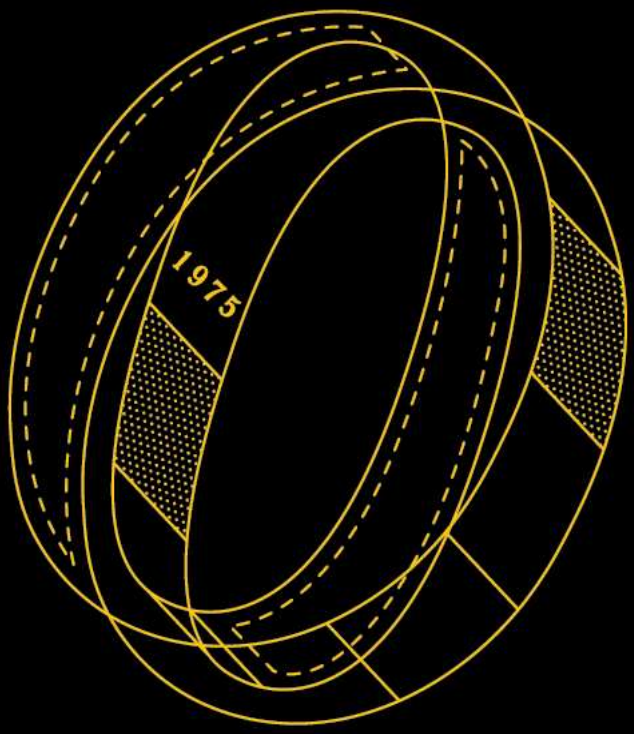
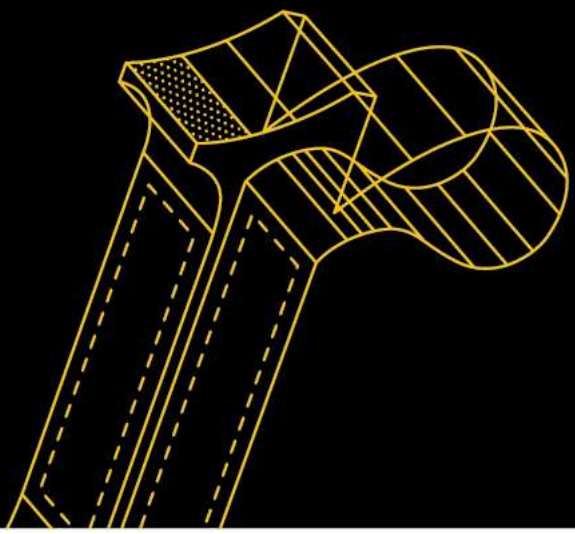
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Project Title:	New Sorting Shed
Document Title:	Flood Risk Assessment and Drainage Strategy
Document No.:	9059-NDA-XX-XX-RP-D-8301 R2





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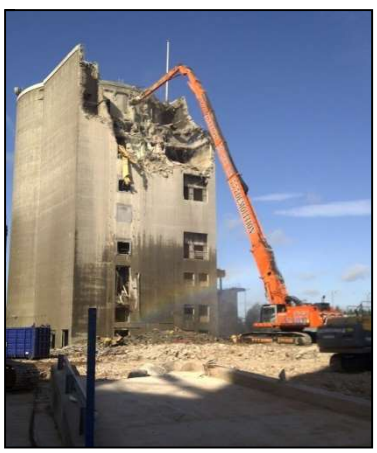
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Appendix A – Site Location Plans

Appendix B – Existing Topographical Survey

Appendix C – Proposed Development Layout Plan

Appendix D – Flood Mapping Information

Appendix E – Sewer Records, Site Drainage and Reservoir Plans

Appendix F – Phase II Geo-environmental Site Assessment

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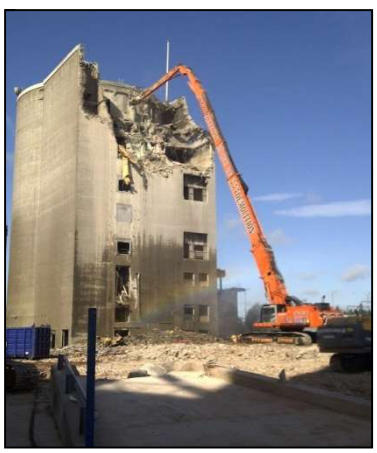
Appendix H – Existing Hard Standing Areas Drawing

Proposed Hard Sanding Areas Drawing

Drainage Strategy Layout Drawing







1 Introduction

This Flood Risk Assessment (FRA) has been produced in accordance with the Development Advice Map and associated planning policy Technical Advice Note (TAN) 15: Development and Flood Risk, read in conjunction with Planning Policy Wales (PPW) 2002.

The FRA has been produced on behalf of Hydro Aluminium in respect of a New Sorting Shed and associated works, proposed at their existing site off Bridge Road, Wrexham Industrial Estate, Wrexham, LL13 9PS. The development includes a new sorting shed building and storage shelter, along with an associated finished goods yard storage area, extended yard and lorry parking.

The comments and opinions contained in this report including the conclusions and recommendations are based on the following information:

(i) Existing OS plans.
(ii) Topographical survey of existing levels.
(iii) Natural Resources Wales flood map for planning.
(iv) Sewer record plans.

This report is prepared solely for the use of Hydro Aluminium and their advisers.

2 Site Information

2.1 Existing Site

The proposed development is located on the existing Hydro Aluminium site off Bridge Road, Wrexham Industrial Estate, Wrexham, LL13 9PS. Grid reference 337516 E, 349285 N. A site location plan is attached under **Appendix A**.

The Hydro Aluminium site is bound by Bridge Road to the south east with a car park and HM Prison Berwyn beyond. To the south west the site is lined with trees, with Clywedog Road East bounding the site and residential housing beyond. To the north west the site is bound by a tree lined strip and Redwither Brook, with further industrial units and Clywedog Road North beyond. To the north east the site is bound by further industrial units.

The River Clywedog is located approximately 870m to the south of the site and the River Dee is located approximately 3km to the south of the site. A railway line runs north/south through Wrexham and is located approximately 5km to the west of the site.

Both vehicular and pedestrian access is taken from Bridge Road via two existing junctions.

The Hydro Aluminium site area is approximately 4.4Ha in total and accommodates the main recycling building, office building and a number of ancillary buildings. The remainder of the site is used as services roads, lorry parking, car parking and storage areas. Landscaping is located to the perimeter of the site and around the car park area, and an established zone of trees line the north west and south west boundaries. There are two long bunds located within the south west area of the site, which consist of stockpiled material that has become overgrown with vegetation.

An attenuation basin is located near the northern boundary which currently serves the majority of the surface water positively drained from the site. The balancing pond ultimately discharges into Redwither Brook, running adjacent to the northern boundary.

The site is generally flat lying with levels to the service road and yard areas around the building being in the region of 31.50m AOD. The yard area levels increase towards the south west boundary to between 31.80m AOD to 32.46m AOD at the highest point. Two long bunds are located to the centre and south west of the site and reach a height of 35.00m AOD and 38.00mAOD respectively.

An existing topographical survey plan showing existing hardstanding and impermeable areas and existing ground levels, is attached under **Appendix B**.

2.2 Proposed Development

The proposed development is to provide a new sorting shed building and storage shelter, along with an associated finished goods yard storage area, extended yard area and lorry parking.

Both vehicular and pedestrian access will continue to be taken from Bridge Road via the two existing junctions.

The proposed development layout plan is attached under **Appendix C**.

2.3 Flood Zone Classification

A Flood Map for Planning has been obtained from the Natural Resources Wales website and a copy of the Flood Map for Planning information is attached under **Appendix D**.

The Flood Map for Rivers and Sea shows that the proposed development is fully located within a low risk Flood Zone 1 area which has an annual probability of flooding from rivers of less than 1 in 1000 (<0.1% chance of flooding in any given year).

There are no allocated flood storage areas or defended zones within the vicinity of the site area.

The Development Advice map has been obtained from Natural Resources Wales and this shows that the site area is fully located within Zone A and therefore considered to be at little or no risk of fluvial or tidal/coastal flooding. The proposed development contains storage buildings, storage areas, and lorry parking. It is considered that this is classed as 'general industry' and would therefore be classed as a Less Vulnerable development in accordance with Figure 2 of TAN 15. This therefore confirms that a justification test is not applicable.

3 Possible Sources of Flooding

3.1 Fluvial (Rivers)

Fluvial sources of flooding include the inundation of floodplains from rivers and watercourses, inundation of areas outside the floodplain due to the influence of bridges, embankments and other features which artificially raise water levels, overtopping or breaching of defences, blockages of culverts, flood channels or flood corridors.

Redwither Brook is located to the north of the site. The River Clywedog is located approximately 870m to the south of the site and the River Dee is located approximately 3km to the south of the site.

The Flood Map for Rivers and Sea shows that the proposed development is fully located within a low risk Flood Zone 1 area which has an annual probability of flooding from rivers of less than 1 in 1000 (<0.1% chance of flooding in any given year). There are no allocated flood storage areas within the vicinity of the site area.

The proposed development is therefore not shown to be affected by fluvial flooding.

The proposed development drainage will offer a form of surface water flow restriction and attenuation to limit and control surface water discharge from the proposed development to match or reduce existing surface water discharge. The proposed development will therefore not increase flood risk to the surrounding area.

3.2 Tidal

The area and associated Rivers are not subject to tidal events.

3.3 Surface Water

Flooding from surface water can include sheet run off from adjacent land and surcharged sewers being combined, foul or surface water sewers.

The Natural Resources Wales Flood Map for Planning showing Flooding for Surface Water shows that the majority of the site is located within Flood Zone 1, which means that it has a chance of flooding of less than 1 in 1000 (<0.1% chance of flooding in any given year). There are a few areas generally adjacent to the existing building which area shown to be Flood Zone 2, having a low risk of flooding of between 0.1% and 1% each year, and these areas are isolated low points on the site. Flood Zone 3 areas, having a risk of flooding of 1% or greater in any given year, are shown in the vicinity of the existing attenuation basin and to isolated low points on the site.

The Flood Map shows that there have been no recorded flood events in the vicinity of the site.

A copy of the Natural Resources Wales Flood Map for Planning information is attached under **Appendix D**.

The proposed development will be located to the south west of the site and will provide a formalised drainage system that will accommodate the current surface water run off arrangement in the areas shown as Flood Zone 3.

The proposed development drainage will also offer a form of surface water flow restriction and attenuation to limit and control surface water discharge from the proposed development. The flow restriction will match or reduce existing surface water discharge, with the attenuation provided to accommodate the volume of excess water generated.

The proposed development is therefore considered not to be at risk of flooding from surface water and considered not to increase the risk of flooding from surface water to the surrounding area.

3.4 Ground Water

Flooding from groundwater can include the water table rising above ground level after prolonged rainfall, remote from a watercourse, low lying areas underlain by permeable rock (aquifers), seepage directly into properties, and groundwater recovery after pumping has ceased from mining or industry.

There is no evidence of groundwater issues on the site.

3.5 Infrastructure Failure

Flooding from the failure of reservoirs, canals, industrial processes, burst water mains, blocked sewers or failed pumping stations.

Welsh Water sewer record plans show a combined sewer running in a south easterly direction within the western verge of Clywedog Road (East). This combined sewer turns to run in a north eastly direction within the northern verge of Bridge Road and then crosses the road to connect onto a 150mm diameter combined sewer detailed below.

Welsh Water sewer record plans show a combined sewer running in a north easterly direction within the southern verge of Bridge Road. This system is shown to be 150mm diameter, downstream of the Hydro Aluminium site.

A copy of the Welsh Water sewer record plan is attached under **Appendix E**.

As these drainage systems are adopted, it is considered that they are likely to be adequately maintained and monitored. Should flooding occur in these adopted systems due to blockage or failure, any surplus water would remain within the road curtilage and run towards the north. As such, the site is considered not to be at significant risk from infrastructure failure or flooding from existing sewers.

Existing site drainage plans show that a foul drainage system commences mid way from the north east side of the existing building, and runs south to connect onto the Wesh Water sewer located within Bridge Road. The existing site surface water drainage systems commence from various locations to the south of the site and run

towards the north western boundary. Some of these systems discharge into an attenuation basin located mid way along the north western boundary of the site, which ultimately discharges into Redwither Brook. The remaining systems discharge into Redwither Brook either directly or via the attenuation basin outfall pipe. A copy of the existing site drainage plan is attached under **Appendix E**.

The site drainage system will be maintained by the owners as part of their site management system. As such, the site drainage is considered not to be at significant risk from infrastructure failure or flooding from existing drains.

The Natural Resources Wales Flood Map for Planning showing Flooding for Reservoirs shows that the whole site is outside of the area potentially affected due to the failure of reservoirs. A copy of the reservoir flood plan is attached under **Appendix E**.

3.6 Development Drainage

An increase in formally drained impermeable area could increase flood risk to a wider catchment.

The proposed development will result in an increase of impermeable surface area but will be designed in accordance with the Welsh Government Statutory Standards for sustainable drainage systems resulting in an overall betterment, being a reduction of surface water discharge from the development area.

This therefore would not result in an increased risk to a wider catchment due to the development drainage.

The provision of SuDS within the proposed drainage design would be considered and proposed in the proposed drainage strategy discussed under Section 4.

4 Proposed SW Drainage strategy

4.1 S1 Surface Water Run Off Destination

The Welsh Government Sustainable Drainage (SuDS) Statutory Guidance and Statutory Standards for sustainable drainage systems, requires the following order of priority to be considered when designing the surface water drainage for a development :

a) Priority Level 1 : Surface water runoff is collected for use;
b) Priority Level 2 : Surface water runoff is infiltrated to ground;
c) Priority Level 3 : Surface water runoff is discharged to a surface water body;
d) Priority level 4 : Surface water runoff is discharge to a surface water sewer, highway drain or another drainage system;
e) Priority Level 5 : Surface water runoff is discharged to a combined sewer.

Level 1 : Run Off Collection

Hydro Aluminium have noted that they require high quality water for use within their process systems and therefore grey water collection would not be suitable for re-use as process water.

Level 2 : Discharging Via Infiltration

A Phase II Geo environmental Site Assessment has been undertaken by e3p in August 2023, reference 16-685-R2-1. The report shows that the site is generally covered by Made Ground overlaying Drift deposits comprising reddish stiff medium strength to very stiff high strength brown slightly gravelly slightly silty CLAY with rare cobbles. No groundwater was encountered during the site investigation.

The report states that the made ground and underlying clay are cohesive in nature and therefore, considering the low permeability of the clay, it is considered that soakaway drainage is likely not suitable for the proposed development. A series of Falling Head tests were completed as part of the site intrusive works. These confirmed that the cohesive materials beneath the site do not exhibit a permeability coefficient considered sufficient for SuDs drainage systems. On this basis, discharge of surface

water via infiltration is not considered a viable option for the discharge of the surface water from the development the site.

A copy of the Phase II Geo environmental Site Assessment is attached under **Appendix F**.

Level 3 : Discharge to Watercourse

The surface water generated by the existing site currently discharges into Redwither Brook which runs adjacent to the north west boundary of the site. The existing surface water drainage located within the development area runs through an attenuation basin and flow control prior to discharge into the brook. Existing surface water from other areas of the site discharges directly to the brook.

Due to the proximity of the Redwither Brook, it is proposed that this is the means of discharge of the surface water generated from the proposed development area.

The discharge flow rate from the development area would be reduced by providing sub catchments incorporating flow controls and SuDs features, prior to discharge to the attenuation basin. This will allow the surface water to be managed as close as possible to the source of the run off, thereby not relying on a single 'end of pipe' feature.

The existing attenuation basin and flow control will not be amended due to physical space limitations in that area, but as the flow into the attenuation basin will be reduced, the attenuation basin flow control will not function to its full capacity in terms of flow rate and/or length of time of high flow rate.

Level 4 and 5 : Discharge to Sewer

As a Level 3 discharge to watercourse can be achieved, it is not proposed to discharge to a sewer. It is noted that there is only a combined sewer network in the vicinity of the site.

4.2 S2 Surface Water Run Off Hydraulic Control

The Welsh Government Sustainable Drainage (SuDS) Statutory Guidance and Statutory Standards for sustainable drainage systems, requires that the surface water run off rate for the 1 in 1 year and 1 in 100 year events should be controlled to help mitigate the negative impact of the development runoff on the receiving surface water bodies and to help protect people and property from flooding from the drainage system. The risks of run off event greater than 1 in 100 year should also be considered.

For previously developed sites, the site run off rates should be reduced to the greenfield rates wherever possible, but a minimum betterment of 30% should be applied.

The existing site is brownfield and currently contains existing recycling buildings and external yards and service roads. The proposals focus on redeveloping the south west portion of the site which is currently occupied by existing yard, storage and parking areas.

It is not proposed to amend the existing attenuation basin or flow control that currently serves the site as there is no space available for expansion of the established pond. It is considered that by reducing the flow into the attenuation basin from the redeveloped areas, this will reduce the head of water in the pond and therefore the flow through the existing flow control currently serving this area of the site.

4.2.1 Hydraulic Control

A planning area boundary around the development area measures 23,440m^2, consisting of 8,685m^2 existing impermeable hard standing surfacing and 14,755m^2 existing permeable surfacing. Refer to drawing number 9059-NDA-XX-DR-C-1003 under **Appendix H**.

The greenfield run off from this development area has been calculated using the Micro Drainage Rural Runoff Calculator. The discharge for a 1 in 1 year storm has been calculated as 24.5 l/s and the discharge from a 1 in 100 year storm event has been calculated as 51.3 l/s. Qbar is shown as 16.5 l/s rural and 27.9 l/s urban.

The development area is however a brownfield site containing an existing hard standing area of 8,685m^2 that is currently formally drained into the balancing pond. The discharge rate has been calculated using the Micro Drainage network design package. The discharge from a 1 in 1 year storm event is calculated as 104.4 l/s and the discharge from a 1 in 100 year storm event is calculated as 306.8 l/s.

it is proposed that the discharge from the development area is limited to 52.0 l/s to provide 50% betterment to the existing 1 in 1 year discharge from the development area. It is also proposed that the discharge from the development area is limited to 52.0 l/s for up to a 1 in 100 year event plus 40% allowance for climate change. This provides a 83% betterment to the existing 1 in 100 year flows and matches the existing 1 in 100 year greenfield run off rate.

Summary of Existing and Proposed Discharge Flows

	1 in 1 Greenfield	1 in 100 Greenfield	Existing 1 in 1 brownfield	Existing 1 in 100 brownfield	Proposed 1 in 1	Proposed 1 in 100
Dev Area	24.5	51.3	104.4	306.8	52	52

Table 1 : Summary of Existing and Proposed Discharge Flows

4.2.2 Interception of run off

Interception mechanisms are based on runoff volume reduction to help mitigate the negative impacts of the development run off on the morphology and associated ecology of the receiving water body. The items considered potentially viable for the site are shaded green.

Green Roof	The building is to have a pitched roof and the roof space is to be occupied by roof lights. It is therefore not suitable for a green roof solution.
Rainwater harvesting systems	Hydro Aluminium have confirmed that grey water would not be suitable for process purposes.
Soakaway / infiltration systems	Infiltration is not considered a viable option for the discharge of the surface water from the development area due to the presence of made ground and cohesive sub strata.
Permeable surfaces	Permeable surfaces are not considered to be suitable for the site access roads and turning areas due to the HG vehicle usage.
Swales	Swales could be positioned to the south west within the vegetated area however, the development area generally falls away from the south west which would not make use of the swale. Provision of a swale has been considered to the south of the proposed sorting facility, however, the existing ground quickly increases in level in this location and the swale would cut into the existing bund, thereby requiring significant earthworks where there is a requirement to minimise disruption to the ecological corridor area.
Filter strips and filter drains	Although infiltration is not considered a viable option for the discharge of the surface water from the development area, roof water to the south side of the sorting facility could potentially discharge via a sealed filter drain to improve water quality and offer additional source control and attenuation volume.

