA) & Environment Agency (EA), 2004. Model Procedures for the Management of Land Contamination (R&D Publication CLR 11).

Environment Agency, 2001. Issues for the Selection of Remedial Strategies. www.environment-agency.gov.uk

Environment Agency 2001. Process Based Remediation of Land Contamination. www.environment-agency.gov.uk

Environment Agency 2001. Remedial Methods for Contaminated Groundwater. www.environment-agency.gov.uk

FIGURES

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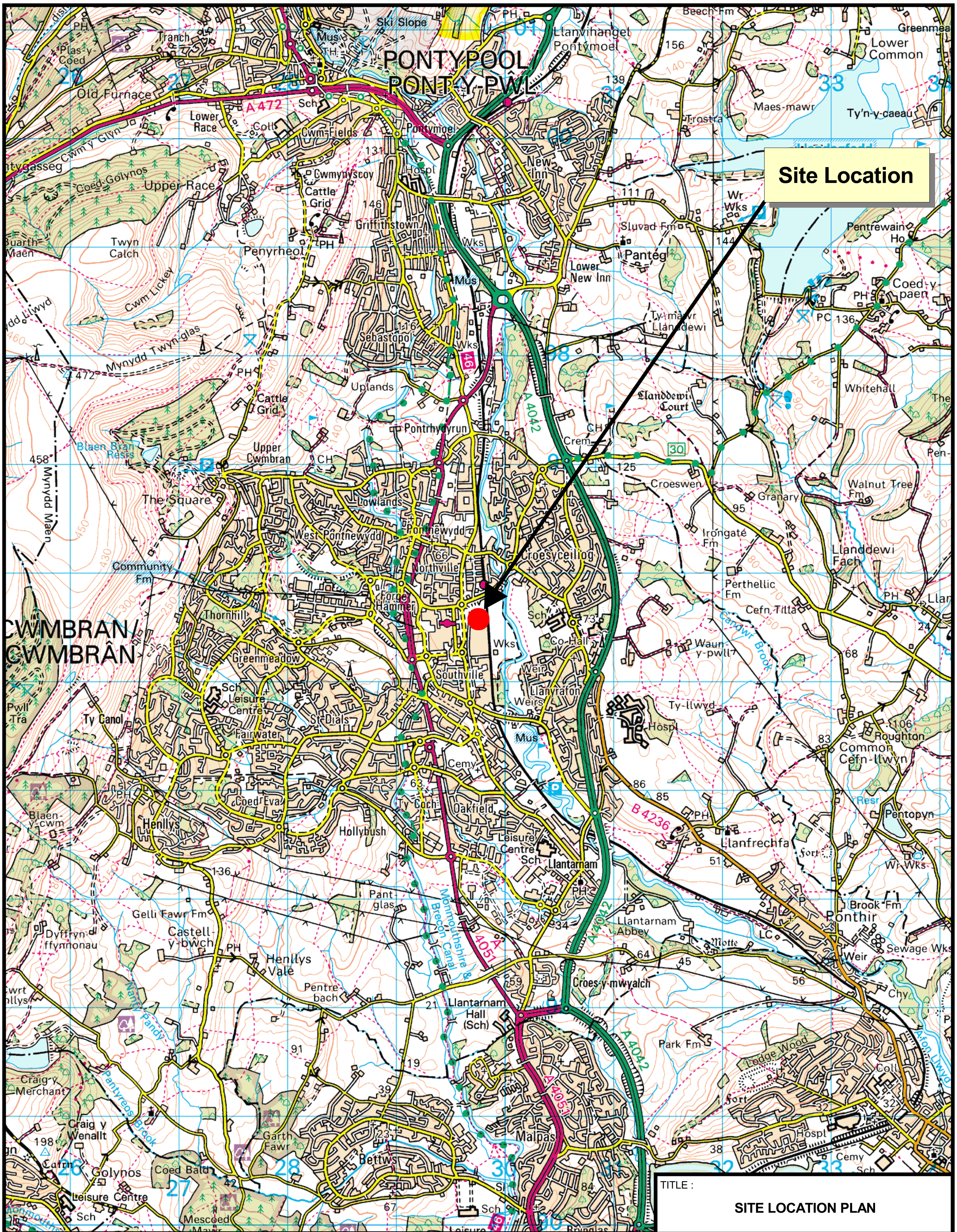

TITLE : **SITE LOCATION PLAN**

SITE : **CWMBRAN**

CLIENT : **MERITOR HVBS (UK) LTD**

PROJECT :	90936.30	FIGURE 1	
DATE :	13/06/11	DRAWN BY :	RJM
DRG No :	909363008.apr / SLP		
SCALE :	1 : 50,000	PRINT :	A4

LEGEND

● SITE LOCATION

NOTES

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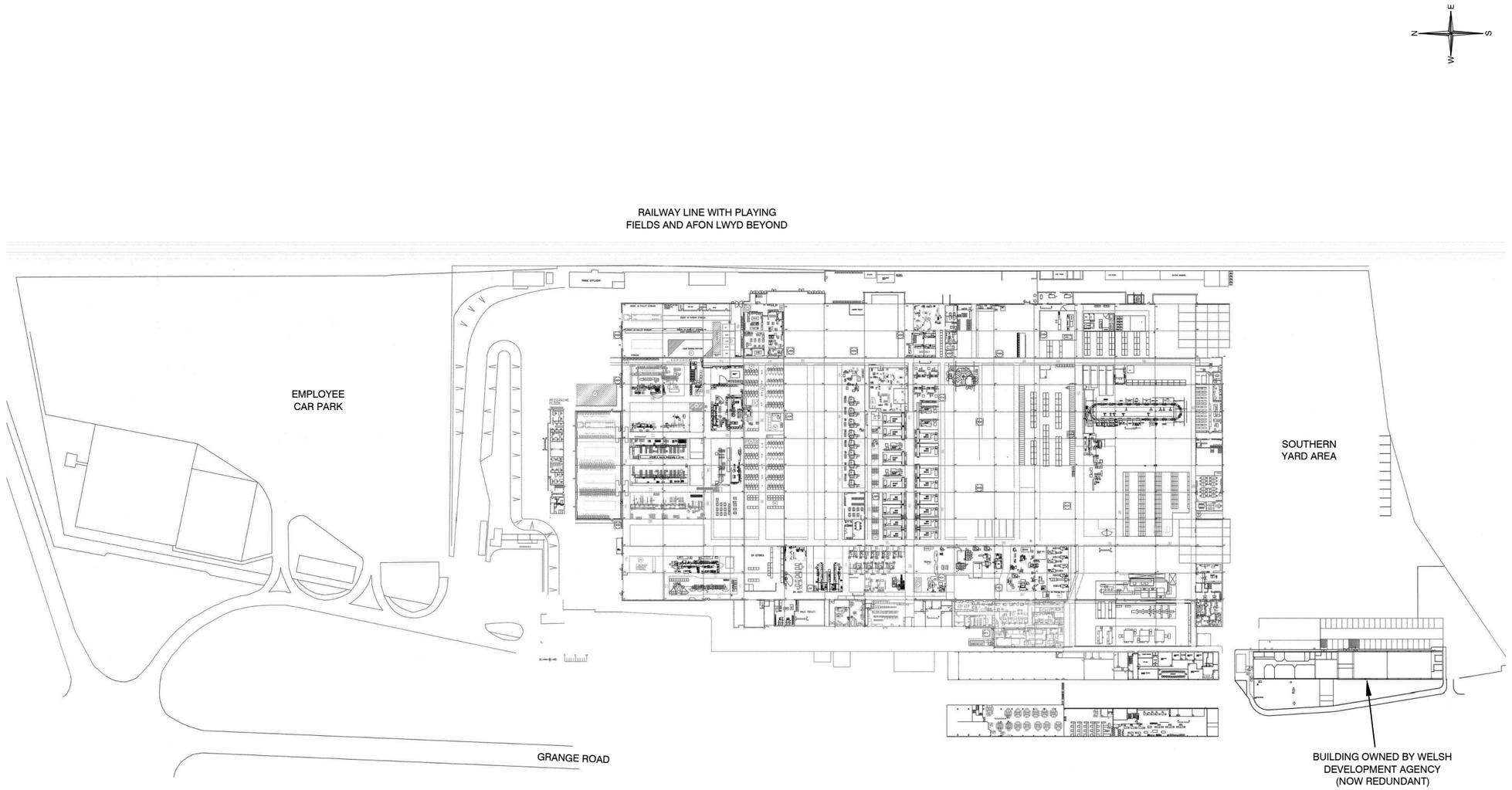