Detention Basins	There is an existing attenuation basin serving the existing site drainage, which is to be maintained. There is insufficient space available on the site to increase the size of this basin or incorporate this feature elsewhere, however, the flow into this basin is to be reduced thereby resulting in more capacity.
Bioretention areas and rain gardens	There is insufficient space available on the site to incorporate this feature.
Ponds and Wetlands	The site is currently served by an attenuation basin and it is intended that this attenuation basin is to remain as part of the design proposals. There is insufficient space available to extend the basin or increase its depth to form a pond however, existing flow into it is proposed to be reduced, and the area has become naturalised.

4.3 S3 Water Quality

It is proposed to provide SuDs features specific to individual areas of the development to managed surface water as close to the source of the run off from the development areas as far as possible, thereby not fully relying on an 'end of pipe' feature. This approach will also maximise the management of the discharge from the site.

The development area measures approximately 23,440m^2 and consists of a new sorting shed building and storage shelter, along with an associated finished goods yard storage area, extended yard area and lorry parking. Large areas of vegetation are located to the south west, including an ecology corridor, and disruption of these areas is to be minimised.

The main development area has been split into two sub catchments with separate flow control and attenuation, to manage the surface water close to the source of the run off. Refer to drawing numbers 9059-NDA-XX-DR-C-1004 and 9059-NDA-XX-DR-C-1005 under **Appendix H**.

AREA A : New finished goods yard, storage area and access road

Area A includes the finished good yard, storage area and access road and accommodates an area of approximately 5,950m^2. It will consist of a concrete slab construction. Channel drain systems are proposed to collect the surface water run off from this area, consisting of large channel cross sections laid relatively flat to maximise attenuation volume and allow easy removal of collected sediments. The channels will be provided with sump units for the collection of silts and will discharge into a catchpit manhole with a grille, for further silt collection and prevention of larger solids entering the downstream network. An orifice flow control is proposed to limit the discharge from this area, with associated crate attenuation to accommodate the additional surface water generated for a 1 in 100 year storm event plus a 40% allowance for climate change.

Area A is therefore proposed as a sub catchment with an independent flow control and attenuation mechanism. The discharge would connect onto the Area B drainage network.

AREA B : New buildings and yard areas

Area B includes the new sorting facility and storage shelter buildings along with an area of yard and access road, and accommodates an area of approximately 5,990m^2. It will consist of impermeable roof areas and concrete slab construction. The new sorting facility is bound by bunded vegetation to the south west. Due to the levels of the vegetation bund increasing to form the side of the bund, it is not considered that there is sufficient space to incorporate a swale without undermining the existing bund. A sealed filter drain could potentially be used in this location to collect roof water from the south side of the sorting facility, which would improve water quality and offer additional source control and attenuation volume. The remainder of the building would be drained via a piped drainage network.

Channel drain systems are proposed to collect the surface water run off from the yard and access road areas, consisting of large channel cross sections laid relatively flat to maximise attenuation volume and allow easy removal of collected sediments. The channels will be provided with sump units for the collection of silts and will discharge into a catchpit manhole with a grille, for further silt collection and prevention of larger solids entering the downstream network.

A final vortex flow control is proposed to limit the discharge from this area, with associated crate attenuation to accommodate the additional surface water generated for a 1 in 100 year storm event plus a 40% allowance for climate change.

4.3.1 Attenuation Volume

The surface water discharge from the development area is proposed to be restricted to 52 l/s. The excess surface water generated by the proposed flow restriction of 52l/s is to be attenuated to accommodate a 1 in 100 year storm plus a 40% allowance for climate change.

The surface water drainage has been modelled using the Micro Drainage computer programme Network Design. The total contributing area of 11,940m^2 has been included in the model, with a final vortex control flow restriction provided to limit the flow into the existing attenuation basis to a maximum of 52 l/s. Channel drainage, storage crates and flow controls have been included in the model with surface water attenuation provided in a crate tank to Area A having a storage volume of 38.5m^3,

surface water attenuation provided in a crate tank to Area B having a storage volume of 128m^3.

This has been simulated and is shown to accommodate a 1 in 100 year storm event plus 40% allowance for climate change and shows the provision is adequate to accommodate this design storm event. A copy of the Micro Drainage calculations are attached under **Appendix G**.

A drainage strategy drawing has been produced which demonstrates the principles of the above design proposals. Other options and layouts can be proposed during the detailed design stage as long as the proposals meet the above requirements. A copy of the Proposed Drainage Strategy Drawing, is attached under **Appendix H**.

4.3.2 Flow paths and Flood Exceedance Routes

The drainage has been designed to accommodate the surface water generated from a 1 in 100 year storm plus a 40% allowance for climate change. It is unlikely that this design storm event is exceeded and the system floods under these circumstances.

The proposals have been designed such that smaller catchment areas are provided with independent attenuation and flow control mechanisms, therefore not relying on a single end of line control feature. As such if one of these features should fail, the impact on the site will be reduced.

If the proposed drainage facilities were to fail or their capacity exceeded, the excess surface water would flow towards the north of the site, thereby maintaining existing flow paths and flood exceedance routes. Flood exceedance routes are shown in the Indicative Drainage Strategy Drawing, attached under **Appendix G.**

4.3.3 Management and Maintenance

The management and maintenance regime for the drainage systems will be undertaken by the site owner/occupier under a Maintenance and Management Plan.

4.4 S4 Amenity

The required vehicular access throughout the external areas of the service roads and the requirement to maximise potential storage space, prevents planting of vegetation and trees in these locations. However, the extent of the development has been restricted to retain the existing vegetation strip to the south west boundary of the site. Due to the landscaping on the western boundary being at a significantly higher level than the site, it is not feasible to incorporate this area into the design.

Where feasible, surface based systems have been provided in the form of permeable car parking and large channel drainage, which will allow a visible view of performance and potential maintenance requirements.

4.5 S5 Biodiversity

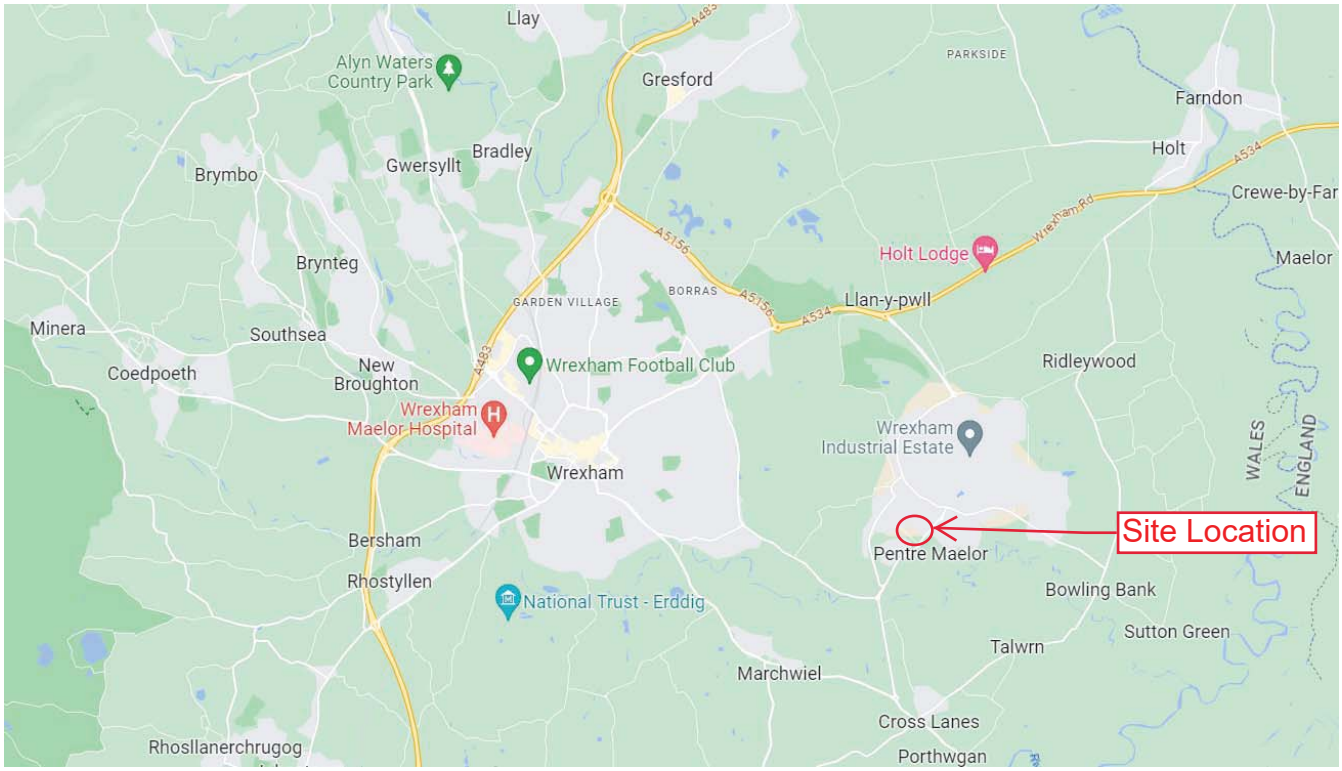
The proposals have been designed to improve the water quality and reduce the volume of water discharging from the site, with the provision of silt traps and grilles and surface based drainage systems.

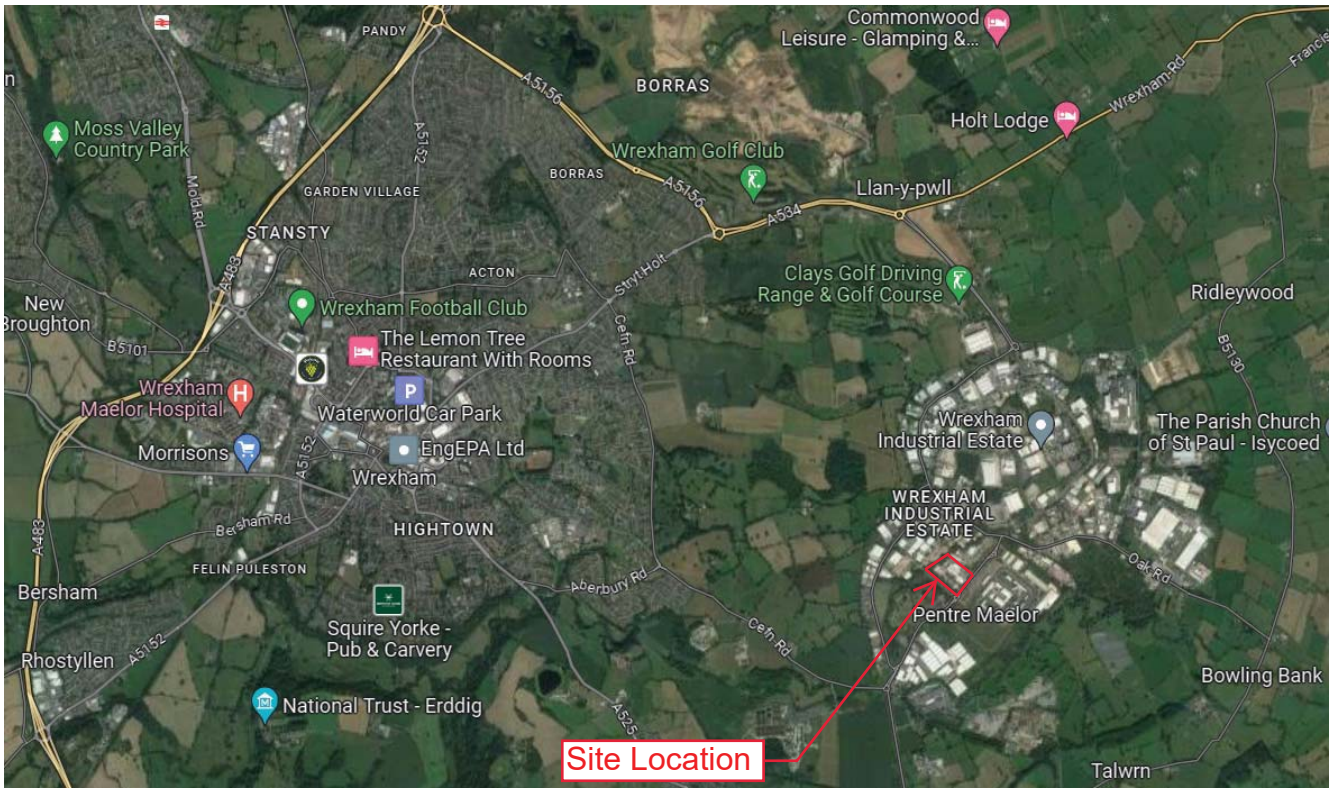
The development proposals, as a whole, include an ecology corridor to the western boundary, and buffer strip to the northern boundary, both of which are proposed to provide habitat and biodiversity.

Appendix A – Site Location Plans

Hydro Aluminium
Wrexham, LL13 9PS

Site Location Plan



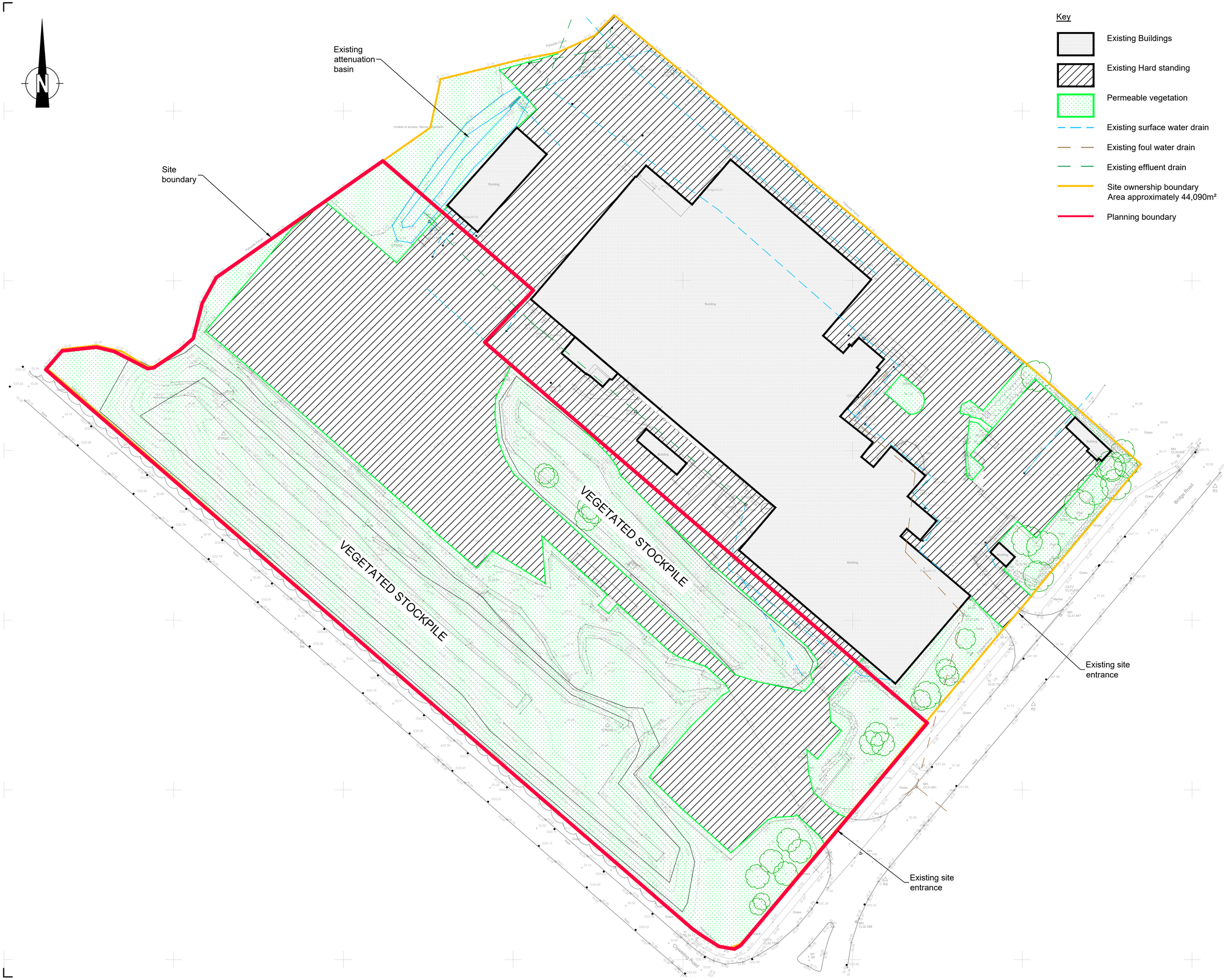


Hydro Aluminium
Wrexham, LL13 9PS

Site Boundary Plan



Appendix B – Existing Topographical Survey



Key

- Existing Buildings
- Existing Hard standing
- Permeable vegetation
- Existing surface water drain
- Existing foul water drain
- Existing effluent drain
- Site ownership boundary
  Area approximately 44,090m²
- Planning boundary

General Notes:

1. The drawings, design and all information contained therein are the sole copyright of Norder Design Associates (NDA) and reproduction in any form is forbidden unless permission is obtained in writing.
2. This drawing is to be read in conjunction with all other relevant Architects, Engineers and specialists drawings, details and specifications.
3. Conflicting information shown on the NDA drawings or discrepancies between the information given by NDA and that provided by others must be referred to NDA before work proceeds.
4. Dimensions must not be scaled from this drawing.
5. Dimensions marked 'dimension to be site checked' are subject to confirmation by site measurement before construction proceeds.
6. Subcontractor surveys, such as for the purposes of steelwork installation, take precedence over 'site dimensions' indicated on this drawing. All surveys should ensure an accurate fit of components.
7. Temporary works associated with the construction of the project shall be the responsibility of the Principal Contractor.
8. Where any temporary works or scaffolding are required the Principal Contractor shall appoint a competent and suitably experienced Temporary Works Coordinator (TWC). Refer to BS 5975 for guidance on temporary works and the role of a TWC.
9. Calculations and drawings of all Contractor designed structural items associated with NDA's design responsibilities shall be submitted to the Engineer for comment at least 10 days prior to manufacture. Any comments made by NDA do not absolve the Contractor of his design responsibilities.
10. Contractor to refer to the Health and Safety File for identification of hazards, including the existence of underground and overhead utilities.
11. The contractor is to work within any planning restriction including working hours, noise levels etc.