KEY

NOTES

NOT TO SCALE

INTERIOR OF PRODUCTION BUILDING HAS BEED ALTERED RECENTLY

REV	DATE	COMMENT	CAD

TITLE: SITE LAYOUT PLAN 2010

SITE: CWMBRAN

CLIENT: MERITOR HVBS (UK) LTD

PROJECT: 90936.30 | FIGURE 2

DATE: 01/11/11 | DRAWN: ASZ | REV: -

DRG.No.: 909363031-CAD | PRINT: A3

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LEGEND

- SITE BOUNDARY
- ZONE 1: REDEVELOPMENT FOR SUPERMARKET AND PETROL FILLING STATION
- ZONE 2: REDEVELOPMENT FOR MIXED COMMERCIAL END-USE
- ZONE 3: REFURBISHMENT OF MERITOR FACILITY (REDUCED FOOTPRINT)

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 10 20 40 60 80 100 Metres

N

TITLE:

FUTURE REDEVELOPMENT ZONES

SITE : **CWMBRAN**

CLIENT : **MERITOR HVBS (UK) LIMITED**

PROJECT :	**90936.30**	**FIGURE 3**	
DATE :	04/01/12	DRAWN BY :	RJM
DRG No. :	909363010 GIS		
SCALE :	**1 : 2,250**	PRINT :	**A3**

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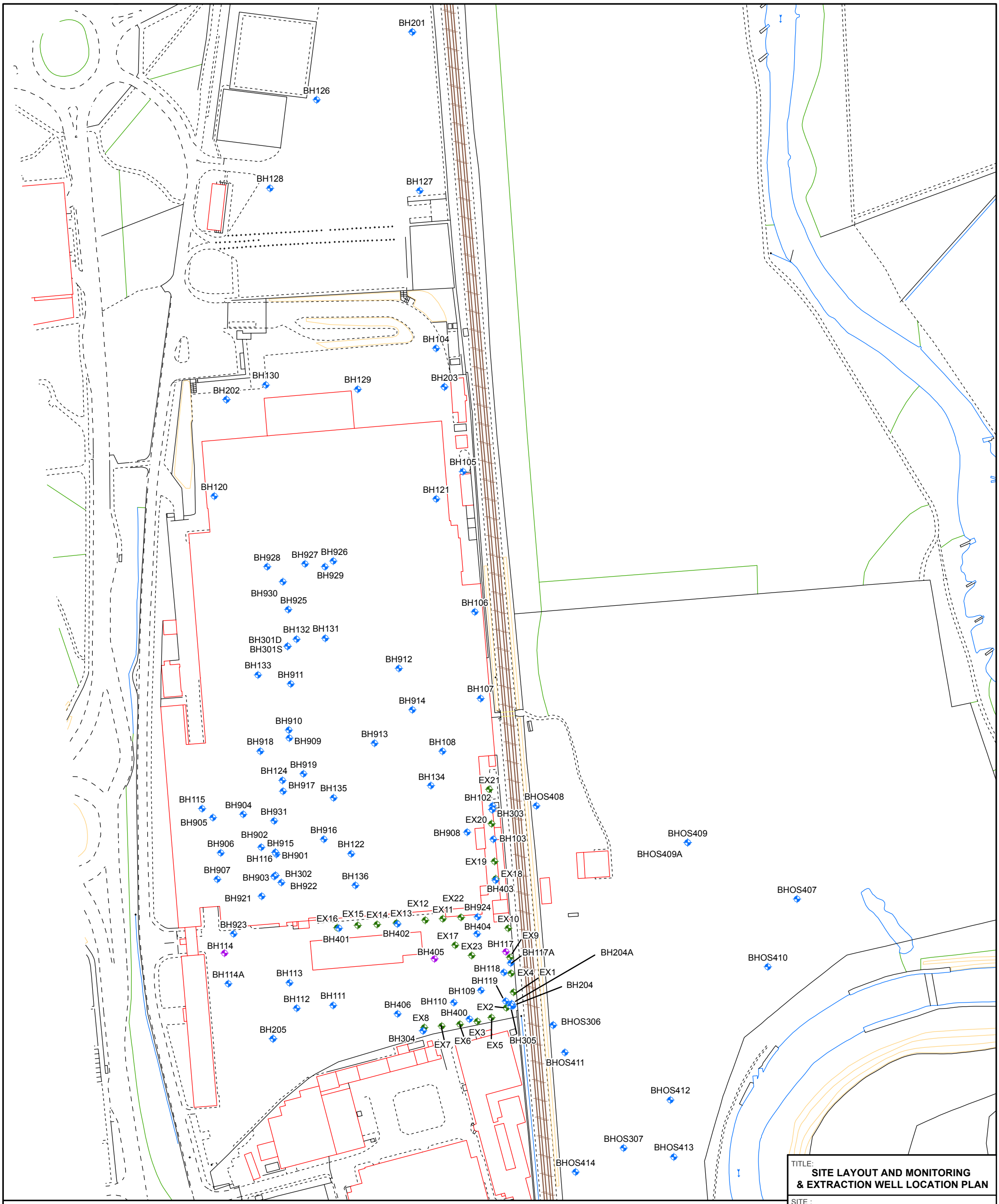