REV	DATE	AMENDMENT	DRW	CHK
P02	29/04/24	Planning boundary amended	AF	ML
P01	12/09/23	For information	AF	ML

CLIENT

Hydro

PROJECT

Hydro Aluminium
Wrexham Industrial Estate
New Sorting Shed

DRAWING TITLE

Existing Topographical Survey and Hard Standing Areas

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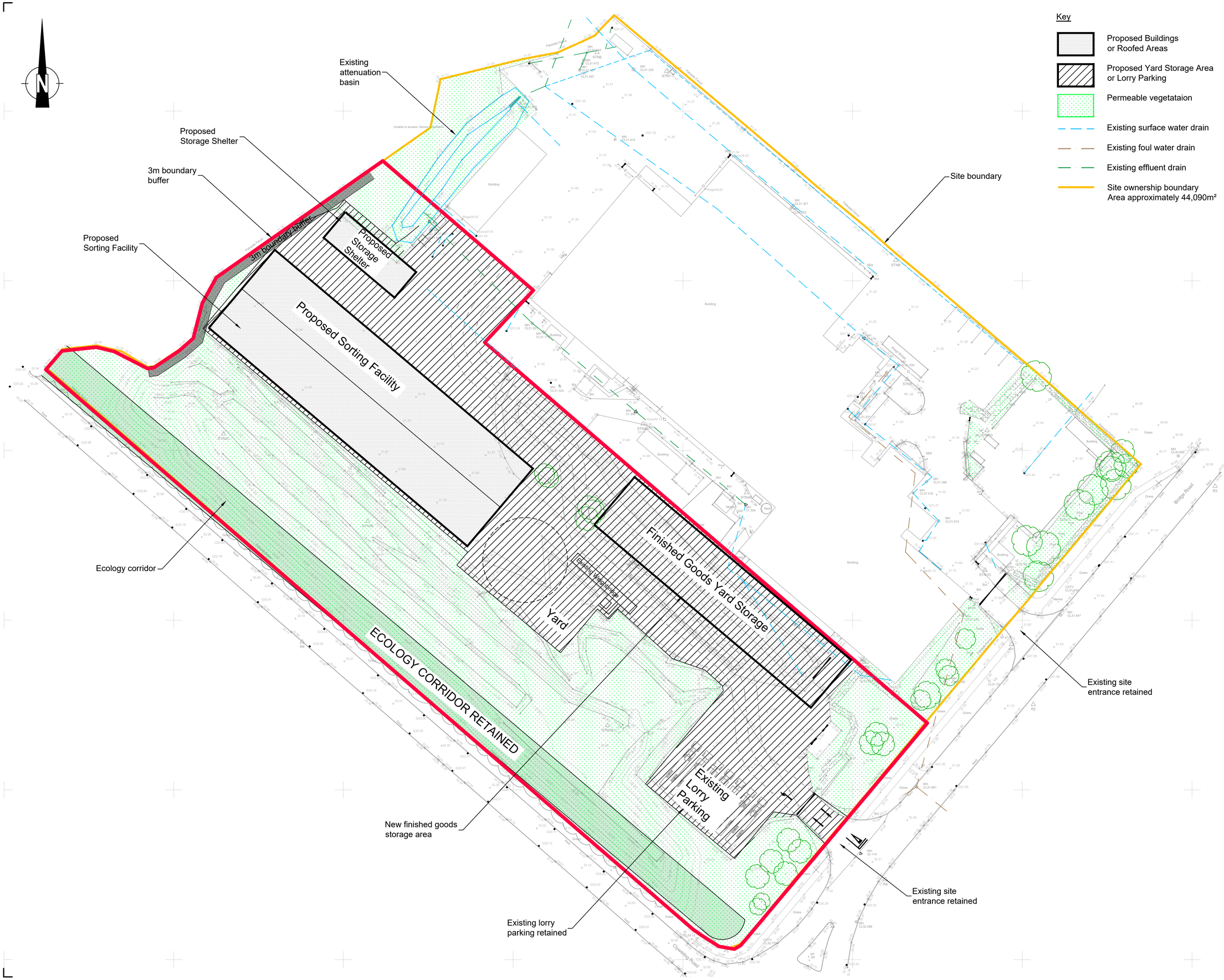
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Scale 1 : 500	A1	9059

SUITABILITY

S2 - Suitable for Information

DRAWING NO.	REV
9059-NDA-XX-DR-C-1001	P02

Appendix C – Proposed Development Layout Plan



Key

- Proposed Buildings or Roofed Areas
- Proposed Yard Storage Area or Lorry Parking
- Permeable vegetataion
- Existing surface water drain
- Existing foul water drain
- Existing effluent drain
- Site ownership boundary Area approximately 44,090m²

General Notes:

1. The drawings, design and all information contained therein are the sole copyright of Norder Design Associates (NDA) and reproduction in any form is forbidden unless permission is obtained in writing.
2. This drawing is to be read in conjunction with all other relevant Architects, Engineers and specialists drawings, details and specifications.
3. Conflicting information shown on the NDA drawings or discrepancies between the information given by NDA and that provided by others must be referred to NDA before work proceeds.
4. Dimensions must not be scaled from this drawing.
5. Dimensions marked 'dimension to be site checked' are subject to confirmation by site measurement before construction proceeds.
6. Subcontractor surveys, such as for the purposes of steelwork installation, take precedence over 'site dimensions' indicated on this drawing. All surveys should ensure an accurate fit of components.
7. Temporary works associated with the construction of the project shall be the responsibility of the Principal Contractor.
8. Where any temporary works or scaffolding are required the Principal Contractor shall appoint a competent and suitably experienced Temporary Works Coordinator (TWC). Refer to BS 5975 for guidance on temporary works and the role of a TWC.
9. Calculations and drawings of all Contractor designed structural items associated with NDA's design responsibilities shall be submitted to the Engineer for comment at least 10 days prior to manufacture. Any comments made by NDA do not absolve the Contractor of his design responsibilities.
10. Contractor to refer to the Health and Safety File for identification of hazards, including the existence of underground and overhead utilities.
11. The contractor is to work within any planning restriction including working hours, noise levels etc.

REV	DATE	AMENDMENT	DRW	CHK
P02	29/04/24	Layout updated	AF	ML
P01	12/09/23	For information	AF	ML

CLIENT

Hydro

PROJECT

Hydro Aluminium
Wrexham Industrial Estate
New Sorting Shed

DRAWING TITLE

Proposed
Development Layout

Norder
Engineers. Architects. Innovators.
Beech Lawn, Green Lane, Belper, Derby DE56 1BY
Tel: 01773 824414
E-mail: enquiries@norder.co.uk

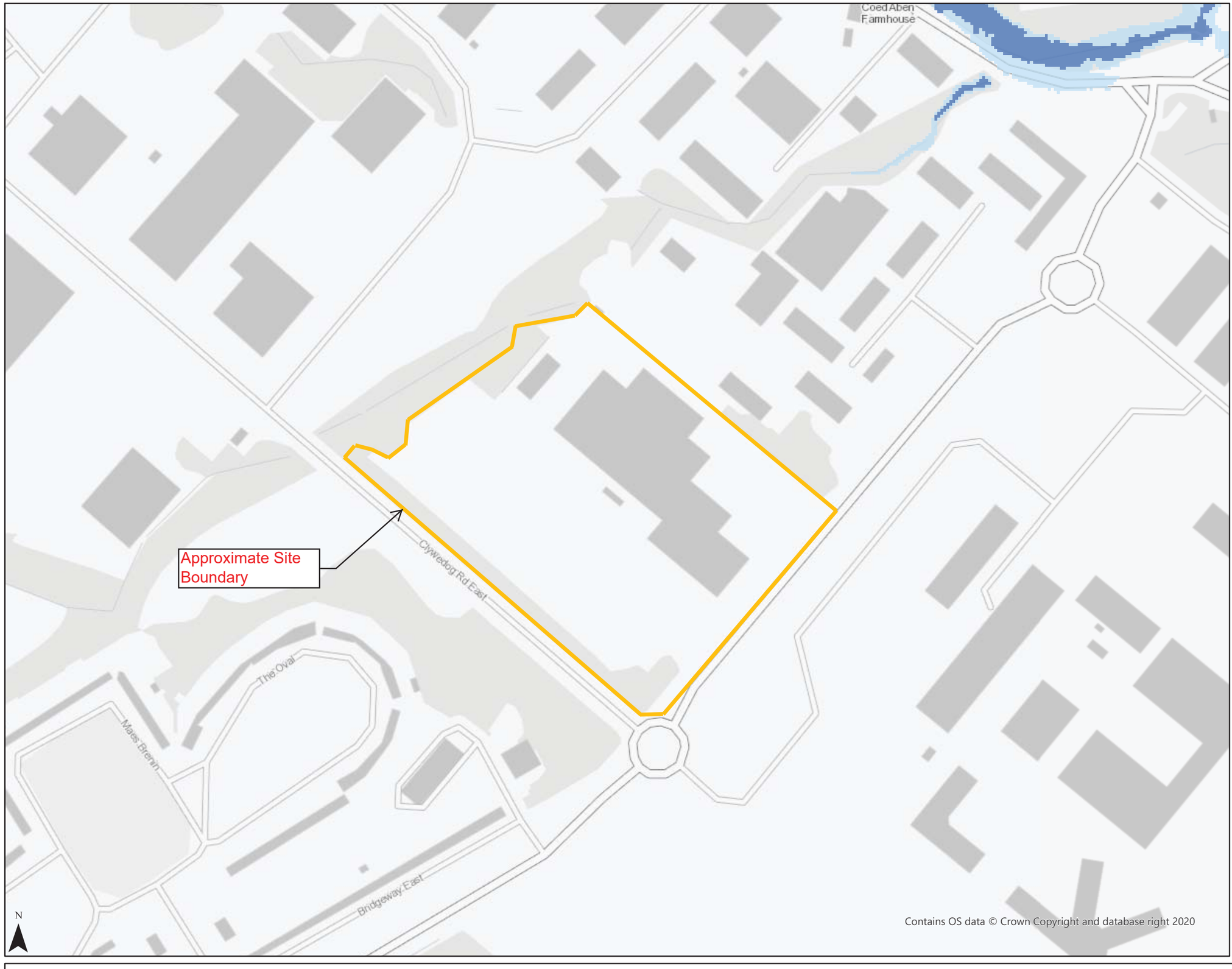
SCALE	SHEET SIZE	NDA REF
Scale 1 : 200	A1	9059

SUITABILITY

S2 - Suitable for Information

DRAWING NO.	REV
9059-NDA-XX-DR-C-1002	P02

Appendix D – Flood Mapping Information



Cyfoeth Naturiol Cymru
Natural Resources Wales

Flood Map for Planning - Basic

Flood Rivers and Sea

Legend

TAN15 Defended Zones

Rivers

Sea

Rivers and Sea

Rivers and Sea

Flood Zone 3

Flood Zone 2

Scale at A3: 1:2,500

Date: 29/07/2023

0.1 0.05 0 0.1

km

British National Grid

Disclaimer

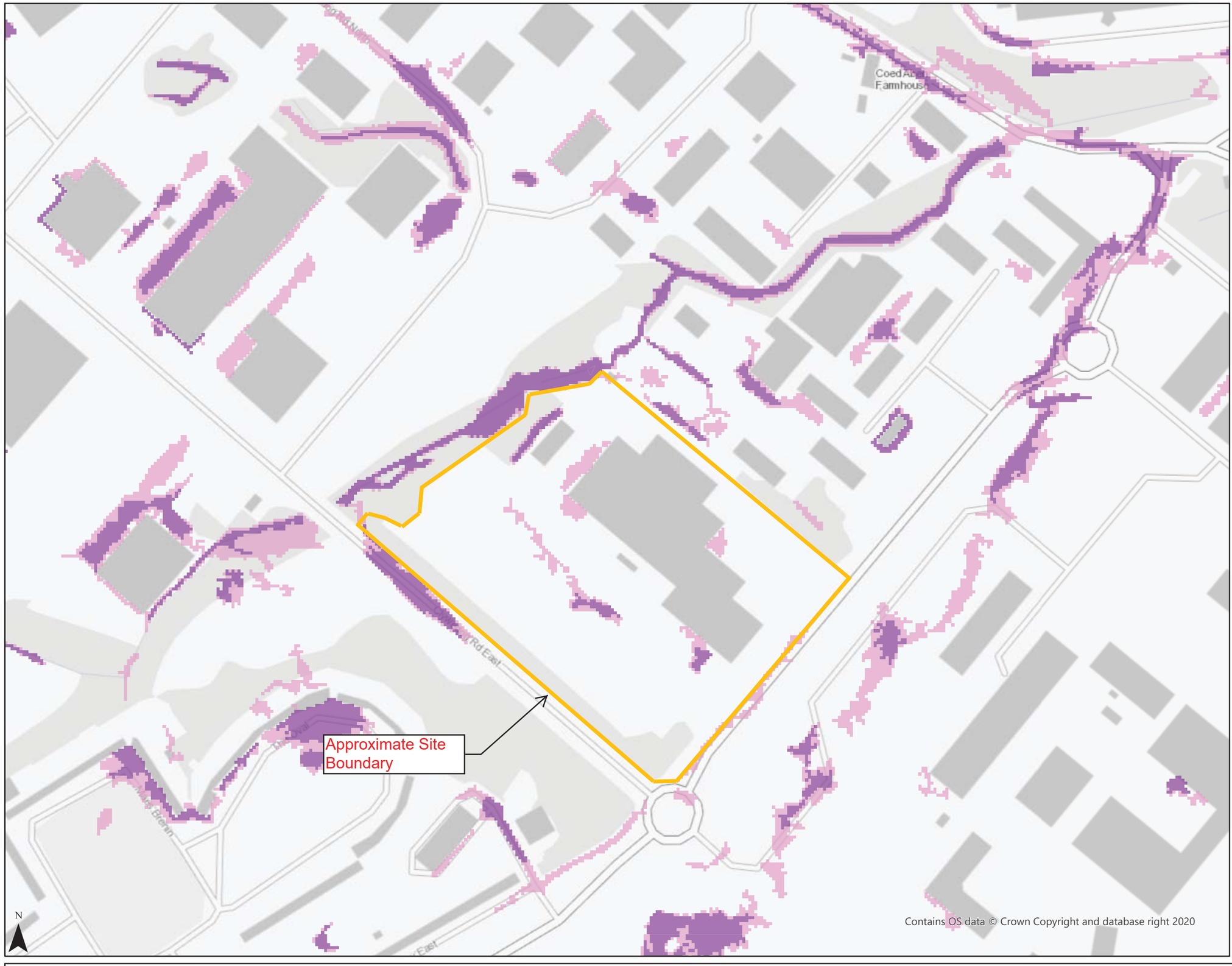
https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

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Cyfoeth Naturiol Cymru
Natural Resources Wales

Flood Map for Planning - Basic

Flood Surface Water



Legend

Surface Water and Small Watercourses

- Flood Zone 3
- Flood Zone 2
- Recorded Flood Extents

Scale at A3: 1:2,500

Date: 29/07/2023

0.1 0.05 0 0.1

km

British National Grid

Disclaimer

https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

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Appendix E – Sewer Records. Site Drainage and Reservoir Plans

Dŵr Cymru
Welsh Water

Wrexham Industrial Estate Bridge Road LL13 9PS

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow (CO)
- Special purpose chamber (SPC)
- Treatment works
- Pumping station
- Outfall
- Lamphole (LH)
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement (S 104)
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

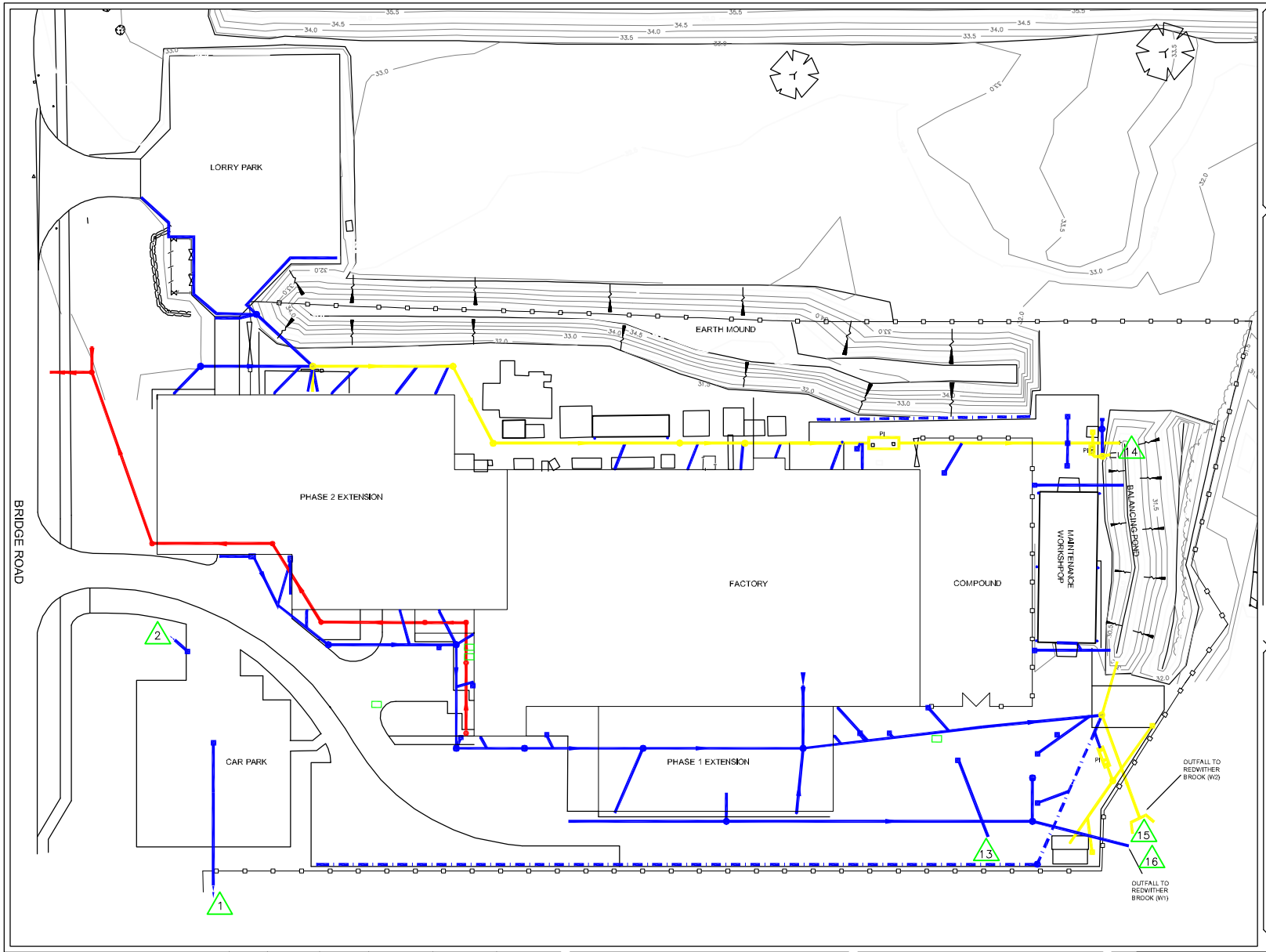
Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map Ref:	337586,349264
Map scale:	1:2000
Printed by:	Zara Howells
Printed on:	26 Jul 2023



KEY

- EXISTING FOUL SEWER
- EXISTING SURFACE WATER SEWER
- EXISTING FILTER DRAIN
- EXISTING SURFACE WATER AND PROCESS WATER SEWER
- EXISTING GULLIES
- EXISTING FOUL MANHOLE
- EXISTING SURFACE WATER MANHOLE
- EXISTING RAINWATER DOWNSPOUTS
- EXISTING FIRE HYDRANTS
- PI PETROL / OIL SEPARATOR

OUTFALL LOCATIONS

- 1 SOAKAWAY SERVING CAR PARK GULLY
- 2 SOAKAWAY SERVING CAR PARK GULLY
- 13 SOAKAWAY SERVING SERVICE YARD GULLY
- 14 OUTFALL TO BALANCING POND
- 15 OUTFALL TO REDWITHER BROOK (W1)
- 16 OUTFALL TO REDWITHER BROOK (W2)

AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN			
DRAWN	GNT	GNT	SEP'09

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HYDRO

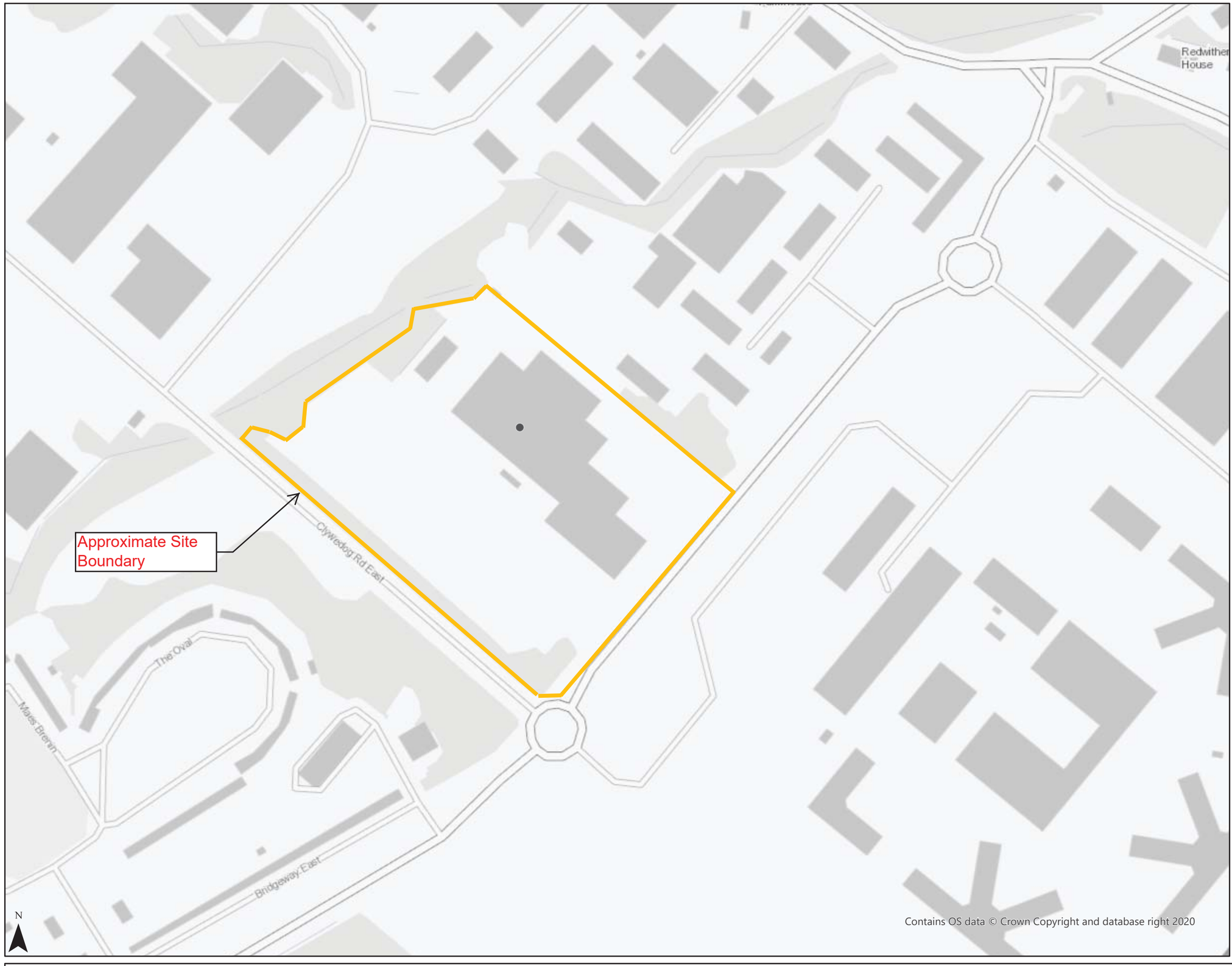
Rossett Office
Burton House, Rossett
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Tel: +44 01244 571444
Fax: +44 01244 570272

TITLE HYDRO ALUMINIUM DEESIDE LTD

EXISITING FOUL & SURFACE DRAINAGE LAYOUT

STATUS		FILE	RC5510			
SCALE	PLOT DATE	FEATURE IDENTIFIER	CODE	SHEET	REVISION
NTS	SEP'09	CL	(50)	02	

ORIGINAL SHEET SIZE A4 [297x210]



Cyfoeth Naturiol Cymru
Natural Resources Wales

Flood Risk Maps

Flood Reservoirs

Legend

Flood Risk from Reservoirs

Scale at A3: 1:2,500

Date: 07/08/2023

0.1 0.05 0 0.1

km

British National Grid

Disclaimer

https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

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Appendix F – Phase II Geo-environmental Site Assessment

Phase II Geoenvironmental Site Assessment
Hydro Aluminium Deeside Ltd

Reference: 16-685-R2-1
Date: August 2023

PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Hydro Aluminium Deeside Ltd
Bridge Road
Wrexham
LL13 9PS

Prepared for:

Portal Construction NW Ltd

Report Ref: 16-685-R2-1
Date Issued: August 2023

E3P

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Manchester
M41 7JQ

+ 44 (0) 161 707 9612
https://e3p.co.uk

Registered in England
CRN: 08725262

QUALITY ASSURANCE

PROJECT NUMBER	16-685		
VERSION	Version 1		
REMARKS	Final		
DATE	August 2023		
PREPARED BY	J. Beer		
QUALIFICATIONS	BSc (Hons), MSc, FGS		
CHECKED BY	E. Fearn		
QUALIFICATIONS	BSc (Hons), MSc, FGS		
AUTHORISED BY	S. Cox		
QUALIFICATIONS	BSc (Hons), FGS, PIEMA, MIEnvSci, CEnv		

EXECUTIVE SUMMARY

Site Address	Hydro Aluminium Deeside Ltd, Bridge Road, Wrexham, LL13 9PS	
Grid Reference	E 337582, N 349213.	
Site Area	2.3 Ha.	
Proposed Development	Portal Construction NW intends to construct a commercial unit with associated service infrastructure. At the time of writing a proposed development plan has not been provided to E3P.	
Current Site Use	The subject site is a rectangular shaped parcel of land located to the east of Wrexham and is currently used an aluminium recycling facility by Hydro Aluminium Deeside Ltd. Site activities involve the importation of waste aluminium and the subsequent sorting, melting and recasting of the material into aluminium rods which are then exported off site. The area of the proposed development is within an area currently used for the loading of aluminium rods onto lorries and the transfer offsite. The site is largely variable in topography with a large stockpile mound running along the southwestern boundary extending approximately 5 m above ground level. There is also a smaller mound running along the northeastern boundary, however this only extends 2 m above ground. The centre of the site, where the majority of works will take place, is flat. Rough scrub vegetation is present on the northeastern mound with the southwestern stockpile covered in semi-compacted soil and gravel. Semi-mature trees line the northwestern and southwestern boundaries, with no vegetation present in the northern sector. A service road runs through the centre of the site, with a storage area and lorry park in the northwest and southeast respectively.	
Site History	Historical mapping suggests that the site remained as undeveloped agricultural land with ponds and trees until circa 1961, when it was transformed as a part of Royal Ordnance Factory (ROF) Wrexham. 3 Buildings were constructed and associated tracks, which remained in place until circa 1976 when all buildings were removed from site. By 1986, the site was empty with no features noted on the mapping and it remained this way until 2000 when an entry gate was constructed along the southeastern boundary. By 2020 the service road through the centre of the site had been constructed, and the site remains in this layout to the present day.	
Environmental Setting	**Drift Geology**	Glacial Till – DIAMICTON
	Bedrock Geology	Salop Formation – MUDSTONE, SANDSTONE and CONGLOMERATE
	Faults	There are no bedrock faults or any other linear features within 500 m of the site.
	Hydrogeology	Secondary A bedrock aquifer with secondary undifferentiated superficial aquifer recorded. One groundwater abstraction licence is recorded within 1 km of the located 559 m south-east with the purpose of process water.

<table>
<tr><td rowspan="2">Environmental Setting continued.</td><td>Hydrology</td><td>The nearest off-site surface water feature is an inland river located 15 m NW. Based on the local topography, the location of surface watercourses and the presence of several drainage ditches, it is considered likely that shallow groundwater, if present, will flow in a northerly direction, following the topographical gradient towards a drain the north.</td></tr>
<tr><td>Flood Risk</td><td>Unaffected by flooding from rivers.</td></tr>
<tr><td>Natural Landform and Geomorphology</td><td colspan="2">Based on the initial geological assessment, a review of available topographic data and pertinent mapping, E3P has undertaken a preliminary geomorphological assessment of the landform and its possible mechanism for formation.

It is likely that artificial levelling has been completed for the development platform for the existing site platform comprising access road, goods yard and lorry park. As such, it is expected that a thin band of Made Ground is present overlying the natural strata in these. In the west of the site artificial raising has occurred to form the stockpile. It is anticipated that across the rest of the site the existing level is similar to that of the natural level.</td></tr>
<tr><td>Previous Reports</td><td colspan="2">A previous report written by Genesis Environmental Limited in 2001 (ref: ADE/178/SR) has been obtained by E3P, with the pertinent information discussed below;

• The top 2 meters of soil in the northwest of the site is Made Ground derived from ROF Wrexham. Made Ground contains building rubble, in addition to ash and slag.

• Elevated concentrations of lead and zinc at two of six sampling locations as a result of Made Ground.

• Concrete floors from former explosive factories are still in place ~2 m bgl.

• In 1995, Royal Ordnance ESG stated the land is likely to be contaminated by conventional contaminants (metals, hydrocarbons, PAHs, PCB and asbestos) and by unconventional contaminants (nitroglycerine, nitrocellulose and picrite). No evidence of asbestos or explosives was found during the intrusive investigation.

• Identified PCBs are assumed to derive from a capacitor factory between 1951 and 1983.

• Exceedences have been identified in groundwater for arsenic, copper, mercury, zinc and sulphate.

• On the basis of information available at the time of writing the report, near-surface contamination with heavy metals does not appear to present unacceptable levels of risk to human receptors.</td></tr>
</table>

Utility Locations	A summary of statutory utility plans has identified the following services on site: • Medium Pressure gas main along the south-western boundary of the site, crossing the southern corner and entering the centre of the recycling facility off Bridge Road into the central area of the site. • Extensive electricity infrastructure is present surrounding the working area. • Within the working area an out of use LV cable bisects the site in a south-west to north east trajectory from the south western site boundary to the electricity substation present in the centre of the recycling facility but outside of the working area. Multiple HV, EHV and non power cables run from the electricity substation through the bund along the north-eastern boundary of the working area. Electricity infrastructure is present across the entrance to the working area. EHV and HV cables cross the southern corner of the site. • Clean water infrastructure is present in the surrounding roads with pipes entering the main recycling facility off Bridge Road. No infrastructure has been identified within the working area. • A sewer is present along the south-eastern boundary along Bridge Road. • BT infrastructure is present within the surrounding roads and enter the main recycling facility buildings from Bridge Road. No infrastructure has been identified within the working area.
Landfill Sites and Ground Gases	No landfill sites (current or historic) are located within 250 m of the site. The site has undergone some historic development and ground working. The Made Ground associated with the historic development may produce hazardous ground gases such as methane and carbon dioxide.
Radon	Less than 1% of houses above the 'Action Level' – no special precautions required.
Coal Mining/Land Stability	The site is located in a coal mining reporting area but not within a development high-risk area. There is no evidence of any coal mining activity within close proximity of the and it is therefore considered that there is no risk from coal mining.
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction have been identified within influencing distance of the subject site.

Initial Conceptual Site Model	The following potential on-site sources of contamination have been identified: • Made Ground (former structures, tracks) – Heavy metals, asbestos, Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPHs), Hazardous Ground Gas (carbon dioxide, methane) • Former earthworks/ infilled ground (former ponds and field boundaries) – Heavy metals, asbestos, PAHs, TPHs, Hazardous Ground Gas (carbon dioxide, methane) • Agricultural land use, argon storage on site (localised spillages of fuel) – PAH, TPH

GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising the following scope of works: • 8 No. mechanically excavated trial pits; • 8 No. window sample probeholes; • 7 No. monitoring well installations; • 3 No. cable tool boreholes.
Ground Conditions	**MADE GROUND – 0.00 m bgl to 4.00 m bgl** Made Ground was encountered within all exploratory hole locations on the site and can generally be split into three distinct strata occurring in the lorry park, the goods yard and the stockpiled material respectively. Within the lorry park area in the south of the site Made Ground was encountered from ground level to 1.00 m bgl. Made Ground comprises grey sandy gravel with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and limestone. Cobbles are subangular of concrete. Made Ground within the goods area in the north of the site was generally encountered from ground level to 0.50 m bgl. In WS108 localised Made Ground was encountered to 2.00 m bgl. Made Ground comprises a 250 mm concrete slab overlying grey sand with gravel of mudstone and limestone to a depth of 0.50 m bgl. In WS108 a membrane was encountered at 0.50 m bgl which is underlain by brown slightly sandy gravel with cobbles. Gravel and cobbles comprise mudstone, brick and concrete. Due to a barrel refusal at 2.00 m bgl the full extent of Made Ground within WS108 could not be proven. Made Ground within the mounded stockpile in the west of the site was encountered from ground level up to 4.00 m above ground level. It should be noted, however, this is not a true representation of the depth of Made Ground beneath the site as the material is built up from natural ground level. The stockpiled material generally comprises brown reworked sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, limestone, brick, concrete, plastic, metal, timber and ceramic. Cobbles are subangular of brick and concrete. Localised sandy gravel of ash and asphalt was encountered within TP109 and WS106 between 2.00 and 2.80 m.

	DRIFT – 1.10 m bgl to >18.25 m bgl Drift deposits were encountered in all exploratory hole locations in the lorry park and goods yard, apart from WS108 where the full extent of Made Ground could not be proven. Drift deposits were also not encountered within certain locations on the stockpile due to the height of the mounded material. Drift deposits are uniform across the site comprising reddish stiff medium strength to very stiff high strength brown slightly gravelly slightly silty CLAY with rare cobbles. Gravel is fine to medium subangular to subrounded of mudstone. Cobbles are subrounded of mudstone. Localised areas of firm low strength clay were encountered at 14.00 m bgl in CP101 and CP103.
	SOLID The solid geology was not encountered during the site investigation.
	GROUNDWATER Groundwater was not encountered during the site investigation.

CONTAMINATED LAND ASSESSMENT

Human Health	A Tier I human health risk assessment has been undertaken using the chemical analysis results of the soils and comparing them to the relevant Tier I criteria. Elevated concentrations of Lead have been identified within one isolated location and is therefore considered to be a localised hotspot. Given that the development will be covered in hardstanding comprising either buildings, concrete slabs or asphalt the pathway through dermal contact and soil ingestion will be broken, removing the associated risks to the end users. During the enabling works and build phase works on site construction workers will mitigate the associated risks through PPE and good site hygiene during the short-term exposure. Additionally, if proposed landscaping were to be constructed within this area, commercial developments generally have a 300mm 6F2 capping across the entire of the development platform and the landscaped area would be subject a clean 300mm growing medium that will also break the associated pathway. No asbestos has been identified within any of the tested samples. Due to the proximity of the electrical substation on site 3 samples were tested for PCB compounds. Results show concentrations of PCB to be below the limit of detection (LOD). Due to the historical use on site as an ordnance factory, selected samples were tested for explosive compounds found in cordite. All result showed the compounds to be below the LOD. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed soft landscaping areas. There are no suitable sources of topsoil on site.

Controlled Waters	Marginal exceedances in metalloids have been identified across the site within groundwater surface water and leachate samples. Heavy metals have been the only determinants to be noted to be exceeding the EQS and DWS criteria; however minimal elevated concentrations against the DWS were identified and as such the surface water features are considered to be at greater risk. It should be noted that leachate analysis overstates the risk and furthermore due to the thickness of cohesive clay overlaying the bedrock aquifer, it is considered that there is no unacceptable risk to the secondary A aquifer. The m-bat tool has shown that copper, despite exceeding EQS threshold values, is not bioavailable and does not pose an unacceptable risk to the surface water receptor. The RCR for zinc exceeded the EQS threshold value and is therefore considered bioavailable, however, no exceedances for zinc have been identified within on site soil, leachate or groundwater samples and therefore it is considered that zinc is not leaching from site. It is likely that zinc exceedances in the surface water samples is due to leaching from the surrounding industrial area. Furthermore, cohesive clay deposits across the site will reduce the migration of contamination to the inland river. It is recommended that further analysis of the surface water in the inland river should be undertaken as groundworks progress.
Ground Gas	Given that there is no obvious source of ground gas and no elevated readings have been encountered, it is recommended that the site is classified as CS1 and no gas protection measures are required. In the vicinity of WS104, WS105 and WS106, stockpiled Made Ground was encountered to a depth of 4.00 m, in these areas the carbon dioxide concentration has been detected as levels of CS2/Amber1, however the GSV values fall as CS1.
Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

GEOTECHNICAL ASSESSMENT

Underground Obstructions	No significant underground obstructions were encountered during the site investigation.
Allowable Bearing Pressure	The natural underlying clay drift deposits have been assessed as generally being stiff medium with calculated ABPs in the order of 82–154 kN/m^2 from 0.50–20.45 m bgl. Very stiff high strength clays have been identified from 0.50–5.45 m bgl with calculated ABPs in the order of 156–277 kN/m^2. Localised firm low strength clays in CP101 and CP103 have been identified from 14.00–15.50 with a calculated ABP of 57 kN/m^2.
Foundation Options	In respect of the proposed development, E3P consider it feasible to construct the proposed commercial unit utilising a pad foundation onto the underlying firm to very stiff clays with the use of vibro stone columns to reengineer the underlying clays to achieve a uniform ABP across the site. Pad foundations could be formed at 2.50mbgl, however, their feasibility may be limited due to groundwater. The final foundation solution will be subject to Final Finished Levels.

	The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer with detailed designs from a specialist piling contractor. It is likely that a phase of cut works and removal/reengineering of the upper Made Ground materials will be required in order to achieve levels. Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content.
Building Floor Slabs	Following enabling works, the site will may have a variable thickness of Made Ground, that may extend to significant depth in places. Given the structure proposed, it is considered that ground-bearing floor slabs will require detailed design in order to accommodate variability of the formation and account for differential settlement. Given the depth of Made Ground and its loose/variable nature, it will be necessary to undertake some form of Ground Improvement work to ensure the total and differential settlement is within tolerable limits for the Uniformly Distributed Load of the floor slab and any external reinforced concrete yards / hardstanding. It is considered that Ground Improvement by either High Energy Impact Compaction or Vibro Stone Columns would provide a viable engineering solution to ensure the required ABP for a ground bearing floor slab. As an alternative to the above, a more traditional solution which comprises the excavation of the upper stratum of Made Ground prior to re-engineering and compaction as a structural upfill be considered. Limitations with this approach would be attributed to the inherent variability of the material and issues arising from fluctuations in moisture content, which are exaggerated during periods of seasonal variance with increased precipitation and reduced evaporation. Where a ground-bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional reinforcement within the slab to be designed by the structural engineer.
Heave Precautions	Given that the underlying clay is of low to medium volume change potential, heave precautions will be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 250 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Soakaway Drainage	The Made Ground and underlying clay soils are cohesive in nature and therefore, considering the low permeability of the clay, it is considered that soakaway drainage is likely not suitable for the proposed development. A series of Falling Head tests were completed as part of the site intrusive works. These confirmed that the cohesive materials beneath the site do not exhibit a permeability coefficient considered sufficient for SUDs drainage systems.
Sulphate Assessment	For the majority of locations, concrete classification is DS-1 AC-1s. In WS108 elevated sulphate levels have resulted in a classification of DS-2 AC-1s.

CBR Design %	Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Cut/Fill	Development levels are unknown at this time; however, significant cut-and-fill works are likely to be required in the vicinity of the stockpiled material.
Civil Engineering Excavations	The E3P intrusive ground investigation has not identified the presence of shallow bedrock. It is anticipated excavations can be undertaken using standard plant equipment. Due to the presence of low permeability cohesive deposits across the site, it is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed upon with the relevant regulatory body and be undertaken under a trade effluent discharge consent, where required. Measures to remove silt and suspended solids may be required and consideration should be given to the provision of space for settling tanks or an attenuation pond.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: Waste Classification – *Guidance on the classification and assessment of waste*.

RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- Additional surface water monitoring
- Arboricultural survey.
- Foundations to be designed by a suitably qualified Structural Engineer.
- Geotechnical earthworks strategy (infrastructure).
- Remediation and enabling works strategy.

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DRAWING LIST

16-685-001 - Site Location Plan
16-685-003 - Historical Features Plan
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16-685-006 - Depth of Made Ground Plan
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16-685-018 – Contamination Issues Plan

1. INTRODUCTION

1.1. BACKGROUND

E3P has been commissioned by Portal Construction NW Ltd to undertake a detailed Phase II Geoenvironmental Site Assessment at land off Bridge Road, Wrexham at the current Hydro Aluminium Deeside Ltd recycling facility.

This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed development for a proposed low-rise residential development.

1.2. PROPOSED DEVELOPMENT

Portal Construction NW intends to construct a commercial unit with associated service infrastructure.

At the time of writing a proposed development plan has not been provided to E3P.

1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:

- Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available in order to complete a desk study in line with Environment Agency (EA) document *Land Contamination: Risk Management (LCRM) (July 2023)*.
- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- Design of suitable intrusive ground investigation;
- Window sample probeholes with, and construction of, environmental monitoring installations;
- Deep cable percussive boreholes with groundwater monitoring installations;
- Mechanically excavated trial pits;
- In-situ geotechnical testing;
- Chemical and geotechnical laboratory analysis;

- Groundwater monitoring and sampling;
- Ground gas monitoring;
- Falling Head Permeability Testing;
- Contamination risk assessment and conceptual site model;
- Geotechnical assessment and interpretation; and,
- Factual and interpretive reporting.