LEGEND

- BOREHOLE, NO MONITORING WELL INSTALLED
- MONITORING WELL
- EXTRACTION WELL

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 10 20 40 60 80 100 Metres

N

TITLE:
SITE LAYOUT AND MONITORING & EXTRACTION WELL LOCATION PLAN

SITE : **CWMBRAN**

CLIENT : **MERITOR HVBS (UK) LIMITED**

PROJECT :	**90936.30**	**FIGURE 4**	
DATE :	04/03/11	DRAWN BY :	RJM
DRG No. :	909363037 GIS		
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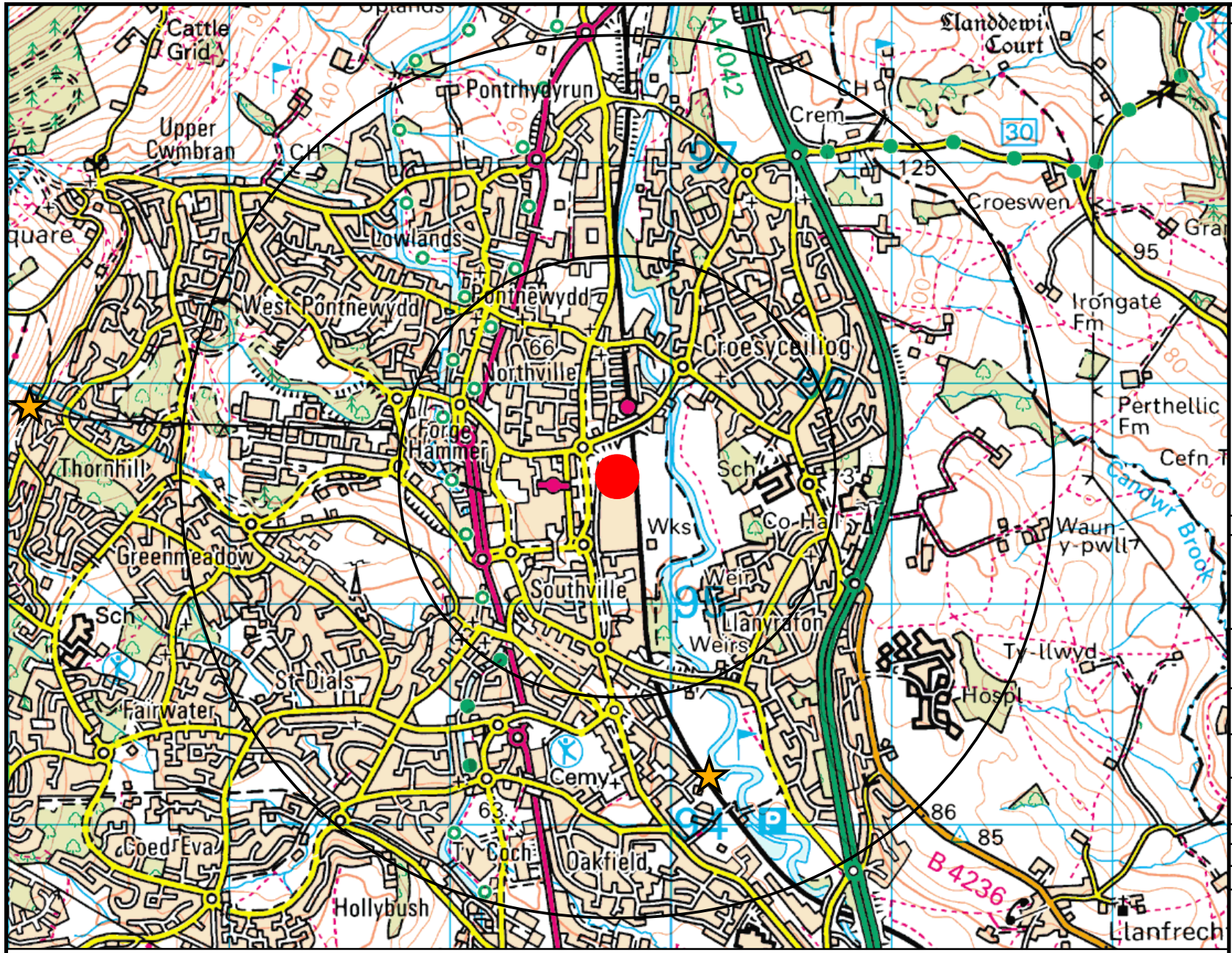

LEGEND

- SITE LOCATION

SOURCE PROTECTION ZONES

- SPZ 1
- SPZ 2
- SPZ 3

GROUNDWATER ABSTRACTIONS

- WATER SUPPLY
- AGRICULTURAL
- OTHER ABSTRACTIONS (E.G. INDUSTRIAL)
- SURFACE WATER ABSTRACTION

NOTES

CIRCLES ARE AT A RADIUS OF 1km AND 2km FROM THE SITE LOCATION

TITLE : **SOURCE PROTECTION ZONES AND ABSTRACTION MAP**

SITE : **CWMBRAN**

CLIENT : **MERITOR HVBS (UK) LTD**

PROJECT :	90936.30	FIGURE	5
DATE :	28/10/11	DRAWN BY :	RJM
DRG No :	909363008.apr / SPZ		
SCALE :	1 : 25,000	PRINT :	A4

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LEGEND

- BOREHOLE LOCATION PHASE II ESA
- BOREHOLE LOCATION PHASE IIB ESA
- BOREHOLE LOCATION SUPPLEMENTARY SITE INVESTIGATION
- MONITORING WELL LOCATION PHASE II ESA
- MONITORING WELL LOCATION PHASE IIB ESA
- MONITORING WELL LOCATION - SUPPLEMENTARY SITE INVESTIGATION
- EXTRACTION WELL - SUPPLEMENTARY SITE INVESTIGATION
- EXTENT OF LNAPL
- ZONE 3 BOUNDARY

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

BOREHOLE = NO MONITORING WELL INSTALLED
PARTIALLY INFERRED FROM PREVIOUS LIF INVESTIGATION

0 5 10 20 30 40 50 Metres

N

TITLE: **EXTENT OF LNAPL FOLLOWING SITE-WIDE GROUNDWATER MONITORING 2011**

SITE : **CWMBRAN**

CLIENT : **MERITOR HVBS (UK) LIMITED**

PROJECT :	**90936.30**	**FIGURE 6**	
DATE :	04/01/12	DRAWN BY :	RJM
DRG No. :	909363023 GIS		
SCALE :	**1 : 1,500**	PRINT :	**A3**