1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.

1.6. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.

2. GROUND INVESTIGATION

2.1. PREVIOUS SITE INVESTIGATIONS

A previous report written by Genesis Environmental Limited in 2001 (ref: ADE/178/SR) has been provided, with the pertinent information discussed below. The report relates to the current site in addition to the adjacent Hydro Aluminium site to the north.

- The top two meters of soil in the northwest of the site is Made Ground derived from ROF Wrexham. Made Ground contains building rubble, in addition to ash and slag.
- Elevated concentrations of lead and zinc were identified in Made Ground in two out of six sampling locations.
- Concrete floors from former explosive factories are still in place ~2 m bgl.
- In 1995, Royal Ordnance ESG stated the land is likely to be contaminated by conventional contaminants (metals, hydrocarbons, PAHs, PCB and asbestos) and by unconventional contaminants (nitro-glycerine, nitrocellulose and picrite). No evidence of asbestos or explosives was found during the intrusive investigation.
- Identified PCBs are likely to derive from a capacitor factory between 1951 and 1983.
- Exceedances have been identified in groundwater for arsenic, copper, mercury, zinc and sulphate.
- It is noted that near-surface contamination with heavy metals does not appear to present unacceptable levels of risk to human receptors.

E3P have also completed a Phase 1 Desk Study for the subject site (Report Ref: 16-685-R1-1, dated April 2023). Pertinent information is provided below:

- Historical mapping suggests that the site remained as undeveloped agricultural land with ponds until circa 1949, when it was transformed as a part of Royal Ordnance Factory (ROF) Wrexham. A number of buildings were constructed and associated tracks, which remained in place until circa 1976 when all buildings were removed from site. By 1986, the site was vacant with no features noted on the mapping and it remained this way until 2000 when an entry gate was constructed along the south-eastern boundary. By 2020 the service road through the centre of the site had been constructed, and the site remains in this layout to the present day.
- **The drift geology comprises Glacial Till (CLAY, SAND and GRAVEL) overlying Salop Formation (Mudstone, Sandstone and Conglomerate) bedrock.**
- Secondary A (bedrock aquifer) is present within the bedrock geology with secondary undifferentiated (superficial aquifer) recorded. One active groundwater abstraction licence is recorded 559 m south-east with the purpose of process water.
- The nearest off-site surface water feature is an inland river located 15 m north-west.
- No landfill sites (current or historic) are located within 250 m of the site. The site has undergone some historic development and ground working, the Made Ground associated with the historic development may produce hazardous ground gases such as methane and carbon dioxide.
- Historical mapping suggests the potential for munition storage on site. This was likely kept in controlled conditions with careful handling to ensure no spillages or damage.



- The site is located in a coal mining reporting area but not within a development high-risk area. There is no evidence of any coal mining activity within close proximity of the and it is therefore considered that there is a low risk from coal mining.

- The following potential on-site sources of contamination have been identified:

  - Made Ground (former structures, tracks) – Heavy metals, asbestos, Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPHs), hazardous ground gas (carbon dioxide, methane)

  - Former earthworks / infilled ground (former ponds and field boundaries) – Heavy metals, asbestos, PAHs, TPHs, Hazardous Ground Gas (carbon dioxide, methane)

  - On site storage and lorry park (localised spillages of fuel) – PAH, TPH

  - Use of the site as a former cordite factory – Explosives (Picrite, nitroglycerine and nitrocellulose).

2.2. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources identified in the previous site investigations. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between 6th March and 14th March 2023. The works are summarised in Table 2.1.

2.3. LIMITATIONS OF INVESTIGATION

The subject site is an active aluminium recycling facility, with a large stockpile of material along the south western boundary of the site.

Works were completed across the site where access was available, however the presence of the stockpile, active utility infrastructure, and ensuring the aluminium facility functions were not disrupted or restricted where locations could be completed.

2.4. SCOPE OF INVESTIGATION

TABLE 2.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General Ground Conditions Including the Presence/Nature of Obstructions	WS101	Window Sample Probehole	5.45	2.00–5.00
	WS102		3.44	1.00–3.00
	WS103		3.44	N/A
	WS107		2.43	1.00–2.00
	WS108		2.00	1.00–2.00
	TP101	Mechanically Excavated trial pit	1.90	N/A
General Ground Conditions Including the Presence/Nature of Obstructions and Nature of Stockpiled Material	WS104	Window Sample Probehole	3.33	1.00–3.00
	WS105		5.45	1.00–2.00
	WS106		4.45	1.00–4.00
	TP102	Mechanically Excavated trial pit	2.60	N/A
	TP103		3.10	N/A
	TP104		3.00	N/A
	TP105		2.10	N/A
	TP107		2.90	N/A
	TP108		2.80	N/A
	TP109		3.00	N/A
Investigation of deeper soil horizons	CP101	Cable Percussive Borehole	20.00	N/A
	CP102		20.00	N/A
	CP103		20.00	N/A

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

Cable percussive boreholes were advanced to undertake in-situ detailed geotechnical testing and to investigate the deeper soil horizons.

The sampling locations are illustrated in Drawing 16-685-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix IV.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater were recovered for chemical analysis.

2.5. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix IV and presented in Table 3.6 and discussed in Section 6.

2.6. PERMEABILITY TESTS

Three falling head permeability tests were undertaken within environmental monitoring wells (WS101, WS102, WS107) in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development. The results are presented in Table 3.8 and the test certificates are included within Appendix IX.

2.7. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analyses comprising:

- Metals.
- pH, total sulphate, water-soluble sulphate (2:1 extract).
- Sulphide.
- Cyanide.
- Phenols.
- Total and speciated polycyclic aromatic hydrocarbons (PAHs).
- Semi Volatile Organic Compounds (SVOC).
- Volatile Organic Compounds (VOC).
- Asbestos identification and quantification.
- Speciated and banded total petroleum hydrocarbon (TPH).
- Polychlorinated biphenyls (PCBs).
- Explosive testing suite.

I2 Analytical undertook the analytical work and the testing results are included in Appendix V and discussed in Section 4.

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

- Atterberg limits determinations;
- Moisture Content;
- Particle Size Distribution;
- Single-stage triaxial tests;

- Consolidation testing.

Laboratory analysis sheets are included in Appendix IX and are summarised in Section 5.

3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 3.1.

TABLE 3.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)				
	MADE GROUND	STOCKPILED MADE GROUND	FIRM CLAY	STIFF CLAY	VERY STIFF CLAY
TP101	0.00–0.55	–	–	–	0.55–1.90
TP102	–	0.00–2.60	–	–	–
TP103	–	0.00–3.10	–	–	–
TP104	–	0.00–2.00	–	–	2.00–3.00
TP105	–	0.00–0.50	–	–	0.50–2.10
TP107	–	0.00–2.60	–	–	–
TP108	–	0.00–2.60	–	–	–
TP109	–	0.00–2.60	–	–	–
WS101	0.00–0.70	–	–	0.70–2.00	2.00–5.45
WS102	0.00–0.60	–	–	0.60–2.00	2.00–3.44
WS103	0.00–0.60	–	–	0.60–2.00	2.00–3.44
WS104	–	0.00–3.33	–	–	–
WS105	–	0.00–2.30	–	–	2.30–5.45
WS106	–	0.00–4.00	–	–	4.00–4.45
WS107	0.00–0.50	–	–	0.50-2.00	2.00–2.43
WS108	0.00–2.00	–	–	–	–
CP101	0.00–1.00	–	14.00–15.50	3.00–14.00 15.50-20.00	1.00–3.00
CP102	0.00–0.50	–	–	0.50–20.00	–
CP103	0.00–0.50	–	14.00–15.50	1.00–14.00 15.50-20.00	–

3.2. MADE GROUND

Made Ground was encountered within all exploratory hole locations on the site and can generally be split into three distinct strata occurring in the lorry park, the goods yard and the stockpiled material respectively.

Within the lorry park area in the south of the site Made Ground was encountered from ground level to 1.00 m bgl. Made Ground comprises grey sandy gravel with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and limestone. Cobbles are subangular of concrete.

Made Ground within the goods area in the north of the site was generally encountered from ground level to 0.50 m bgl. In WS108 localised Made Ground was encountered to 2.00 m bgl. Made Ground comprises a 250 mm concrete slab overlying grey sand with gravel of mudstone and limestone to a depth of 0.50 m bgl. In WS108 a membrane was encountered at 0.50 m bgl which is underlain by brown slightly sandy gravel with cobbles. Gravel and cobbles comprise mudstone, brick and concrete. Due to a barrel refusal at 2.00 m bgl the full extent of Made Ground within WS108 could not be proven.

Made Ground within the mounded stockpile in the west of the site was encountered from ground level up to 4.00 m above ground. It should be noted, however, this is not a true representation of the depth of Made Ground beneath the site as the material is built up from natural ground level. The stockpiled material generally comprises brown reworked sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, limestone, brick, concrete, plastic, metal, timber and ceramic. Cobbles are subangular of brick and concrete. Localised sandy gravel of ash and asphalt was encountered within TP109 and WS106 between 2.00 and 2.80 m.

A Depth of Made Ground Plan is presented as Drawing 16-685-006 in Appendix III. The plan is a conceptual model of Made Ground below ground level and therefore stockpiled Made Ground is not included in the model.

3.3. DRIFT DEPOSITS

Drift deposits were encountered in all exploratory hole locations in the lorry park and goods yard, apart from WS108 where the full extent of Made Ground could not be proven. Drift deposits were also not encountered within certain locations on the stockpile due to the height of the mounded material.

Drift deposits are uniform across the site comprising reddish stiff medium strength to very stiff high strength brown slightly gravelly slightly silty CLAY with rare cobbles. Gravel is fine to medium subangular to subrounded of mudstone. Cobbles are subrounded of mudstone. Localised areas of firm low strength clay were encountered at 14.00 m bgl in CP101 and CP103.

3.4. SOLID GEOLOGY

The solid geology was not encountered during the site investigation.

3.5. GROUNDWATER

Groundwater was not encountered during the site investigation.

3.6. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual evidence of potential contamination has been identified during the site investigation and these are summarised in Table 3.2.

TABLE 3.2 SUMMARY OF VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

LOCATION	DEPTH (m)	STRATUM	NOTES
TP109	2.00-2.40	Stockpiled Made Ground	Ash

3.7. SOIL CONSISTENCY

Undrained shear strength values were measured using both field hand shear vane tests and laboratory undrained triaxial tests. Results of the tests are presented in Table 3.3 and Table 3.4, which indicate the clay soils to vary between stiff and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 3.3 SUMMARY OF HAND SHEAR VANE TESTS

LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m^2)
TP101	0.80	195	459.89
TP101	1.10	195	459.89
TP104	2.20	195	459.89
TP104	2.60	195	459.89
TP105	1.40	182	428.17
TP105	2.00	185	435.92

Notes
ABP Calculated using Stroud and Butler et al 1974.

TABLE 3.4 SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kPA)	CONSISTENCY
WS105	3.50–4.00	Very stiff brown slightly gravelly slightly sandy CLAY	161	Very stiff
WS107	1.50–2.00	Stiff brown slightly gravelly slightly sandy CLAY	116	Stiff
CP102	6.50–7.00	Soft brown slightly gravelly sandy CLAY	33	Soft

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 3.5.

3.8. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

TABLE 3.5 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING PRESSURE (kN/m^2)*
WS101	1.00	Silty gravelly CLAY	12	12.10	N/A	Medium strength	Stiff	60.49	124.37
WS101	2.00	Silty gravelly CLAY	20	18.27	N/A	High strength	Very Stiff	91.35	187.82
WS101	3.00	Silty gravelly CLAY	19	16.52	N/A	High strength	Very Stiff	82.62	169.86
WS101	4.00	Silty gravelly CLAY	18	15.21	N/A	High strength	Very Stiff	76.04	156.33
WS101	5.00	Silty gravelly CLAY	26	21.57	N/A	High strength	Very Stiff	107.85	221.74
WS102	1.00	Silty gravelly CLAY	13	13.11	N/A	Medium strength	Stiff	65.53	134.73
WS102	2.00	Silty gravelly CLAY	22	20.10	N/A	High strength	Very Stiff	100.49	206.61
WS102	3.00	*Cobble in CLAY*	50	43.48	Dense	N/A	N/A	N/A	434.83
WS103	1.00	Silty gravelly CLAY	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS103	2.00	Silty gravelly CLAY	22	20.10	N/A	High strength	Very Stiff	100.49	206.61
WS103	3.00	*Cobble in CLAY*	50	43.48	Dense	N/A	N/A	N/A	434.83



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING PRESSURE (kN/m^2)*
WS104	1.00	Stockpiled Made Ground	9	9.07	Loose	N/A	N/A	N/A	90.73
WS104	2.00	Stockpiled Made Ground	4	3.65	Very Loose	N/A	N/A	N/A	36.54
WS104	3.00	Stockpiled Made Ground	50	43.48	Dense	N/A	N/A	N/A	434.83
WS105	1.00	Stockpiled Made Ground	1	1.01	Very Loose	N/A	N/A	N/A	10.08
WS105	2.00	Stockpiled Made Ground	16	14.62	Medium Dense	N/A	N/A	N/A	146.17
WS105	3.00	Silty CLAY	31	26.96	N/A	High strength	Very Stiff	134.80	277.14
WS105	4.00	Silty CLAY	23	19.43	N/A	High strength	Very Stiff	97.16	199.76
WS105	5.00	Silty CLAY	26	21.57	N/A	High strength	Very Stiff	107.85	221.74
WS106	1.00	Stockpiled Made Ground	4	4.03	Loose	N/A	N/A	N/A	40.33
WS106	2.00	Stockpiled Made Ground	11	10.05	Medium Dense	N/A	N/A	N/A	100.49
WS106	3.00	Stockpiled Made Ground	5	4.35	Loose	N/A	N/A	N/A	43.48
WS106	4.00	Silty CLAY	25	21.12	N/A	High strength	Very Stiff	105.61	217.13
WS107	1.00	CLAY	14	14.11	N/A	Medium strength	Stiff	70.57	145.09

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING PRESSURE (kN/m^2)*
WS107	2.00	CLAY	50	45.68	N/A	Very high strength	Very Stiff	228.38	469.56
WS108	1.00	Made Ground: Sandy gravel	10	10.08	Medium Dense	N/A	N/A	N/A	100.81
CP101	1.00	Silty gravelly CLAY	18	18.15	N/A	High strength	Very Stiff	90.73	186.55
CP101	2.00	Silty gravelly CLAY	19	17.36	N/A	High strength	Very Stiff	86.79	178.43
CP101	3.00	Silty gravelly CLAY	14	12.18	N/A	Medium strength	Stiff	60.88	125.16
CP101	4.00	Silty gravelly CLAY	17	14.36	N/A	Medium strength	Stiff	71.81	147.65
CP101	5.00	CLAY	18	14.93	N/A	Medium strength	Stiff	74.67	153.51
CP101	8.00	CLAY	14	11.33	N/A	Medium strength	Stiff	56.66	116.50
CP101	11.00	CLAY	16	12.37	N/A	Medium strength	Stiff	61.87	127.20
CP101	17.00	CLAY	8	5.54	N/A	Low strength	Firm	27.71	56.97
CP101	20.00	CLAY	13	8.16	N/A	Medium strength	Stiff	40.81	83.90
CP102	1.00	CLAY	8	8.07	N/A	Medium strength	Stiff	40.33	82.91
CP102	2.00	CLAY	9	8.22	N/A	Medium strength	Stiff	41.11	84.52
CP102	3.00	CLAY	11	9.57	N/A	Medium strength	Stiff	47.83	98.34
CP102	4.00	CLAY	14	11.83	N/A	Medium strength	Stiff	59.14	121.59



BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING PRESSURE (kN/m^2)*
CP102	5.00	CLAY	13	10.79	N/A	Medium strength	Stiff	53.93	110.87
CP102	8.00	CLAY	15	12.14	N/A	Medium strength	Stiff	60.71	124.82
CP102	11.00	CLAY	15	11.60	N/A	Medium strength	Stiff	58.00	119.25
CP102	17.00	CLAY	15	10.39	N/A	Medium strength	Stiff	51.95	106.82
CP102	20.00	CLAY	15	9.42	N/A	Medium strength	Stiff	47.08	96.80
CP103	1.00	CLAY	12	12.10	N/A	Medium strength	Stiff	60.49	124.37
CP103	2.00	CLAY	13	11.88	N/A	Medium strength	Stiff	59.38	122.09
CP103	3.00	CLAY	11	9.57	N/A	Medium strength	Stiff	47.83	98.34
CP103	4.00	CLAY	11	9.29	N/A	Medium strength	Stiff	46.47	95.54
CP103	5.00	CLAY	11	9.13	N/A	Medium strength	Stiff	45.63	93.81
CP103	8.00	CLAY	14	11.33	N/A	Medium strength	Stiff	56.66	116.50
CP103	11.00	CLAY	13	10.05	N/A	Medium strength	Stiff	50.27	103.35
CP103	17.00	CLAY	8	5.54	N/A	Low strength	Firm	27.71	56.97
CP103	20.00	CLAY	16	10.04	N/A	Medium strength	Stiff	50.22	103.26

NOTES
* The Allowable Bearing Pressure (ABP) should be considered indicative.
The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).
Allowable bearing pressure on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.



3.9. CONSOLIDATION

Two undisturbed samples of Glacial Till were submitted for oedometer analysis. The results are provided in Table 3.6.

TABLE 3.6 OEDOMETER CONSOLIDATION RESULTS

LOCATION	DEPTH (m)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	Mv (m^2/MN)	Cv (m^2/year)
WS102	1.50–2.00	U100	22	0–35	Swelling	–
				35–70	0.054	8.012
				70–140	0.097	1.146
				140–280	0.084	0.991
				280–35	0.071	0.598
CP102	6.50 – 7.00	U100	24	0–135	0.448	0.786
				135–270	0.161	0.838
				270–540	0.099	1.123
				540–1080	0.058	1.176
				1080–135	0.030	1.557

When considered at over-burden pressure with an additional load of 110 kPa the coefficient of volume compressibility (Mv) ranged from 0.030 m^2/MN up to 0.448 m^2/MN.

3.10. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of material via wet sieve to obtain information on the soil fractions. The results are included in Table 3.7. The full results can be found in Appendix VIII.

TABLE 3.7 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

LOCATION	DEPTH (m)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
TP104	0.80 (Made Ground)	0	11	13	76

3.11. SOIL INFILTRATION

In-situ variable (falling) head permeability tests were undertaken within the monitoring well installations located in three probeholes (WS101, WS102 and WS107). The installations were noted to be dry prior to the test being undertaken, therefore the tests were undertaken in the unsaturated zone.

The results are presented in Table 3.8 and the test certificates are included within Appendix IX.

TABLE 3.8 SOIL INFILTRATION RESULTS

LOCATION	DEPTH (m)	MATERIAL	TEST No.	SOIL INFILTRATION RATE (m/s)
WS101	1.0–5.0	Silty, gravelly CLAY	1	1.02E-07
WS102	1.0–3.0	Silty, gravelly CLAY	1	1.80E-07
WS107	1.0–2.0	Silty CLAY	1	4.36E-07

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. All tests showed clay drift deposits to do not have good soakage potential.

Therefore, considering the significant volumes of clay on the site, it is considered that soakaway drainage is not suitable for the proposed development.

3.12. SOIL PLASTICITY

The Atterberg limits determinations, summarised in Table 3.9, show the clay to be of predominantly low plasticity with discrete areas of moderate plasticity clay.

TABLE 3.9 SUMMARY OF PLASTICITY INDEX TEST RESULTS

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 µm SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS102	1.00	21	23	45	22	98	21.56	Medium
WS105	2.00	22	25	56	31	100	31.00	Medium
WS107	1.00	20	24	52	28	96	26.88	Medium
WS107	2.00	17	21	41	20	97	19.40	Low
CP103	1.00	51	24	51	27	99	26.73	Medium

The results of the Atterberg limits testing confirmed that the soils would be deemed to be "Low/Medium/ Volume Change Potential" in accordance with the classification system utilised by the LABC/NHBC industry guidance.

3.13. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix V (summarised in Table 3.10), shows that the soils at the site generally meet Class DS-1 AC-1s, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

Elevated sulphate concentrations meeting Class DS-2, AC-1s were noted within the Made Ground deposits in WS108 at 0.6 m bgl.

TABLE 3.10 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO_4 IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.40	0.015	8.5	DS-1 AC-1s
TP101	1.00	0.028	8.5	DS-1 AC-1s
TP104	0.60	0.024	8.4	DS-1 AC-1s
TP104	2.40	0.029	8.3	DS-1 AC-1s
TP107	2.60	0.026	8.2	DS-1 AC-1s
TP108	1.80	0.096	9.0	DS-1 AC-1s
TP109	2.20	0.051	7.6	DS-1 AC-1s
WS106	0.40	0.033	8.4	DS-1 AC-1s
WS107	0.30	0.17	8.8	DS-1 AC-1s
WS107	0.90	0.072	8.6	DS-1 AC-1s
WS108	0.60	0.54	10.4	**DS-2 AC-1s**

4. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 2 qualitative risk assessment in accordance with LCRM (July 2023) to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. DEVIATING SAMPLES

Deviating samples were to be avoided during the ground investigation by using best practice sampling procedures including use of appropriate sampling containers and adhering to the laboratory holding times for each contaminant analysis undertaken.

4.2. HUMAN HEALTH RISK ASSESSMENT

At Tier 2 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

Where Tier 2 screening values are not provided by LQM, other screening values have been used and these are referenced in Table 4.1.

The results of this comparison have been summarised in Table 4.1.

TABLE 4.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A COMMERCIAL END USE

DETERMINAND	UNITS	GAC	N	MC	LOC. OF EX	PATH WAY	ASSESSMENT
Arsenic	mg/kg	640	13	29	N/A	1	No Further Action
Cadmium	mg/kg	190	13	10	N/A	1	No Further Action
Chromium (VI)	mg/kg	33	13	0	N/A	1	No Further Action
Lead	mg/kg	2300	13	1900	N/A	1	No Further Action
Mercury	mg/kg	58	13	0	N/A	4	No Further Action
Nickel	mg/kg	980	13	45	N/A	1	No Further Action
Selenium	mg/kg	12000	13	0	N/A	1	No Further Action
Copper	mg/kg	68000	13	230	N/A	1	No Further Action
Zinc	mg/kg	730000	13	17000	N/A	1	No Further Action
Cyanide - Total	mg/kg	791	11	0	N/A	1	No Further Action
Phenols - Total.	mg/kg	440	11	0	N/A	1	No Further Action
Asbestos	Fibres	NFD	10	ND	N/A	3	No Further Action
Naphthalene	mg/kg	190	13	1.6	N/A	4	No Further Action
Acenaphthylene	mg/kg	83000	13	0	N/A	2	No Further Action
Acenaphthene	mg/kg	84000	13	0	N/A	1	No Further Action
Fluorene	mg/kg	63000	13	0	N/A	1	No Further Action
Phenanthrene	mg/kg	22000	13	0.93	N/A	2	No Further Action
Anthracene	mg/kg	520000	13	0	N/A	2	No Further Action
Fluoranthene	mg/kg	23000	13	0.49	N/A	2	No Further Action
Pyrene	mg/kg	54000	13	0.44	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	170	13	0.27	N/A	2	No Further Action
Chrysene	mg/kg	350	13	0.25	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	44	13	0.32	N/A	2	No Further Action
Benzo(k)Fluoranthene	mg/kg	1200	13	0.18	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	35	13	0.25	N/A	2	No Further Action
Indeno(123-cd)Pyrene	mg/kg	500	13	0	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	3.5	13	0	N/A	2	No Further Action
Benzo(ghi)Perylene	mg/kg	3900	13	0	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	3200	13	0	N/A	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	7800	13	0	N/A	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	2000	13	0	N/A	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	16000	13	3	N/A	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	36000	13	5.4	N/A	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	28000	13	14	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	28000	13	190	N/A	1	No Further Action

Notes
PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants.

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; NFD = no fibres detected.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 4.1, the results of this direct comparison indicates that the data does not exceed the screening criteria for a commercial end-use.

Asbestos has not been identified within any of the tested samples.

The soil in TP101 and WS108 was tested for PCBs due to the proximity to an electricity substation. No PCBs exceeding the GAC screening values were recorded.

Soils within the TP105, TP107 and WS102 were tested for an explosive suite of contaminants due to the historic site use as an ammunitions factory. No contaminants of concern exceeded the limit of detection (LOD).

No significant concentrations of SVOCs or VOCs were identified in the soils submitted for chemical analysis.

Given that the development will be covered in hardstanding comprising either buildings, concrete slabs or asphalt any pathway from previously unidentified contamination through dermal contact and soil ingestion will be broken, removing the associated risks to the end users.

During the enabling works and build phase works on site construction workers will mitigate the associated risks through PPE and good site hygiene during the short-term exposure.

Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed development. There are no suitable sources of topsoil available on the site.

4.3. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 4.2.

TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Heavy metal and PAH contamination may be present as a result of the potential Made Ground infill material from historical features on-site and historically infilled ponds.		**Medium**
Pathway		
Vertical Migration Due to the majority of the site being underlain by cohesive clay deposits, vertical migration of contaminants is unlikely to occur as a result of the thickness and low permeability of the drift deposits. The presence of this low permeability drift will offer some protection to the underlying aquifer and inhibit lateral migration of any contaminants towards the adjacent inland river.		**Low**
Lateral migration Lateral migration of contaminants is not considered likely due to the presence of cohesive clay deposits across the site.		**Low**
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary undifferentiated.	**Medium**

Aquifer Classification in Bedrock	Secondary A Aquifer.	**Medium**
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not affected	**Low**
Distance to the Closest Groundwater Abstraction Point	The nearest active groundwater abstraction point is located 559 m southeast of the site for the purpose of process water.	**Low**
Is the Site Located Within 50 m of a Surface Watercourse?	The nearest surface watercourse is an inland river located 15 m NW of the site.	**High**
The ICSM developed within the context of the site setting has viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying secondary A aquifer and the lateral migration towards the inland river 15 m NW of the site. The underlying cohesive clay deposits will inhibit the migration of potential contaminants to the controlled waters receptors.		

To ensure a robust appraisal of the identified risk to controlled waters, E3P has identified the sources of potential contamination that represent a risk to controlled waters from the initial CSM, we have then assessed the availability of ground investigation data in the form of analysis of the solid phase (soil) and dissolved phase within the perched groundwater or aquifer. The results of this assessment are presented in Table 4.3.

TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of VOCs above 1mg/kg or TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	SVOC analysis recorded concentrations below the laboratory LOD, however, PAH analysis has identified levels above the laboratory LOD throughout the site.	Further discussion
C5-C10 > 5 mg/kg	All concentrations are below the laboratory LOD.	None
C10-C12 > 10 mg/kg	All concentrations are below the laboratory or slightly exceeding LOD.	None
C12-C16 > 50 mg/kg	All concentrations are below the laboratory or slightly exceeding LOD.	None
Phenols > 2 mg/kg	All concentrations are below the laboratory LOD.	None
Naphthalene > 2 mg/kg	All concentrations are below the laboratory or slightly exceeding LOD.	None
Total PAH > 10 mg/kg	All concentrations are below the laboratory or slightly exceeding LOD.	None
PCB > 1 mg/kg	All concentrations are below the laboratory LOD.	None
Heavy metals > 500 mg/kg	Concentrations of heavy metals above 500 mg/kg have been recorded in TP109	Further discussion

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground, groundwater samples and surface water samples to drinking water standards and environmental quality standards (EQS).

These are presented in Table 4.4 and Table 4.5.

TABLE 4.4 COMPARISON OF GROUNDWATER AND LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS [1,2] AA	DWS [3,4]	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
Arsenic	µg/l	50	10	3	0.49	N/A	2	4	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	3	0.12	N/A	2	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	3	<5.0	N/A	2	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	3	4	N/A	2	2.3	N/A	No Further Action
Copper	µg/l	1	2000	3	7.8 4.2 3.4	WS101 (EQS) WS102 (EQS) WS107 (EQS)	2	14 5.6	TP107 (EQS) WS101 (EQS)	Further Action
Total Cyanide	µg/l	1	50	3	<10	N/A	2	<1.0	N/A	No Further Action
Lead	µg/l	1.2	10	3	0.7	N/A	2	4.6 1.7	WS101 (EQS) TP107 (EQS	Further Action
Mercury	µg/l	–	1.0	3	<0.05	N/A	2	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	3	3.9	N/A	2	2.4	N/A	No Further Action
Selenium	µg/l	–	10	3	23 16	WS101 (DWS) WS102 (DWS)	2	<4.0	N/A	Further Action
Zinc	µg/l	10.9	–	3	7.3	N/A	2	9.7	N/A	No Further Action
pH	6–9			3	7.5–7.9	N/A	2	8.1–8.5	N/A	No Further Action
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/l	2	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action



DETERMINAND	UNIT	EQS [1,2] AA	DWS [3,4]	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Aromatic Hydrocarbon										
TPH C5-C7 (benzene)	µg/l	10	1	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C7-C8 (toluene)	µg/l	74	700	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C8-C10 (xylene)	µg/l	30	300	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C10-C12 (naphthalene)	µg/l	2	90	3	<10	N/A	2	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	90	3	<10	N/A	2	<10	N/A	No Further Action
TPH C16-C35	µg/l	–	90	3	<10	N/A	2	<10	N/A	No Further Action
Aliphatic Hydrocarbon										
TPH C5-C6	µg/l	–	1000[5]	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	1000[5]	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	3	<10	N/A	2	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	3	<10	N/A	2	<10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	3	<10	N/A	2	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	3	<10	N/A	2	<1.0	N/A	No Further Action
Volatile Organic Compounds										
Tetrachloroethylene	µg/l	0.4	10	3	<3.0	N/A	2	N/A	N/A	No Further Action
Trichloroethylene	µg/l	10	10	3	<3.0	N/A	2	N/A	N/A	No Further Action

DETERMINAND	UNIT	EQS [1, 2] AA	DWS [3,4]	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
Trichlorobenzene	µg/l	0.4	–	3	<3.0	N/A	2	N/A	N/A	No Further Action
Trichloromethane	µg/l	2.5	–	3	<3.0	N/A	2	N/A	N/A	No Further Action
Dichloromethane	µg/l	20	200	3	<3.0	N/A	2	N/A	N/A	No Further Action
Carbon Tetrachloride	µg/l	12	3	3	<3.0	N/A	2	N/A	N/A	No Further Action
Vinyl Chloride	µg/l	–	0.3	3	<3.0	N/A	2	N/A	N/A	No Further Action

Notes

Solubility <0.01µg/l
AA – Annual Average
* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water
** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (legislation.gov.uk)
2. The Water Supply (Water Quality) Regulations 2018 (legislation.gov.uk)
3. Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum (who.int)
4. CL:AIRE publishes Petroleum Hydrocarbons in Groundwater guidance (claire.co.uk)
5. A total TPH criteria of 1000 mg/kg will act as a surrogate criterion for remaining aliphatic and aromatic TPH fractions.

TABLE 4.5 COMPARISON OF SURFACE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS [1,2] AA	DWS [3,4]	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER 16/03/2023	LOCATION OF EXCEEDANCE	ASSESSMENT
Arsenic	µg/l	50	10	1	1.07	N/A	No Further Assessment
Cadmium	µg/l	0.08-0.25	5	1	0.42	Downstream (EQS)	Further Action
Chromium (VI)	µg/l	3.4	–	1	N/A	N/A	No Further Assessment
Chromium (III)	µg/l	4.7	50	1	0.6	N/A	No Further Assessment
Copper	µg/l	1	2000	1	6.5	Downstream (EQS)	Further Action
Total Cyanide	µg/l	1	50	1	< 10	N/A	No Further Assessment
Lead	µg/l	1.2	10	1	0.2	N/A	No Further Assessment
Mercury	µg/l	–	1.0	1	< 0.05	N/A	No Further Assessment
Nickel	µg/l	4	20	1	1.5	N/A	No Further Assessment
Selenium	µg/l	–	10	1	0.7	N/A	No Further Assessment
Zinc	µg/l	10.9	–	1	140	Downstream (EQS)	Further Action
pH	6–9			1	8	N/A	No Further Assessment
Naphthalene	µg/l	2	10*	1	<0.01	N/A	No Further Assessment
Anthracene	µg/l	0.1	10*	1	<0.01	N/A	No Further Assessment
Benzo[b]fluoranthene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Assessment
Benzo[k]fluoranthene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Assessment
Benzo(a)pyrene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Assessment
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	1	<0.01	N/A	No Further Assessment
Fluoranthene	µg/l	0.0063	10*	1	<0.01	N/A	No Further Assessment
Benzo(ghi)perylene	µg/l	1.7–4	10*	1	<0.01	N/A	No Further Assessment
TPH C5-C7 (benzene)	µg/l	10	1	1	<1.0	N/A	No Further Assessment

DETERMINAND	UNIT	EQS [1,2] AA	DWS [3,4]	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER 16/03/2023	LOCATION OF EXCEEDANCE	ASSESSMENT
TPH C7-C8 (toluene)	µg/l	74	700	1	<1.0	N/A	No Further Assessment
TPH C8-C10 (xylene)	µg/l	30	300	1	<1.0	N/A	No Further Assessment
TPH C10-C12 (naphthalene)	µg/l	2	90	1	<10	N/A	No Further Assessment
TPH C12-C16	µg/l	–	90	1	<10	N/A	No Further Assessment
TPH C16-C35	µg/l	–	90	1	<10	N/A	No Further Assessment
TPH C5-C6	µg/l	–	1000[5]	1	<1.0	N/A	No Further Assessment
TPH C6-C8	µg/l	–	1000[5]	1	<1.0	N/A	No Further Assessment
TPH C8-C10	µg/l	–	300	1	<1.0	N/A	No Further Assessment
TPH C10-C12	µg/l	–	300	1	<10	N/A	No Further Assessment
TPH C12-C16	µg/l	–	300	1	<10	N/A	No Further Assessment
TPH C16 – C21	µg/l	–	300**	1	<10	N/A	No Further Assessment
TPH C21-C35	µg/l	–	300**	1	<10	N/A	No Further Assessment
Tetrachloroethylene	µg/l	0.4	10	1	<3.0	N/A	No Further Assessment
Trichloroethylene	µg/l	10	10	1	<3.0	N/A	No Further Assessment
Trichlorobenzene	µg/l	0.4	–	1	<3.0	N/A	No Further Assessment
Trichloromethane	µg/l	2.5	–	1	<3.0	N/A	No Further Assessment
Dichloromethane	µg/l	20	200	1	<3.0	N/A	No Further Assessment
Carbon Tetrachloride	µg/l	12	3	1	<3.0	N/A	No Further Assessment
Vinyl Chloride	µg/l	–	0.3	1	<3.0	N/A	No Further Assessment

Notes

Solubility <0.01µg/l
AA – Annual Average
* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water
** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (legislation.gov.uk)
2. The Water Supply (Water Quality) Regulations 2018 (legislation.gov.uk)
3. Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum (who.int)
4. CL:AIRE publishes Petroleum Hydrocarbons in Groundwater guidance (claire.co.uk)
5. A total TPH criteria of 1000 mg/kg will act as a surrogate criterion for remaining aliphatic and aromatic TPH fractions.

4.3.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the screening values for the following inorganic compounds:

- Copper (EQS in groundwater, surface water and leachate analysis)
- Cadmium (EQS in surface water)
- Lead (EQS in leachate analysis)
- Selenium (DWS in groundwater)
- Zinc (EQS in surface water)

Marginal exceedances in metalloids have been identified across the site within groundwater surface water and leachate samples. It should be noted that leachate analysis overstates the risk posed to controlled water receptors.

4.3.2. M-BAT ASSESSMENT

Due to exceedances in surface water samples for copper and zinc, an m-BAT assessment has been completed to assess the bioavailability of the metals with respect to surface water receptors. The chemical values from the groundwater analysis have been input into the assessment.

Where the Risk Characterisation Ratio (RCR) is greater than 1, this indicates the bioavailable concentration is above the EQS and the receptor is therefore at risk. In this instance, surface water chemical data for DOC was input into the m-BAT for the downstream location. The following locations exceed the RCR:

1. Downstream
    - Copper (0.22)
    - Zinc (3.06)

The m-BAT assessment has confirmed that copper, is below the EQS and is not considered bioavailable. Zinc is above the EQS and is considered bioavailable due to the RCR values being above 1. Exceedances in zinc, however, have not been identified within on-site soil, leachate, or groundwater samples.

Furthermore, this assessment is considered to be conservative given that several of the concentrations of copper and zinc within the inland river are greater than the concentrations of groundwater at the site, based on the analysis completed to date.

In light of the above assessment, E3P does not consider the site to pose an unacceptable level of risk to surface waters for copper and zinc. It should also be noted the site is currently uncapped and the proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential.

However, further analysis of the surface water in the inland river should be undertaken as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the watercourse.

4.3.3. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically, the site has been subject to development including the construction and demolition of commercial units and the use as a munitions factory from 1941 to 1945. Chemical by-products of manufacturing processes and compounds within the Made Ground may have subsequently leached down into the underlying ground and contaminated groundwater both within Made Ground and natural drift deposits.

Chemical analysis of soils has shown localised exceedances of lead within stockpiled Made Ground.

The site is underlain by cohesive clay to depths of >20 m bgl which will greatly reduce the potential for migration of contaminants to the secondary A bedrock aquifer and the off site inland river. Furthermore the closest groundwater abstraction point is 559 m southwest of the site and there are no potable water abstractions within 2km of the site.

Heavy metals have been the only determinants to be noted to be exceeding the EQS and DWS criteria; however minimal elevated concentrations against the DWS were identified and as such the surface water features are considered to be at greater risk. It should be noted that leachate analysis overstates the risk and furthermore due to the thickness of cohesive clay overlaying the bedrock aquifer, it is considered that there is no unacceptable risk to the secondary A aquifer.

Surface Water Receptor

A comparison of the inland river surface water samples to the Tier 2 criteria (Table 4.5) has shown exceedances in copper, zinc and cadmium within all samples downstream. The other contaminants of original concern, PAHs and TPH, are not identified within the chemical testing and all results are below the LOD. This shows extensive lateral migration of contaminants identified within soils and groundwater is not occurring at the site and is not causing a detrimental impact on the inland river.

The m-bat tool has shown that copper, despite exceeding EQS threshold values, is not bioavailable and does not pose an unacceptable risk to the surface water receptor. The RCR for zinc exceeded the EQS threshold value and is therefore considered bioavailable, however, no exceedances for zinc have been identified within on site soil, leachate or groundwater samples and therefore it is considered that zinc is not leaching from site. It is likely that zinc exceedances in the surface water samples is due to leaching from the surrounding industrial area. Furthermore, cohesive clay deposits across the site will reduce the migration of contamination to the inland river.

Historically the site was mainly impermeable. Additionally, the proposed development will create / maintain hardstanding cover and drainage systems across the site, thus reducing the amount of infiltration generated. This will in turn, reduce the amount of contaminants present in leachate off the site and reduce the risk further to the underlying aquifer and adjacent surface watercourses.

The results of the data review and Tier 2 qualitative risk assessment has allowed E3P to draw the following conclusions in respect to the risk to controlled waters:

- The primary receptors identified are the secondary A bedrock aquifer and offsite inland river located 15 m northwest of the site.
- The site is underlain by >20 m of cohesive clay and therefore there is not considered to be a viable pathway for potential contamination to migrate to the underlying bedrock aquifer. Localised Made Ground deposits may facilitate the migration of contaminants to the off site inland river.
- Marginal exceedances in metalloids have been identified across the site within groundwater, surface water and leachate samples.

- There have been no elevated concentrations of PAHS, TPHs, VOCs or SVOCs.
- Drainage systems and hardstanding will manage surface water in the proposed development reducing the risk of vertical and horizontal migration.
- It is recommended that further analysis of the surface water in the inland river should be undertaken as groundworks progress.