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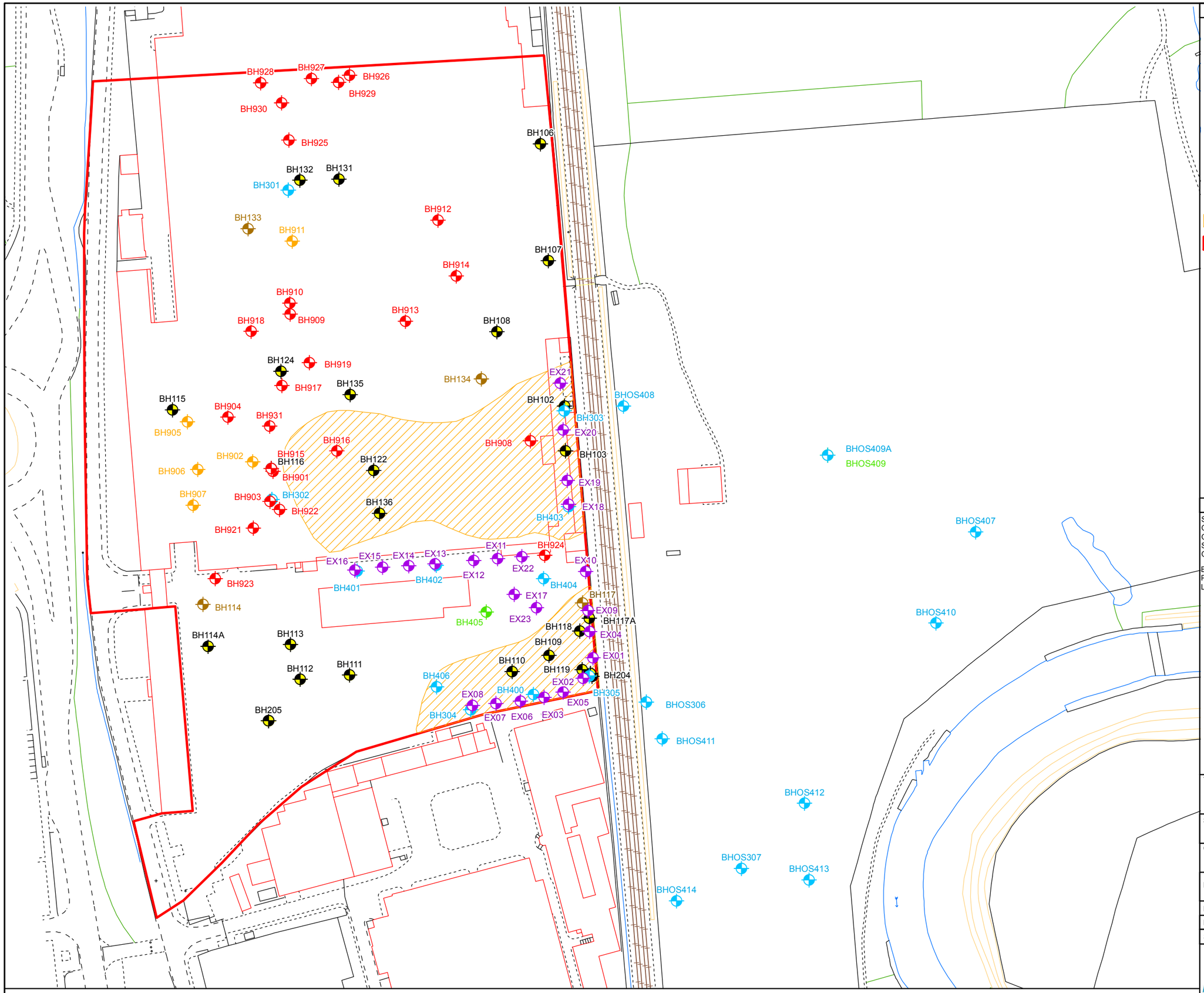

LEGEND

- BOREHOLE LOCATION PHASE II ESA
- BOREHOLE LOCATION PHASE IIB ESA
- BOREHOLE LOCATION SUPPLEMENTARY SITE INVESTIGATION
- MONITORING WELL LOCATION PHASE II ESA
- MONITORING WELL LOCATION PHASE IIB ESA
- MONITORING WELL LOCATION - SUPPLEMENTARY SITE INVESTIGATION
- EXTRACTION WELL - SUPPLEMENTARY SITE INVESTIGATION
- AREAS OF GREATEST ESTIMATED RECOVERABLE LNAPL
- ZONE 3 BOUNDARY

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

BOREHOLE = NO MONITORING WELL INSTALLED
PARTIALLY INFERRED FROM PREVIOUS LIF INVESTIGATION

N

0 5 10 20 30 40 50 Metres

TITLE:
AREAS OF GREATEST ESTIMATED RECOVERABLE LNAPL

SITE :
CWMBRAN

CLIENT :
MERITOR HVBS (UK) LIMITED

PROJECT :	**90936.30**	**FIGURE 7**	
DATE :	04/01/12	DRAWN BY :	RJM
DRG No. :	909363041 GIS		
SCALE :	**1 : 1,500**	PRINT :	**A3**

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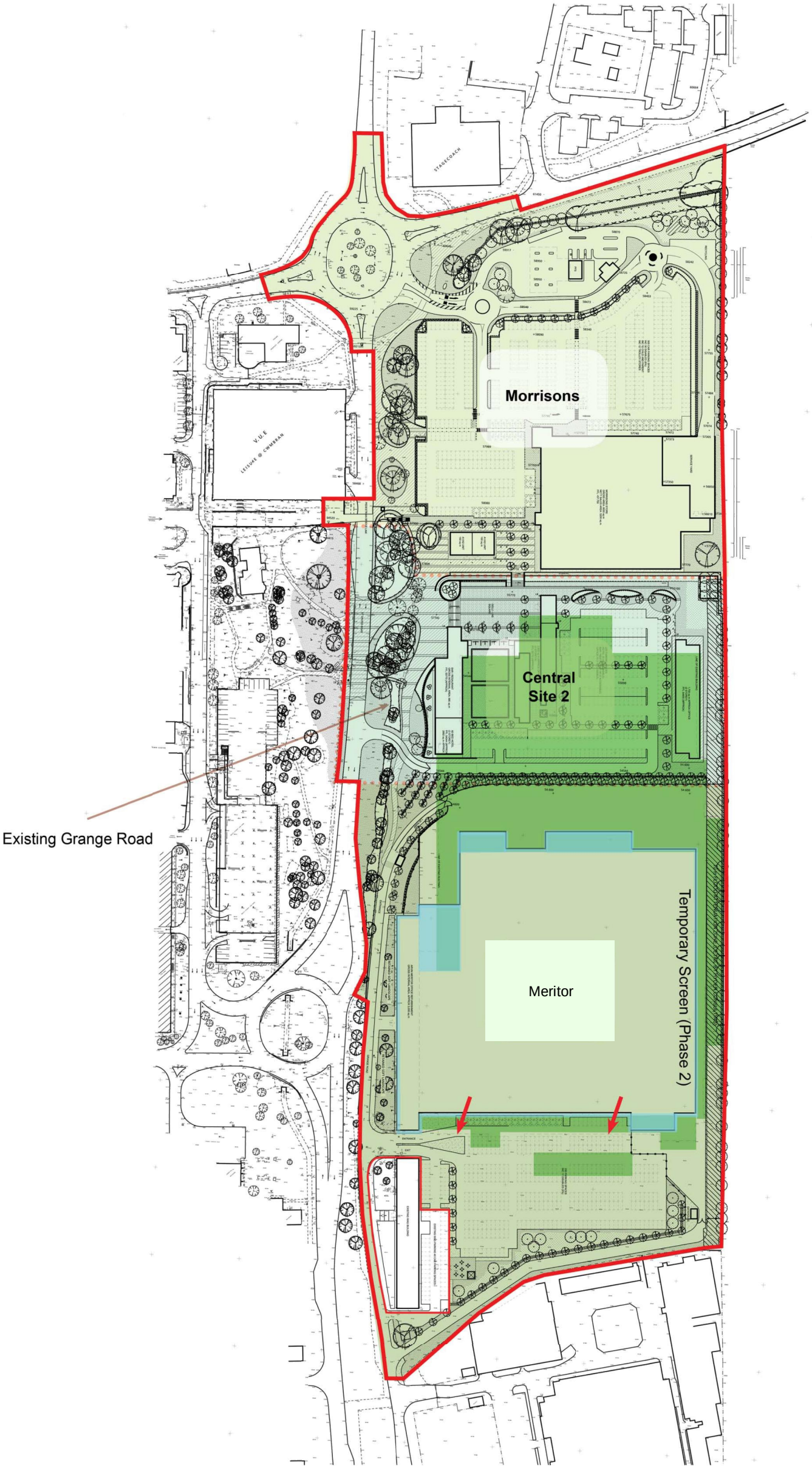