4.4. GROUND GAS

Hazardous ground gas qualitative risk assessment is based on a conceptual site model (CSM) similar to that used for soil and groundwater contamination sources (i.e., source pathway receptor pollutant linkages).

The risk can be assessed based on knowledge of the ground conditions and CSM and a measure of hazardous gas concentrations and gas flow at the site within monitoring standpipes.

4.4.1. GROUND CONDITIONS

Made Ground was encountered within all exploratory hole locations on the site and can generally be split into three distinct strata occurring in the lorry park, the goods yard and the stockpiled material respectively.

Drift deposits were encountered beneath Made Ground and comprise cohesive CLAY to a depth of >20 m bgl.

Groundwater was not encountered during the site investigation.

4.4.2. SOURCES AND PATHWAYS OF GROUND GAS (CSM)

In this instance, the CSM (14-747-R2, December 2020) identified the following potential sources of ground gas:

- Limited Made Ground
- Stockpiled Made Ground
- Infilled ponds
- No landfills have been identified within 250 m of the site, and the site is not in an area affected by radon.

There is potential for localised ground gas migration in proximity of the identified sources, albeit reduced by predominantly low permeability strata.

The CIRIA C665 guidance on gas risk assessment includes recommendations for periods and frequencies for monitoring visits. These recommendations take into account the nature of the proposed development and the likely generation potential of the source.

The proposed development comprises commercial structures with hardstanding, which would be classified as a Type D development (low sensitivity) in accordance with BS8485:2015+A1:2019.

Therefore within the context of the proposed residential end-use and ground gas generation potential, the gas assessment requires six visits over three months, with at least two sets of readings at low or falling atmospheric pressure.

4.4.3. GROUND GAS RISK ASSESSMENT METHODOLOGY

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in:

- CIRIA Report 665 – Assessing risks posed by hazardous ground gases to buildings (2007)
- BS8485:2015+A1:2019 – Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation (CS) and the proposed development based on building type.

Therefore, in accordance with BS8485, based on the measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) shall be derived for each monitoring point, from which the site characteristic hazardous gas flow rate (Q_{hgs}), and then the Characteristic Situation (CS) can be determined.

The following equation should be utilised:

$$Q_{hg} = q\left(\frac{C_{hg}}{100}\right)$$

Where:
q is the measured flow rate (in litres per hour) of combined gases from the monitoring standpipe
C_{hg} is the measured hazardous gas concentration (in percentage volume/volume).

The subsequent derived gas screening value (GSV) should be the maximum Q_{hg} (flow rate x concentration as a percentage volume) for all the monitoring events.

A 'worst case check' may be carried out using the maximum recorded flow in any hole with the maximum concentration in any hole to present the plausible worst case conditions. Adoption of the worst case Q_{hg} requires thorough justification and reference to the CSM.

The final derived GSV can then be used to characterise the site as summarised in Table 4.6.

TABLE 4.6 SITE CHARACTERISATION BY GSV (BS8485:2015)

CS	HAZARD POTENTIAL	GSV (l/hr) FOR METHANE AND CARBON DIOXIDE	ADDITIONAL FACTORS
CS1	Very Low	< 0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2)
CS2	Low	< 0.70	Typical measured flow rate <70 l/h (otherwise consider an increase to CS3)
CS3	Moderate	< 3.5	N/A
CS4	Moderate to High	< 15	N/A
CS5	High	< 70	N/A
CS6	Very High	> 70	N/A

Notes
1. The CS is equivalent to the characteristic GSV in CIRIA C665.
2. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter should be considered.
3. Gas Screening Value is the Borehole Gas Volume Flow Rate, in litres per hour, multiplied by the concentration in the air stream of the particular gas being considered.
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

4.4.4. MONITORING METHODOLOGY

Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) (hydrogen sulphide) were measured using a calibrated infrared gas analyser (GFM435) with gas flow rates measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 500 seconds at each location, at which point the maximum concentration of CH_4 and CO_2, together with the lowest concentration of O_2 were recorded.

The results of the ground gas monitoring are presented in Table 4.7.

In addition to the raw data, the results for each individual standpipe have been assessed with reference to guidance provided in BS8485:2015. Based on the initial peak measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) have been derived for each monitoring point, from which an individual Characteristic Situation (CS) can ultimately be determined.

TABLE 4.7 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	STRATA	DATE	CH_4 PEAK (%V/V)	CH_4 STEADY (%V/V)	CH_4 Q_{hg} (l/hr)	CO_2 PEAK (%V/V)	CO_2 STEADY (%V/V)	CO_2 Q_{hg} (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	Natural CLAY Drift	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1017	Steady	0.10	0.10	2.00-5.00	4.85	3.26*
		17/04/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	1023	Rising	0.10	0.10		4.85	4.21*
		24/04/2023	Monitoring obstructed by parked HGV.												–	
		02/05/2023	0.10	0.10	0.0001	0.90	1.30	0.0013	17.0	1020	Falling	0.10	0.10		4.85	3.60
		15/05/2023	Monitoring obstructed by parked HGV.												–	
		22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	1018	Falling	0.10	0.10		4.85	2.39
WS102	Natural CLAY Drift	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1019	Steady	0.10	0.10	1.00-3.00	2.40	1.90*
		17/04/2023	0.10	0.10	0.0001	0.10	0.40	0.0004	19.3	1023	Rising	0.10	0.10		2.40	1.93*
		24/04/2023	0.10	0.10	0.0001	0.30	0.60	0.0006	19.2	1005	Rising	0.10	0.10		2.40	1.98*
		02/05/2023	0.10	0.10	0.0001	0.40	0.70	0.0007	19.7	1020	Falling	0.10	0.10		2.40	1.96*
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.1	1016	Falling	0.10	0.10		2.40	2.04*
		22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.5	1018	Falling	0.10	0.10		2.40	2.06*
WS104	Stockpiled Made Ground	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1017	Steady	0.10	0.10	1.00-3.00	2.97	2.93
		17/04/2023	0.10	0.10	0.0001	7.10	6.80	0.0068	9.6	1022	Rising	0.10	0.10		2.97	2.95
		24/04/2023	0.10	0.10	0.0001	4.00	1.30	0.0013	18.9	1004	Rising	0.10	0.10		2.95	2.95
		02/05/2023	0.10	0.10	0.0001	5.40	6.30	0.0063	7.8	1019	Falling	0.10	0.10		2.95	2.93
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.0	1016	Falling	0.10	0.10		2.96	2.92
		22/05/2023	0.10	0.10	0.0001	0.10	0..10	0.0001	20.3	1018	Falling	0.10	0.10		2.96	2.90
WS105	Stockpiled Made Ground	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1017	Steady	0.10	0.10	1.00-2.00	1.90	1.71
		17/04/2023	0.10	0.10	0.0001	4.90	4..90	0.0049	8.6	1022	Rising	0.10	0.10		1.89	1.73
		24/04/2023	0.10	0.10	0.0001	5.40	5.50	0.0055	7.0	1004	Rising	0.10	0.10		1.89	1.70
		02/05/2023	0.10	0.10	0.0001	5.30	5.30	0.0053	12.5	1020	Falling	0.10	0.10		1.89	1.72
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1017	Falling	0.10	0.10		1.89	1.75

WELL	STRATA	DATE	CH_4 PEAK (%V/V)	CH_4 STEADY (%V/V)	CH_4 Q_{hg} (l/hr)	CO_2 PEAK (%V/V)	CO_2 STEADY (%V/V)	CO_2 Q_{hg} (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS105 cont.	Stockpiled MG	22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.5	1019	Falling	0.10	0.10	1.00-2.00	1.89	1.74
WS106	Stockpiled Made Ground	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1017	Steady	0.10	0.10	1.00-4.00	3.86	Dry
		17/04/2023	0.10	0.10	0.0001	5.10	4.90	0.0049	18.0	1022	Rising	0.10	0.10		3.86	Dry
		24/04/2023	0.10	0.10	0.0001	3.20	3.10	0.0031	17.9	1003	Rising	0.10	0.10		3.86	Dry
		02/05/2023	0.10	0.10	0.0001	3.10	3.20	0.0032	17.2	1019	Falling	0.10	0.10		3.86	Dry
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.0	1015	Falling	0.10	0.10		3.86	Dry
		22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20..3	1017	Falling	0.10	0.10		3.86	Dry
WS107	Natural CLAY Drift	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	19.9	1015	Steady	0.10	0.10	1.00-2.00	1.57	1.34*
		17/04/2023	0.10	0.10	0.0001	0.10	0.20	0.0002	20.2	1022	Rising	0.10	0.10		1.57	1.28*
		24/04/2023	0.10	0.10	0.0001	1.40	1.70	0.0017	18.9	1004	Rising	0.10	0.10		1.58	1.10
		02/05/2023	0.10	0.10	0.0001	0.10	0.40	0.0004	20.2	1019	Falling	0.10	0.10		1.58	1.43*
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.1	1016	Falling	0.10	0.10		1.58	1.34*
		22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.5	1019	Falling	0.10	0.10		1.57	1.32*
WS108	Made Ground	27/03/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.0	1016	Steady	0.10	0.10	1.00-2.00	1.70	Dry
		17/04/2023	0.10	0.10	0.0001	0.20	0.40	0.0004	20.2	1022	Rising	0..10	0.10		1.70	Dry
		24/04/2023	0.10	0.10	0.0001	0.20	0.10	0.0001	20.4	1004	Rising	0.10	0.10		1.70	Dry
		02/05/2023	0.10	0.10	0.0001	0.60	0.60	0.0006	18.6	1019	Falling	0.10	0.10		1.70	Dry
		15/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.0	1015	Falling	0.10	0.10		1.70	Dry
		22/05/2023	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	1017	Falling	0.10	0.10		1.70	Dry

*Depth to water after well bailed and left to recharge

Notes

CIRIA Characteristic Situation	Q_{hg}		
CS1	<0.07	Typical Max CO2 <5 % Typical Max CH4 <1 %	Values in **BOLD** exceed CS1 Thresholds
CS2	<0.7	Flow rate not to exceed 70 l/hr otherwise consider increase to CS3	Values in BLUE denote water above level of response zone (flooded)
CS3	<3.5		
CS4	<15	Quantitative Risk Assessment required to evaluate scope of protective measures	

4.5. SUMMARY OF MONITORING RESULTS

4.5.1. GROUNDWATER

The water level within several of the monitoring wells was recorded to be above the top of the response zone (flooded) on a number of occasions, as summarised in Table 4.8, thus rendering some of the monitoring data unreliable. Therefore, each time a flooded well was encountered, the well was bailed and left to re-equilibrate. Wells were re-monitored after a period of 20–30 minutes.

TABLE 4.8 FLOODED MONITORING WELL DATA

Well	Visit 1 27/03/2023	Visit 2 17/04/2023	Visit 3 24/04/2023	Visit 4 02/05/2023	Visit 5 15/05/2023	Visit 6 22/05/2023
WS101	Y	Y	N/A	N	N/A	N
WS102	Y	Y	Y	Y	Y	Y
WS104	N	N	N	N	N	N
WS105	N	N	N	N	N	N
WS106	–	–	–	–	–	–
WS107	Y	Y	N	Y	Y	Y
WS108	–	–	–	–	–	–

4.5.2. BAROMETRIC PRESSURE

All monitoring visits were undertaken during a period of relatively high pressure.

The visits were undertaken across representative pressures of steady, rising and falling conditions.

4.5.3. GAS FLOW

Throughout the monitoring period, flow rates were recorded to be 0.10 l/hr (limit of detection of the analyser).

4.5.4. GAS CONCENTRATIONS

The maximum methane value recorded within the monitoring wells was 0.10% v/v (limit of detection of the analyser).

Carbon dioxide concentrations were recorded at concentrations of 0.1% v/v (limit of detection of the analyser) to 6.80% v/v in WS104.

4.6. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 4.0. This indicates that based on the peak flow rates the majority of the monitoring visits classify as Characteristic Situation (CS)1 – Very Low Gas Risk.

TABLE 4.9 GAS RISK PROFILE AND LOCATION

WELL	MAX FLOW (l/hr)	MAX CH_4 (%V/V)	MAX CH_4 Q_{hg} (l/hr)	MAX CO_2 (%V/V)	MAX CO_2 Q_{hg} (l/hr)	CHARACTERISTIC SITUATION	NHBC TRAFFIC LIGHT
WS101	0.10	0.10	0.0001	1.30	0.0013	CS1	Green
WS102	0.10	0.10	0.0001	0.70	0.0007	CS1	Green
WS104	0.10	0.10	0.0001	6.80	0.0068	CS2	Amber 1
WS105	0.10	0.10	0.0001	5.50	0.0055	CS2	Amber 1
WS106	0.10	0.10	0.0001	4.90	0.0049	CS1	Green
WS107	0.10	0.10	0.0001	1.70	0.0017	CS1	Green
WS108	0.10	0.10	0.0001	0.60	0.0006	CS1	Green

E3P has assessed the previous variables and come to the following conclusions:

- In the vicinity of WS108, Made Ground was encountered to a depth of 2.00 m, however, monitoring to date does not indicate any gas generation potential within this stratum.
- In the vicinity of WS104, WS105 and WS106, stockpiled Made Ground was encountered to a depth of 4.00 m, in these areas the carbon dioxide concentration has been detected as levels of CS2/Amber1, however the GSV values fall as CS1.
- The site is predominantly CLAY at depths of 0.50 m bgl to 20.00 m bgl and monitoring to date does not indicate gas generation potential within the clay.

Given that there is no obvious source of ground gas and no elevated readings have been encountered, it is recommended that the site is classified as CS1 and no gas protection measures are required.

Further monitoring visits will be undertaken to confirm the findings of the initial assessment, however visits to date indicate the site is likely to be classified as Characteristic Situation 1 (CS1).

4.7. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "*Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites*"

TABLE 4.10 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at Current pipeline depth (mg/kg)
Total VOC	0.5	N/A
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<6.0
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	<12
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	NA
Ethers*	0.5	NA
Nitrobenzene*	0.5	NA
Ketones*	0.5	NA
Aldehydes*	0.5	NA
Amines	Fail	NA
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	None.	
Is free product present in soil and groundwater?	None.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	No hydrocarbon or low solubility PAH impact has been identified below pipeline depth.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	Currently unknown.	
Will soils be imported to site as part of any future earth works	Currently unknown. Post remediation ground conditions may differ therefore a UKWIR assessment should be complete following these works.	

Notes - Pipe line depth normally between 0.75m–1.35m

Based on the assessment of current site conditions it is likely that PE pipe will be suitable at the proposed development.

4.8. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 4.11 has been prepared for the site.

TABLE 4.11 CONCEPTUAL MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Heavy Metals, non-volatile PAH (Made Ground)	Dermal contact. Dermal contact and ingestion.	Future site users. Off-site receptors.	Likely	High	LOW
Discussion: Localised exceedances of heavy metals encountered within the vicinity of TP109 within stockpiled Made Ground. These elevated levels have a dermal contact and ingestion pathway to future site users and construction workers when coming into direct contact with impacted soils. **Recommendation:** It is proposed that parts of the stockpile will remain on site due to its use as an acoustic bund. Should this be the case the localised heavy metal exceedance will not pose a risk to the proposed development due to its low mobility. Should the material be transferred off site it will not pose a risk to the proposed development.						
PL3	ACM in Made Ground	Inhalation of dust.	Future site users. Buildings. Off-site land users.	Unlikely	Low	LOW
Assessment: No asbestos has been identified in the soils analysed to date. **Recommendation:** Due to the presence of Made Ground, construction works should be completed with PPE and provision of welfare.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL4	Volatile Contaminants such as hydrocarbons (Made Ground)	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Unlikely	Low	LOW
Assessment: No elevated concentrations of volatile contaminants have been identified. **Recommendation:** Due to the presence of Made Ground, construction works should be completed with PPE and provision of welfare.						
PL4	Methane, carbon dioxide (Made Ground and potentially infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Low likelihood	Low	LOW
Assessment: Made Ground has been identified as a potential source of hazardous ground gas. **Recommendation:** During development, the shallow Made Ground will be removed as part of the enabling works with natural ground remaining. Given that there is no obvious source of ground gas, it is recommended that the site is classified as CS1 and no gas protection measures are required. This will be confirmed following the completion of the ground gas monitoring regime.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL5	Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground, mills, works, and scrap yards)	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (secondary A aquifer). Surface water (Inland River).	Likely	Moderate	LOW
Assessment: Elevations of heavy metals in groundwater, leachate and surface water samples compared to EQS and DWS values. The m-bat assessment for copper and zinc exceedances in surface water samples shows that copper is not bioavailable. Zinc is bioavailable, however, unlikely to have leached from site due to no zinc exceedances within on site soil, leachate and groundwater samples. **Recommendation:** Considering the restricted pathway for contamination due to >20 m of cohesive deposits and lack of potable abstractions within 1km of site, there is considered to be a low level of risk to the secondary A bedrock aquifer. Further analysis of the surface water in the inland river should be undertaken as groundworks progress.						
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Likely	Moderate/Low	LOW
Assessment: The majority of soils at the site meet class DS-1, AC-1s. One localised instance of soils meeting class DS-2 AC-1s. **Recommendation:** Concrete should be designed in accordance with the chemical testing results.						

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL7	Organic contaminants such as hydrocarbons, solvents (Made Ground)	Ingestion of tainted water supply.	Future site users. Water pipes.	Low Likelihood	Low	LOW
Assessment: Initial indications suggest that PE pipe may be suitable for the proposed development. **Recommendation:** An assessment will need to be completed post-remediation to confirm this.						
PL8	Phytotoxic contaminants (Made Ground)	Direct Contact (plant uptake).	Flora.	Low Likelihood	Low	LOW
Assessment: Localised exceedances of heavy metals within the vicinity of TP109 within stockpiled Made Ground **Recommendation:** Installation of a clean cover system within any areas of soft landscaping in the vicinity of TP109 to prevent plant uptake of contaminants.						

Main exposure pathways:
PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants.

5. GEOTECHNICAL ASSESSMENT

5.1. PROPOSED DEVELOPMENT

Portal Construction NW intends to construct a commercial unit with associated service infrastructure.

5.2. SUMMARY OF GROUND CONDITIONS

- Made Ground

Made Ground was encountered within all exploratory hole locations on the site and can generally be split into three distinct strata occurring in the lorry park, the goods yard and the stockpiled material respectively.

Within the lorry park area in the south of the site Made Ground was encountered from ground level to 1.00 m bgl. Made Ground comprises grey sandy gravel with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and limestone. Cobbles are subangular of concrete.

Made Ground within the goods area in the north of the site was generally encountered from ground level to 0.50 m bgl. In WS108 localised Made Ground was encountered to 2.00 m bgl. Made Ground comprises a 250 mm concrete slab overlying grey sand with gravel of mudstone and limestone to a depth of 0.50 m bgl. In WS108 a membrane was encountered at 0.50 m bgl which is underlain by brown slightly sandy gravel with cobbles. Gravel and cobbles comprise mudstone, brick and concrete. Due to a barrel refusal at 2.00 m bgl the full extent of Made Ground within WS108 could not be proven.

Made Ground within the mounded stockpile in the west of the site was encountered from ground level to 4.00 m bgl. It should be noted, however, this is not a true representation of the depth of Made Ground beneath the site as the material is built up from natural ground level. The stockpiled material generally comprises brown reworked sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, limeston, brick, concrete, plastic, metal, timber and ceramic. Cobbles are subangular of brick and concrete. Localised sandy gravel of ash and asphalt was encountered within TP109 and WS106 between 2.00 and 2.80 m bgl.

- Drift

Drift deposits were encountered in all exploratory hole locations in the lorry park and goods yard, apart from WS108 where the full extent of Made Ground could not be proven. Drift deposits were also not encountered within certain locations on the stockpile due to the height of the mounded material.

Drift deposits are uniform across the site comprising reddish stiff medium strength to very stiff high strength brown slightly gravelly slightly silty CLAY with rare cobbles. Gravel is fine to medium subangular to subrounded of mudstone. Cobbles are subrounded of mudstone. Localised areas of firm low strength clay were encountered at 14.00 m bgl in CP101 and CP103.