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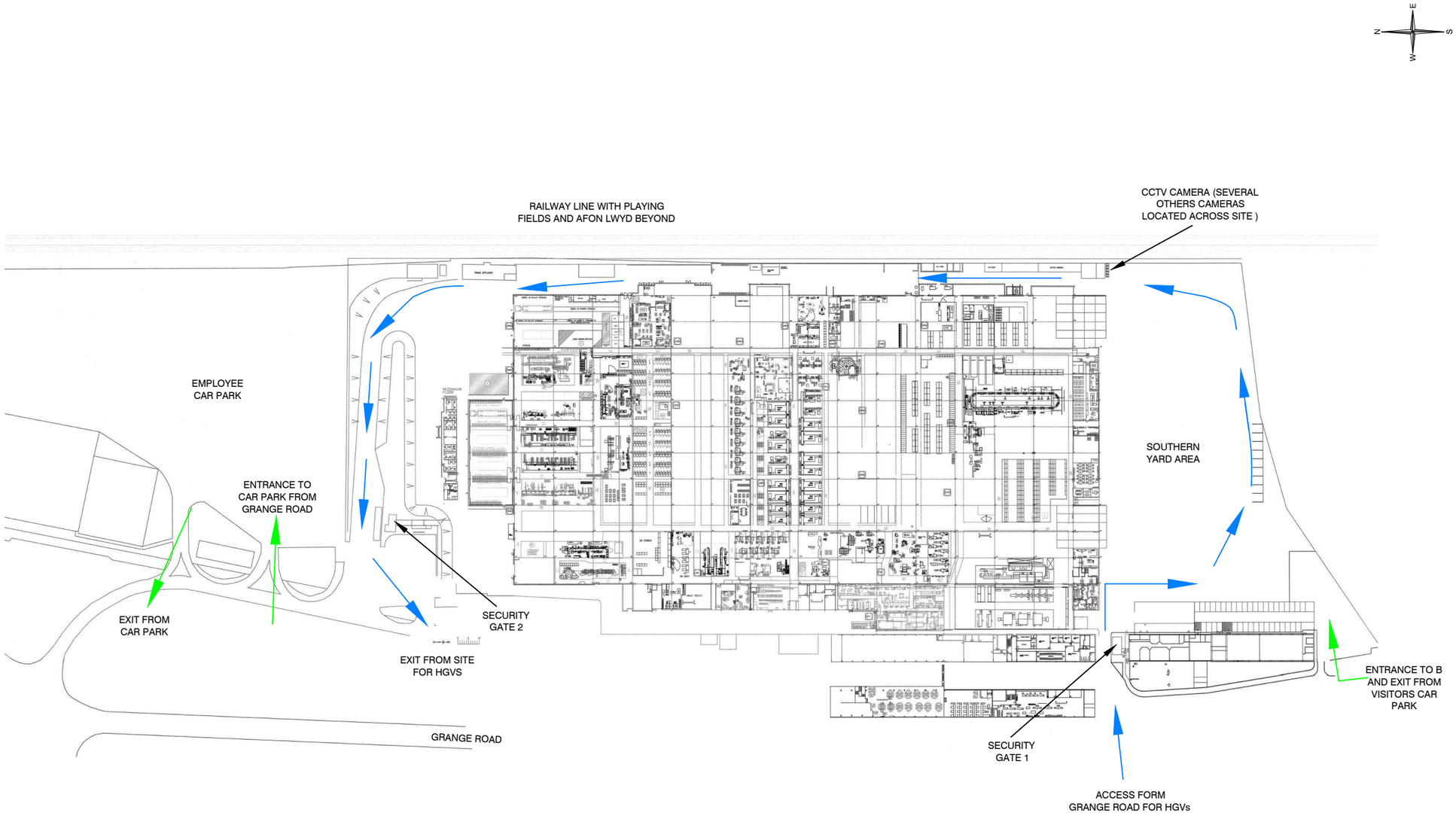
TITLE: PROPOSED REDEVELOPMENT PLAN		SITE: CWMBRAN	
PROJECT: 90936.30		CLIENT: MERITOR HVBS (UK) LTD	FIGURE 8
DATE: 01/11/11	PRINT: A3	ARCADIS	
DRAWN BY: ASZ	REV: -		
DRG.No.: 909363030-CAD		Infrastructure · Water · Environment · Building	



KEY

ONE WAY SYSTEM FOR HGVs AROUND SITE

ENTRANCE AND EXITS FROM SITE CAR PARKS

NOTES

NOT TO SCALE

CCTV = CLOSED CIRCUIT TELEVISION

REV	DATE	COMMENT	CAD

TITLE: CURRENT SITE LAYOUT, ACCESS AND SECURITY PLAN

SITE: CWMBRAN

CLIENT: MERITOR HVBS (UK) LTD

PROJECT: 90936.30 | FIGURE 9

DATE: 01/11/11 | DRAWN: ASZ | REV: -

DRG.No.: 909363032-CAD | PRINT: A3

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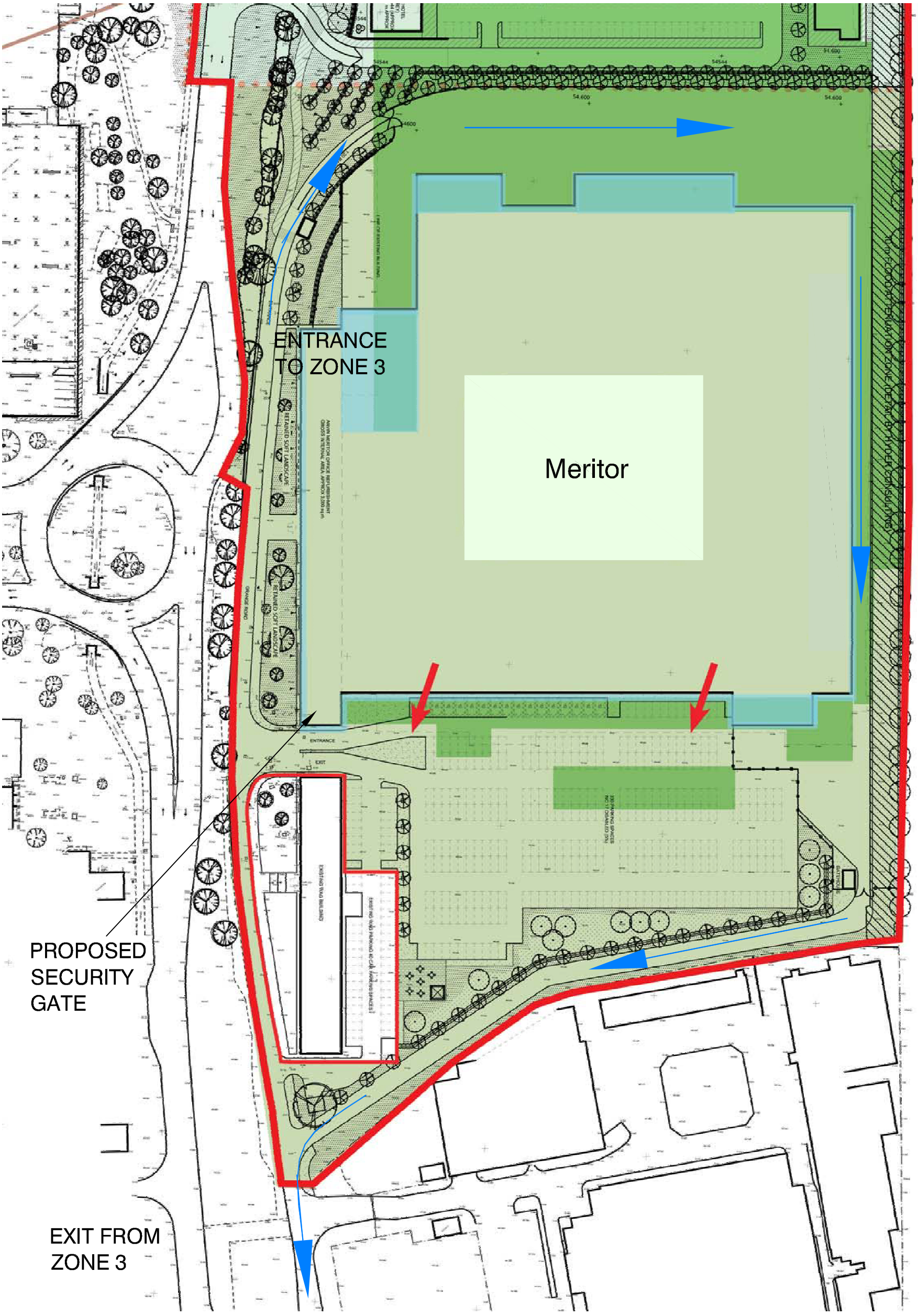

DISCLAIMER	NOTES	KEY
NOTE: ALL ENTITIES SHOWN ON THIS DRAWING ARE TO BE REGARDED AS APPROXIMATE AND ARE INDICATIVE ONLY. NO MEASUREMENTS TAKEN FROM THIS DRAWING SHOULD BE USED FOR THE LOCATION OF INTRUSIVE INVESTIGATION WORKS ON SITE. SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE. - CONTACT ARCADIS UK IN CASE OF ANY QUERY	BASED ON DRAWING BY DLA ARCHITECTURE. DRAWING No:2000-027/503 DATE:JAN 2011 NOT TO SCALE	DEMOLITIONS TO EXISTING MERITOR FACTORY PROPOSED FOOTPRINT OF THE MERITOR FACTORY PROPOSED ONE WAY SYSTEM AROUND ZONE 3 MERITOR PROPERTY BOUNDARY

TITLE: PROPOSED ACCESS AND SECURITY ZONE 3 PLAN		SITE: CWMBRAN	
PROJECT: 90936.30		CLIENT: MERITOR HVBS (UK) LTD	FIGURE 10
DATE: 02/11/11	PRINT: A3		
DRAWN BY: ASZ	REV: -		
DRG.No.: 909363033-CAD			

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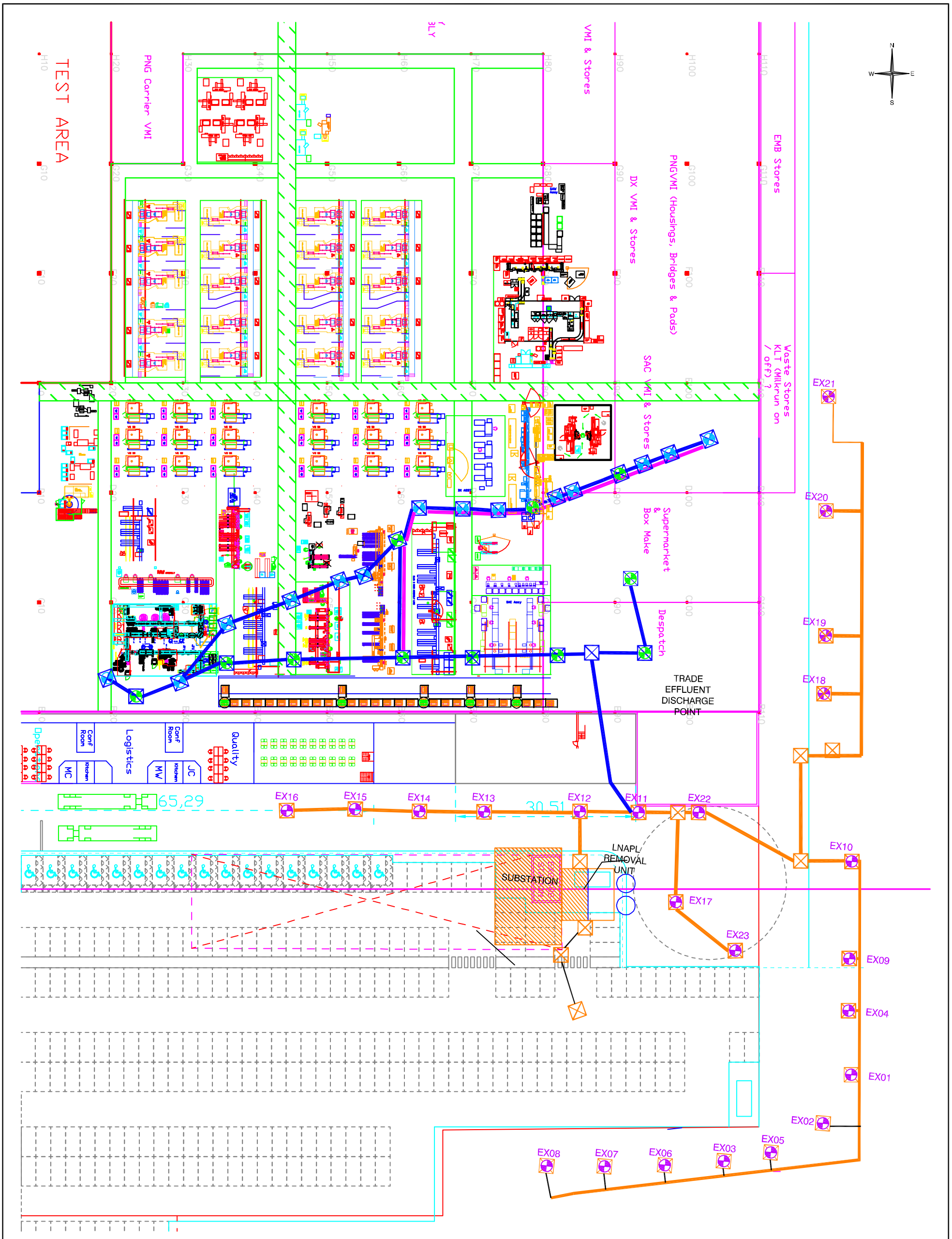

DISCLAIMER	NOTES	KEY
NOTE: ALL ENTITIES SHOWN ON THIS DRAWING ARE TO BE REGARDED AS APPROXIMATE AND ARE INDICATIVE ONLY. NO MEASUREMENTS TAKEN FROM THIS DRAWING SHOULD BE USED FOR THE LOCATION OF INTRUSIVE INVESTIGATION WORKS ON SITE. SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE. - CONTACT ARCADIS UK IN CASE OF ANY QUERY	BASED ON DRAWING BY CLIENT DRAWING No: NLC 17-12 EMPTY V1 ERD ENHANCED REDUCTIVE DECHLORINATION	PROPOSED ERD AND SVE WELL PROPOSED LNAPL EXTRACTION WELL EXISTING LNAPL EXTRACTION WELL INSPECTION CHAMBER COVER EXISTING REMEDIATION DUCTING PROPOSED SUB-SURFACE REMEDIATION DUCTING LNAPL RECOVERY WELLS LINKED BACK TO REMEDIATION SYSTEM THROUGH ERD SYSTEM DUCTING

TITLE: PROPOSED TOTAL FLUIDS PUMPING SYSTEM LAYOUT PLAN

SITE: CWMBRAN

PROJECT: 90936.30

CLIENT: MERITOR HVBS (UK) LIMITED

FIGURE 11

DATE: 17/02/12 PRINT: A3

DRAWN BY: AP REV: -

DRG.No.: 909363045-CAD

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APPENDICES

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Appendix A
Legislative Context and Regulatory Guidance

APPENDIX A
Legislative Context and Regulatory Guidance

Land contamination is generally dealt with by the following types of regulation:

- Acts of Parliament to investigate and remedy harm caused by land contamination;
- Conditions placed upon Planning Permissions for the redevelopment of land; and,
- Acts of Parliament and Regulations for the control of waste.

In Wales land contamination is identified and dealt with through Acts / Regulations including:

- The Contaminated Land (Wales) Regulations (2006);
- Part 2A of the Environmental Protection Act (1990);
- The Environment Act 1995;
- The Town and Country Planning Act (1990);
- The Environmental Permitting (England and Wales) Regulations (2007);
- The Water Resources Act (1991);
- The Water Act (2003);
- The Environmental Damage (Prevention and Remediation) (Wales) Regulations (2009); and,
- The Groundwater (England and Wales) Regulations (2009).

Part 2A of the Environmental Protection Act 1990

Part 2A of the Environmental Protection Act 1990 (which was inserted by Section 57 of the Environment Act 1995) created a regime for the identification and remediation of contaminated land. Section 78A(2) of the Environmental Protection Act 1990 defines contaminated land for the purposes of Part 2A as:

'*any land which appears to 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 a significant possibility of such harm being caused; or
(b) pollution of controlled waters is being, or is likely to be caused.'[3]

Harm is defined under section 78A of the Environmental Protection Act as meaning 'harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property'. Types of harm are related to specific receptors in order to determine whether they can be regarded as "significant", as defined in Table A of Part 3 of the Welsh Assembly Government (2006)[4] statutory guidance.

Part 2A sets the definition of contaminated land within the context of the 'suitable for use' approach. The legal definition of contaminated land is also discussed within Statutory Guidance released by DEFRA (2008)[5], although this is currently only applicable for England the paper was prepared in consultation with the other UK countries.

The 'suitable for use' approach underlies the assessment process, and is based on the principles of risk assessment, including the concept of the 'pollutant linkage'.

In the event that there are unacceptable levels of risk posed by a Site, a remediation notice can be served under the contaminated land regime introduced under Part 2A of the Environmental Protection Act 1990.

Regulation of Development on Land Affected by Contamination

-

[3] Definition to be amended to "significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused" under the Water Act 2003
[4] Part 2A. Statutory Guidance on Contaminated Land. Welsh Assembly Government, December 2006
[5] Guidance on the legal definition of contaminated land. DEFRA July 2008

Management of risks from contamination in development of land is also regulated in Wales under the Town and Country Planning Act 1990. Land contamination is a material planning consideration within this planning regime. The Local Planning Authority may impose conditions on the development during planning that include preliminary risk assessment, Site investigation, risk assessment and remediation. The Environment Agency may use its role as a statutory consultee to provide the Local Planning Authority with advice.

Assessment of risk is again based on the pollutant linkage concept. The aim of risk management in the development should be to render the land suitable for the proposed use and, therefore, to prevent consideration of the Site under Part 2A.

The Welsh Assembly Government document Planning Policy Wales (March 2002) provides guidance on the relationship between development and the management of risks from land contamination caused by historical use. The Building Regulations 2000, made under the Building Act 1984, also require measures to be taken to protect new buildings and their occupants from the effects of contamination.

Voluntary Remediation Action

Voluntary remediation action on contamination resulting from historical activities can often anticipate future remediation requirements, such as through the Planning regime, and is encouraged, especially where the Site is not being assessed under Part 2A.

Environmental Damage

The Environmental Damage (Prevention and Remediation) Regulations 2009 came into force on 1st March 2009 to implement EC Directive 2004/35 on environmental liability with regard to the prevention and remedying of environmental damage.

These Regulations do not apply retrospectively; environmental damage that took place before the Regulations came into force (1st March 2009), or damage that takes place (or is likely to take place) after that date but is caused by an incident, event or emission that occurred before that date are exempt from the requirements of the Regulations.

The Regulation is concerned with preventing environmental damage. It requires that all operators of activities that cause an imminent threat of environmental damage to take all reasonably practical steps to prevent the damage. Where damage has already been caused, the operator must take all reasonably practical steps to prevent further damage from occurring.

Non-statutory regulatory technical guidance Documents

The UK non-statutory regulatory technical guidance on the assessment of land contamination, primarily released as part of the Contaminated Land Exposure Assessment (CLEA) methodology (DEFRA and EA) has recently been updated. New guidance has been released by the EA, for use in England and Wales. The following documents currently present guiding principles in investigating and assessing potentially contaminated land, which are generally adopted in considering Sites within any of the legal frameworks discussed above, or when considering voluntary remediation action:

- *Investigation of potentially contaminated Sites – Code of Practice* (British Standard 10175: 2001).
- Contaminated Land Report CLR11 *Model Procedures for the Management of Land Contamination.* (DEFRA and EA, 2004).
- *Human health toxicological assessment of contaminants in soil* Environment Agency Science Report SC050021/SR2 (EA, 2009)
- *Updated technical background to the CLEA model* Environment Agency Science Report SC050021/SR3 (EA, 2009)
- *Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* Environment Agency Science Report SC050021/SR7 (EA, 2008)

- *An ecological risk assessment framework for contaminants in soil.* Environment Agency Science Report SC070009/SR1 and related reports S2a-e
- *Groundwater Protection: Policy and Practice*, Environment Agency GP3 Parts 1-4
- *Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination* (EA of England and Wales, 2006) developed in consultation with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Heritage and Environment Service.
- *Assessing risks posed by hazardous ground gases to buildings* Report C665 (CIRIA, 2007)
- *BS 8485:2007 Code of practice for the characterization and remediation from ground gas in affected developments(British Standards Institution, 2007)*
- *Risk Based Corrective Action (RBCA) Methodology* (ASTM designation E1739-95, E2081-00).
- *DoE Industry Profiles*

Appendix B
Soil & Groundwater Site-Specific Assessment Criteria

Appendix B
Water Resources SSAC for Petroleum CoC in Groundwater

Source 8R	
CoC	**SSAC (mg/l)**
Benzene	
Sum Xylenes	
Aliphatic >C5-C6	
Aliphatic >C6-C8	
Aromatics >C10-C12	
Aromatics >C12-C16	2857

Source 9R	
CoC	**SSAC (mg/l)**
Benzene	1.67
Sum Xylenes	0.00419
Aliphatic >C5-C6	7.4
Aliphatic >C6-C8	7.19
Aromatics >C10-C12	
Aromatics >C12-C16	100

Source 10	
CoC	**SSAC (mg/l)**
Benzene	0.909
Sum Xylenes	2.43
Aliphatic >C5-C6	42
Aliphatic >C6-C8	4.12
Aromatics >C10-C12	7.17
Aromatics >C12-C16	25.1

Notes

SSAC	Site-Specific Assessment Criteria
CoC	Contaminant of Concern
	No SSAC derived

Appendix B
Human Health Site Specific Assessment Criteria for Soil (mg/kg)
- Meritor Reduced Footprint -

CoC	Clayey Sand / Gravel Source** SSAC (mg/kg)				Clayey Sand / SSAC (mg/kg)
	Theoratical Soil Saturation Limit	Oral	Inhalation	Combined	Final
VOC					
Vinyl chloride	1,370	26.7	0.122	0.121	0.0824
1,1-dichloroethene	1,990	*95,200*	37.2	37.2	25.3
trans-1,2-dichloroethene	3,960	*32,300*	341	337	230
cis-1,2-dichloroethene	1,890	*11,300*	20.3	20.2	13.8
Benzene	1,240	553	52.6	48	32
Trichloroethene	1,570	*9,920*	20.3	20.2	13.8
Toluene	890	*425,000*	*116,000*	*91,200*	*59,357*
1,1,2-Trichloroethane	2,580	343	4.1	4.06	2.8
Tetrachloroethene	435	*26,500*	269	266	182
Ethylbenzene	532	*191,000*	*29,900*	*25,900*	*17,085*
Total Xylenes	577	*343,000*	*10,800*	*10,500*	*7,065*
Naphthalene	79	*36,400*	*3,210*	*2,950*	*1,895*
TPH					
Aliphatic >C_8-C_{10}	89.1	*95,300*	*2,110*	*2,090*	*1,418*
Aliphatic >C_{10}-C_{12}	51.8	*95,300*	*9,750*	*9,490*	*6,373*
Aliphatic >C_{12}-C_{16}	22.7	*95,300*	*46,100*	*39,200*	*25,141*
Aromatic >C_{10}-C_{12}	383	*38,100*	*18,400*	*15,700*	*10,007*
Aromatic >C_{12}-C_{16}	171	*38,100*	*92,200*	*33,400*	*19,225*
Aromatic >C_{16}-C_{21}	48.4	*28,600*		*28,600*	*16,150*
Aromatic >C_{21}-C_{35}	5.08	*28,600*		*28,600*	*16,150*
PAH					
Benz(a)anthracene	1.76	*366*	*271 #*	*156*	*112*
Chrysene	0.453	*3,660*	*2,710 #*	*1,560*	*1,121*
Benzo(b)fluoranthene	1.25	*366*	*271 #*	*156*	*112*
Benzo(k)fluoranthene	0.707	*366*	*271 #*	*156*	*112*
Benzo(a)pyrene	0.938	*36.6*	*27.1 #*	*15.6*	*11.2*
Indeno(123cd)pyrene	0.0632	*366*	*271 #*	*156*	*112*
Dibenzo(ah)anthracene	0.00405	*36.6*	*27.1 #*	*15.6*	*11.2*
METALS AND INORGANICS					
Arsenic	NVP	635	774 #	349	*239*
Cadmium	NVP	399	431 #	243	*164*
Chromium (assessed as Chrom	NVP	6,250	NR	6,250	*3,576*
Copper	NVP	156,000	109,000 #	74,700	*53,378*
Lead*	NVP	6,190	1,330,000 #	6,160	*3,530*
Nickel	NVP	22,200	1,990 #	1,830	*1,579*
Selenium	NVP	13,000	NR	13,000	*7,459*
Zinc	NVP	333,000	NR	333,000	*190,652*
Boron	NVP	132,000	2,210,000 #	125,000	*72,917*
Barium	NVP	22,200	55,400 #	19,500	*11,708*
Beryllium	NVP	4,430	2,190 #	1,470	*1,114*
Vanadium	NVP	14,900	102,000 #	13,000	*7,816*

Notes:

	not selected for the pathway
Italics	Target exceeds theoretical soil saturation limit. Concentrations above the soil saturation limit may indicate the presence of separate phase in soil, but does not
NR	No appropriate reference dose identified during review of toxicological data
*	In the absence of specific current guidance on the assessment of lead, a review of worldwide target levels was undertaken, with this value representing the typical mid-point (USEPA Region 9)
NVP	Contaminant has only a low vapour pressure in soil
#	Inhalation exposure via dust inhalation only
**	It was found that this part of the site is primarily underlain by clayey sand / gravel lithology

Appendix B
Human Health Site Specific Assessment Criteria for Groundwater (µg/l)
- Meritor Reduced Footprint -

CoC	Clayey Sand / Gravel Unsaturated Zone**				Clayey Sand / Gravel Unsaturated Zone**			
	Theoratical Solubility Concentration (µg/l)	SSAC (µg/l) Commercial Worker - Meritor Reduced Footprint (Building B)			Theoratical Solubility Concentration (µg/l)	SSAC (µg/l) Commercial Worker playing rugby at Off Site Playing Fields - Meritor Reduced Footprint (Building B)		
		Indoor Air	Outdoor Air	Combined		Commercial Worker	Rugby Player	Both Uses Combined
TPH								
Aliphatic >C_8-C_{10}	430	>Sol	>Sol	ND	430	ND	ND	ND
Aliphatic >C_{10}-C_{12}	34	>Sol	>Sol	ND	34	ND	ND	ND
Aliphatic >C_{12}-C_{16}	0.76	>Sol	>Sol	ND	0.76	ND	ND	ND
Aromatic >C_{10}-C_{12}	25,000	>Sol	>Sol	ND	25,000	ND	ND	ND
Aromatic >C_{12}-C_{16}	5,800	>Sol	>Sol	ND	5,800	ND	ND	ND

Notes:

>Sol	Target acceptable risk is not exceeded at the theoretical solubility concentration.Solubility concentrations are presented for guidance purposes only: These are not SSA
ND	Results of risk assessment demonstrate contaminant does not present significant level of risk *via* this pathway.
**	It was found that this part of the site is primarily underlain by clayey sand/ gravel lithology

Appendix B
Water Resources SSAC for Petroleum CoC in Soil

Source 8R	
CoC	**SSAC (mg/kg)**
Benzene	
Sum Xylenes	
Aliphatic >C5-C6	
Aliphatic >C6-C8	
Aromatics >C10-C12	43,805
Aromatics >C12-C16	24,234,694

Source 9R	
CoC	**SSAC (mg/kg)**
Benzene	26
Sum Xylenes	181
Aliphatic >C5-C6	1,044
Aliphatic >C6-C8	3,554
Aromatics >C10-C12	3,268
Aromatics >C12-C16	4,339

Source 10	
CoC	**SSAC (mg/kg)**
Benzene	22
Sum Xylenes	109
Aliphatic >C5-C6	516
Aliphatic >C6-C8	1,834
Aromatics >C10-C12	1,696
Aromatics >C12-C16	2,647

Notes

SSAC	Site-Specific Assessment Criteria
CoC	Contaminant of Concern
	No SSAC derived