- Solid

The solid geology was not encountered during the site investigation.

- Groundwater

Groundwater was not encountered during the site investigation.

5.3. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW)*. This should include the following:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- Demolition of all existing buildings and removal of all concrete hardstanding.
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

5.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 5.1.

TABLE 5.1 SUMMARY OF ABP

COHESIVE SOILS			
Description	**Depth (range m bgl)**	**Undrained Shear Strength (Cu) (kN/m^2)**	**Allowable Bearing Pressure (kN/m^2)**
Firm low strength CLAY	14.00–15.50	28	57
Stiff medium strength CLAY	0.50–20.45	40–75	82–154
Very stiff high strength CLAY	0.50–5.45	76–134	156–277
Very stiff very high strength CLAY	2.00–2.45 (WS107)	228	470

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY.

In respect of the proposed development, E3P consider it feasible to construct the proposed commercial unit utilising a pad foundation onto the underlying firm to very stiff clays with the use of vibro stone columns to reengineer the underlying clays to achieve a uniform ABP across the site.

Pad foundations could be formed at 2.50mbgl, however, their feasibility may be limited due to groundwater. The final foundation solution will be subject to Final Finished Levels.

The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer with detailed designs from a specialist piling contractor. It is likely that a phase of cut works and removal/reengineering of the upper Made Ground materials will be required in order to achieve levels.

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content.

It is recommended that, at working drawing stage, a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current/proposed locations of trees.

5.5. GROUND FLOOR SLABS

Following enabling works, the site will may have a variable thickness of Made Ground, that may extend to significant depth in places. Given the structure proposed, it is considered that ground-bearing floor slabs will require detailed design in order to accommodate variability of the formation and account for differential settlement.

Given the depth of Made Ground and its loose/variable nature, it will be necessary to undertake some form of Ground Improvement work to ensure the total and differential settlement is within tolerable limits for the Uniformly Distributed Load of the floor slab and any external reinforced concrete yards / hardstanding.

It is considered that Ground Improvement by either High Energy Impact Compaction or Vibro Stone Columns would provide a viable engineering solution to ensure the required ABP for a ground bearing floor slab.

As an alternative to the above, a more traditional solution which comprises the excavation of the upper stratum of Made Ground prior to re-engineering and compaction as a structural upfill be considered. Limitations with this approach would be attributed to the inherent variability of the material and issues arising from fluctuations in moisture content, which are exaggerated during periods of seasonal variance with increased precipitation and reduced evaporation.

Where a ground-bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional reinforcement within the slab to be designed by the structural engineer.

5.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils, which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectured zones of influence.

As the clay is deemed to be low to medium plasticity, heave precautions will be required to the internal face of the external load-bearing walls (outside or within tree influence).

If a ground beam is to be constructed within the zone of tree influence, heave precautions are required to the underside of this and edge beams.

If the ground floor slab is to be constructed with a beam and block floor, a minimum subfloor void of 250 mm is required within any structures located in the zone of conjectured tree influence.

If the ground floor slab is constructed with a cast in-situ suspended floor slab, then heave precautions that can tolerate 100 mm of clay swelling are required within any part of the floor slab to be located within the zone of influence of a tree.

A summary of heave precautions is presented in Table 5.2.



TABLE 5.2 SUMMARY OF HEAVE PRECAUTIONS

		MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS		MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS
Plasticity Index of Soil	**Required Foundation Depth (m)**	**Thickness of Void Former Against Side of Foundation or Ground Beam (mm)**	**Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)**	**Void Dimension (mm)**
High Plasticity (> 40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	35	150	300
	1.5–2.0	25	75	
Moderate Plasticity (20–40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	25	100	250
	1.5–2.0	25	50	
Low Plasticity (< 20)	2.0–2.5	N/A	50	200
	> 2.0	No Special Precautions		

5.7. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification For Highway Works (Series 600-Earthworks) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

5.8. DRAINAGE

The presence of substantial depths of Made Ground across some areas of the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

Furthermore, the site is predominantly underlain by circa >20 m of likely low-permeability gravelly CLAY. Therefore, the use of soakaway drainage will be limited, and as the lateral continuity of the Made Ground cannot be assured, it is not recommended that soakaways are utilised for disposal of surface water runoff.

5.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

Elevated sulphate concentrations meeting Class DS-2, AC-1s were noted within the Made Ground deposits in WS108 at 0.6 m bgl. However, upon completion of site enabling works it will, in all likelihood, be DS1 AC1s.

5.10. EXCAVATIONS

The E3P intrusive ground investigation has not identified the presence of shallow bedrock. It is anticipated excavations can be undertaken using standard plant equipment.

Due to the presence of low permeability cohesive deposits across the site, it is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed upon with the relevant regulatory body and be undertaken under a trade effluent discharge consent, where required. Measures to remove silt and suspended solids may be required and consideration should be given to the provision of space for settling tanks or an attenuation pond.

5.11. SLOPE STABILITY

A significant embankment is present at the west of the site forming the acoustic bund from stockpiled Made Ground

As and when detailed topographic information is available and in due consideration of the proposed development design, structural and infrastructure loading, a detailed slope stability model will be required. This model will seek to determine the potential for newly imposed loadings to generate a risk of instability or failure within the off-site embankment and the need for any mitigation measures such as piled foundations to transfer loadings below the base of the slope.

5.12. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated into the site works:

- Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.

- Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.

- The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).

5.13. GEOTECHNICAL RISK REGISTER

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils	On site	TBC	Chemical analysis suggests that natural clay soils will be suitable for re-use below hardstanding.
Obstructions	All	TBC	Site has been subject to significant historical development and, while above-ground structures have been removed, potential subsurface obstruction from relict foundations, chimney and slabs remain.
Artificially levelled and filled platforms	All	100	The site appears to have been levelled and artificially backfilled. Stockpiled material forms acoustic bund in west of site.
Trench collapse	All	100	Made Ground present beneath the site is likely to be loosely compacted and possibly prone to collapse.
Mature trees	TBC	TBC	Arboriculture survey required to determine areas of potential tree influence.
Volume change potential clay	On site	100	The site is underlain by cohesive soils. The geotechnical assessment indicates that the soils are of low to medium volume change potential, and therefore heave precautions will be required.
Concrete design	N/A	N/A	The soils generally class DS-1, AC-1s.
Low-permeability ground	On site	70	Soakaways unlikely to be effective in areas where low permeability cohesive deposits are present.
Services/sensitive structures	Throughout site	30	A review of online services has identified a number of services within the site boundary Piling may not be possible within close proximity to any sensitive infrastructure.
Abnormal foundation solutions	TBC	TBC	An engineered foundation solution may be required depending on proposed site levels and structural loadings

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Historically infilled pond	Centre and southeast	5	Variable ground conditions may be present in areas of historic infilled ponds.
Slope	TBC	TBC	A significant slope is identified, detailed assessment and modelling is required to assess the long term stability in both the temporary and permanent state associated with current, temporary and permanent loading

5.14. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Additional surface water monitoring.
- Arboricultural survey.
- Foundations to be designed by a suitably qualified Structural Engineer.
- Geotechnical earthworks strategy (infrastructure).
- Remediation and enabling works strategy.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. CONTAMINATED LAND ASSESSMENT

Human Health	A Tier I human health risk assessment has been undertaken using the chemical analysis results of the soils and comparing them to the relevant Tier I criteria. Elevated concentrations of Lead have been identified within one isolated location and is therefore considered to be a localised hotspot. Given that the development will be covered in hardstanding comprising either buildings, concrete slabs or asphalt the pathway through dermal contact and soil ingestion will be broken, removing the associated risks to the end users. During the enabling works and build phase works on site construction workers will mitigate the associated risks through PPE and good site hygiene during the short-term exposure. Additionally, if proposed landscaping were to be constructed within this area, commercial developments generally have a 300mm 6F2 capping across the entire of the development platform and the landscaped area would be subject a clean 300mm growing medium that will also break the associated pathway. No asbestos has been identified within any of the tested samples. Due to the proximity of the electrical substation on site 3 samples were tested for PCB compounds. Results show concentrations of PCB to be below the limit of detection (LOD). Due to the historical use on site as an ordnance factory, selected samples were tested for explosive compounds found in cordite. All result showed the compounds to be below the LOD. Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed soft landscaping areas. There are no suitable sources of topsoil on site.
Controlled Waters	Marginal exceedances in metalloids have been identified across the site within groundwater surface water and leachate samples. Heavy metals have been the only determinants to be noted to be exceeding the EQS and DWS criteria; however minimal elevated concentrations against the DWS were identified and as such the surface water features are considered to be at greater risk. It should be noted that leachate analysis overstates the risk and furthermore due to the thickness of cohesive clay overlaying the bedrock aquifer, it is considered that there is no unacceptable risk to the secondary A aquifer.

	The m-bat tool has shown that copper, despite exceeding EQS threshold values, is not bioavailable and does not pose an unacceptable risk to the surface water receptor. The RCR for zinc exceeded the EQS threshold value and is therefore considered bioavailable, however, no exceedances for zinc have been identified within on site soil, leachate or groundwater samples and therefore it is considered that zinc is not leaching from site. It is likely that zinc exceedances in the surface water samples is due to leaching from the surrounding industrial area. Furthermore, cohesive clay deposits across the site will reduce the migration of contamination to the inland river. It is recommended that further analysis of the surface water in the inland river should be undertaken as groundworks progress.
Ground Gas	Given that there is no obvious source of ground gas and no elevated readings have been encountered, it is recommended that the site is classified as CS1 and no gas protection measures are required. In the vicinity of WS104, WS105 and WS106, stockpiled Made Ground was encountered to a depth of 4.00 m, in these areas the carbon dioxide concentration has been detected as levels of CS2/Amber1, however the GSV values fall as CS1.
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation.

6.2. GEOTECHNICAL ASSESSMENT

The natural underlying clay drift deposits have been assessed as generally being stiff medium with calculated ABPs in the order of 82–154 kN/m^2 from 0.50–20.45 m bgl. Very stiff high strength clays have been identified from 0.50–5.45 m bgl with calculated ABPs in the order of 156–277 kN/m^2. Localised firm low strength clays in CP101 and CP103 have been identified from 14.00–15.50 with a calculated ABP of 57 kN/m^2.

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying firm to very stiff clays.

In respect of the proposed development, E3P consider it feasible to construct the proposed commercial unit utilising a pad foundation onto the underlying firm to very stiff clays with the use of vibro stone columns to reengineer the underlying clays to achieve a uniform ABP across the site.

Pad foundations could be formed at 2.50mbgl, however, their feasibility may be limited due to groundwater. The final foundation solution will be subject to Final Finished Levels.

The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer with detailed designs from a specialist piling contractor. It is likely that a phase of cut works and removal/reengineering of the upper Made Ground materials will be required in order to achieve levels.

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content.

It is recommended that, at working drawing stage, a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current/proposed locations of trees.

END OF REPORT

APPENDIX I
LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II
GLOSSARY

TERMS

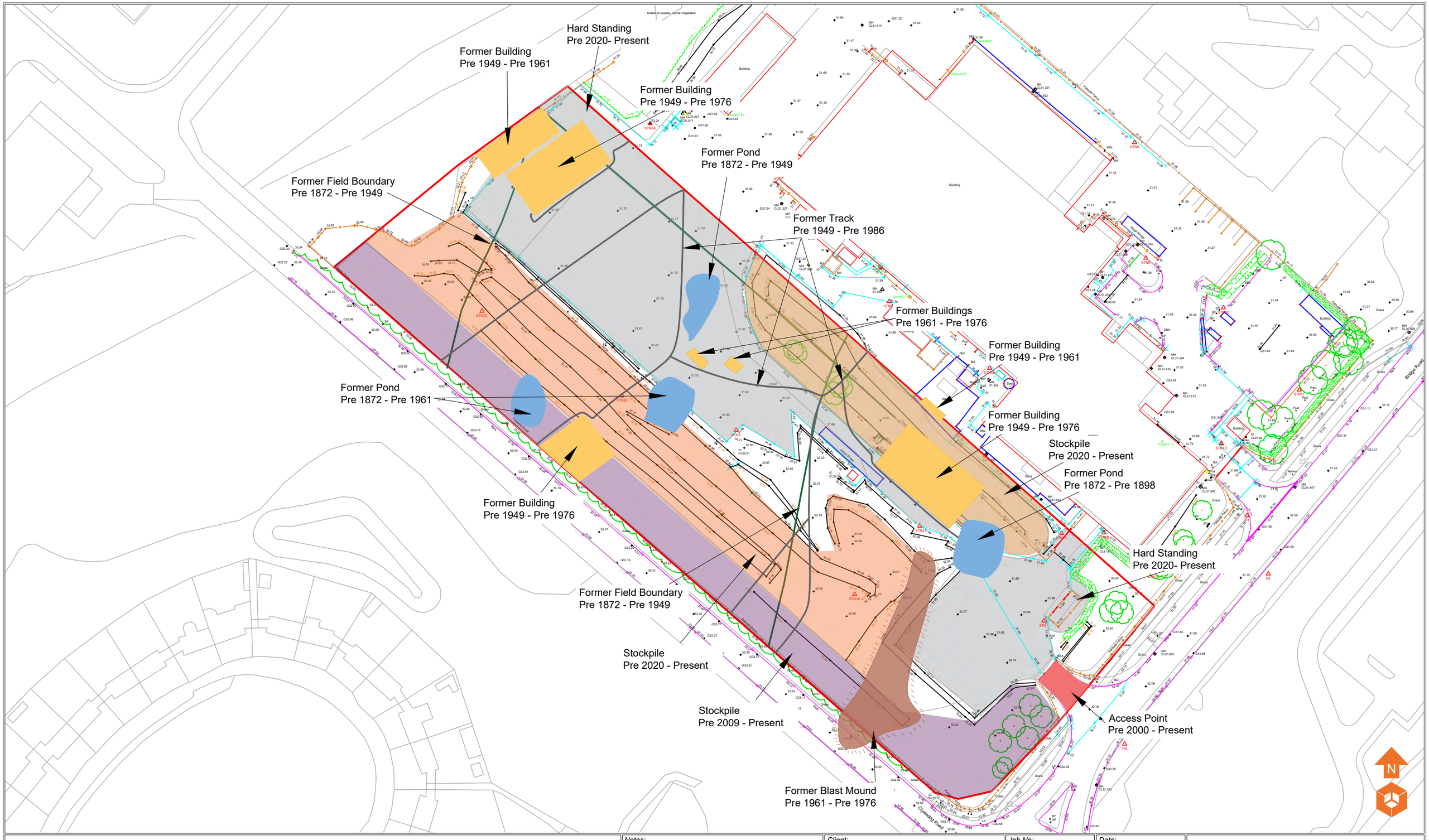
ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns
LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme

MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation
m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection

APPENDIX III
DRAWINGS

DRAWING 16-685-001 – SITE LOCATION PLAN





Historical Features

- Former Buildings
- Former Ponds
- Former Field Boundaries
- Former Footpaths
- Former Blast Mound
- Stockpile
- Stockpile
- Stockpile
- Hard Standing

Notes:

Client: Pace

Job No: 16-685

Date: 12.04.2023

Drawing No: 003

Scale: NTS

Phase	Issue	Date	Drawn	Checked
P1	REVD	12.04.2023	OW	GB
P1	REVC	04.04.2023	OW	GB
P1	REVB	27.02.2023	HM	BH
P1	REVA	15.02.2023	LM	MD

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Historical Features Plan

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Historical Features

- HGV Parking
- Stockpile
- Finished Product Storage Area
- Softstanding
- Service Road / Hardstanding
- Liquid Argon Storage
- HGV Loading Area
- Office Cabin
- Weighbridge
- Hedge
- Trees
- Lamp Posts
- Wooden Fence
- Site Enrance
- Barrier

Notes:

Client: Pace

Job No: 16-685

Date: 05.05.2023

Drawing No: 004

Scale: NTS

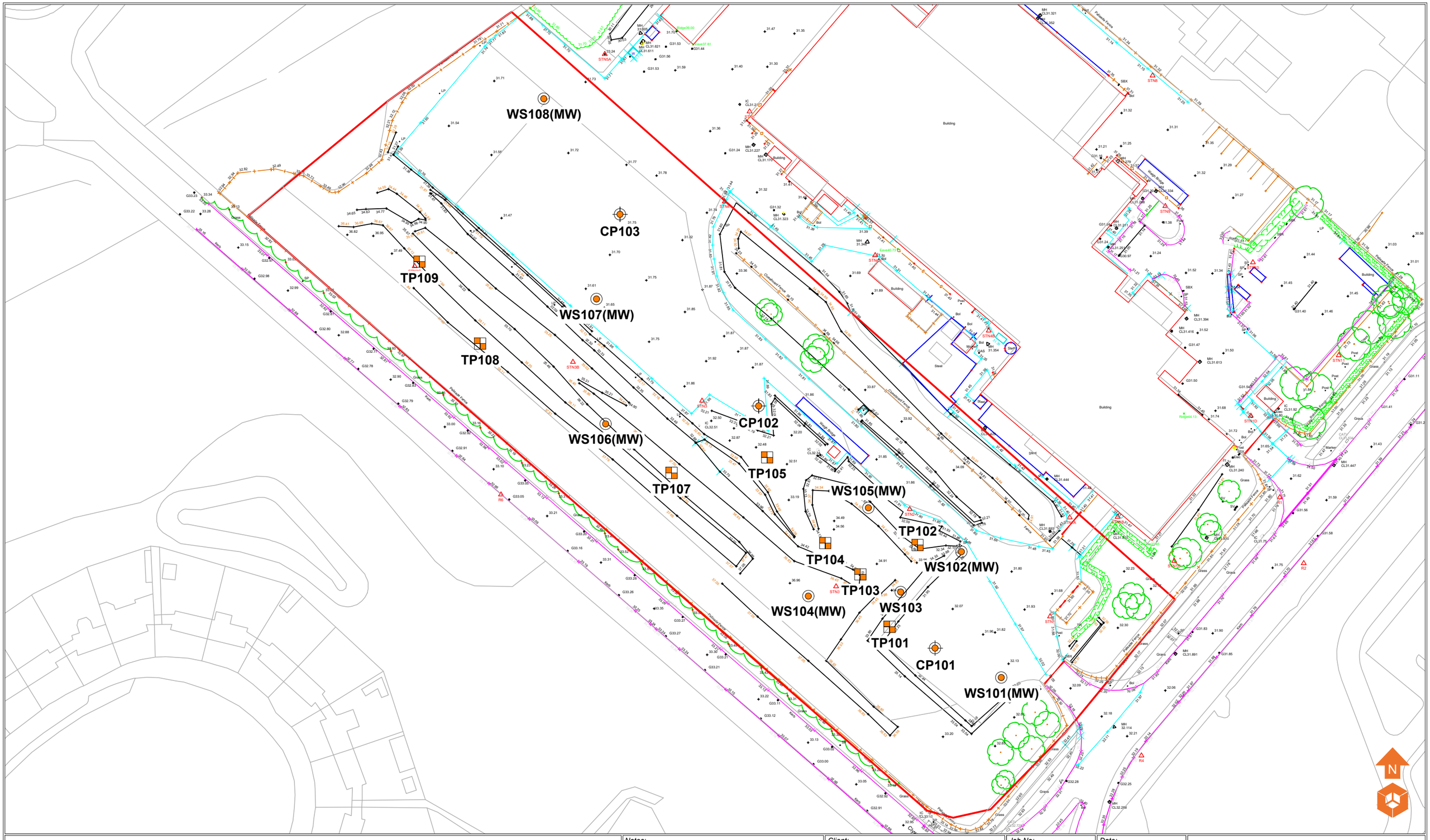
Phase	Issue	Date	Drawn	Checked
P1	REVC	05.05.2023	LM	BH
P1	REVB	27.02.2023	HM	BH
P1	REVA	17.02.2023	LM	MD

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Site Features Plan

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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Cable Percussive Borehole Location

Notes:

Client: Pace

Job No: 16-685

Date: 13.03.2023

Drawing No: 005

Scale: NTS@ A3

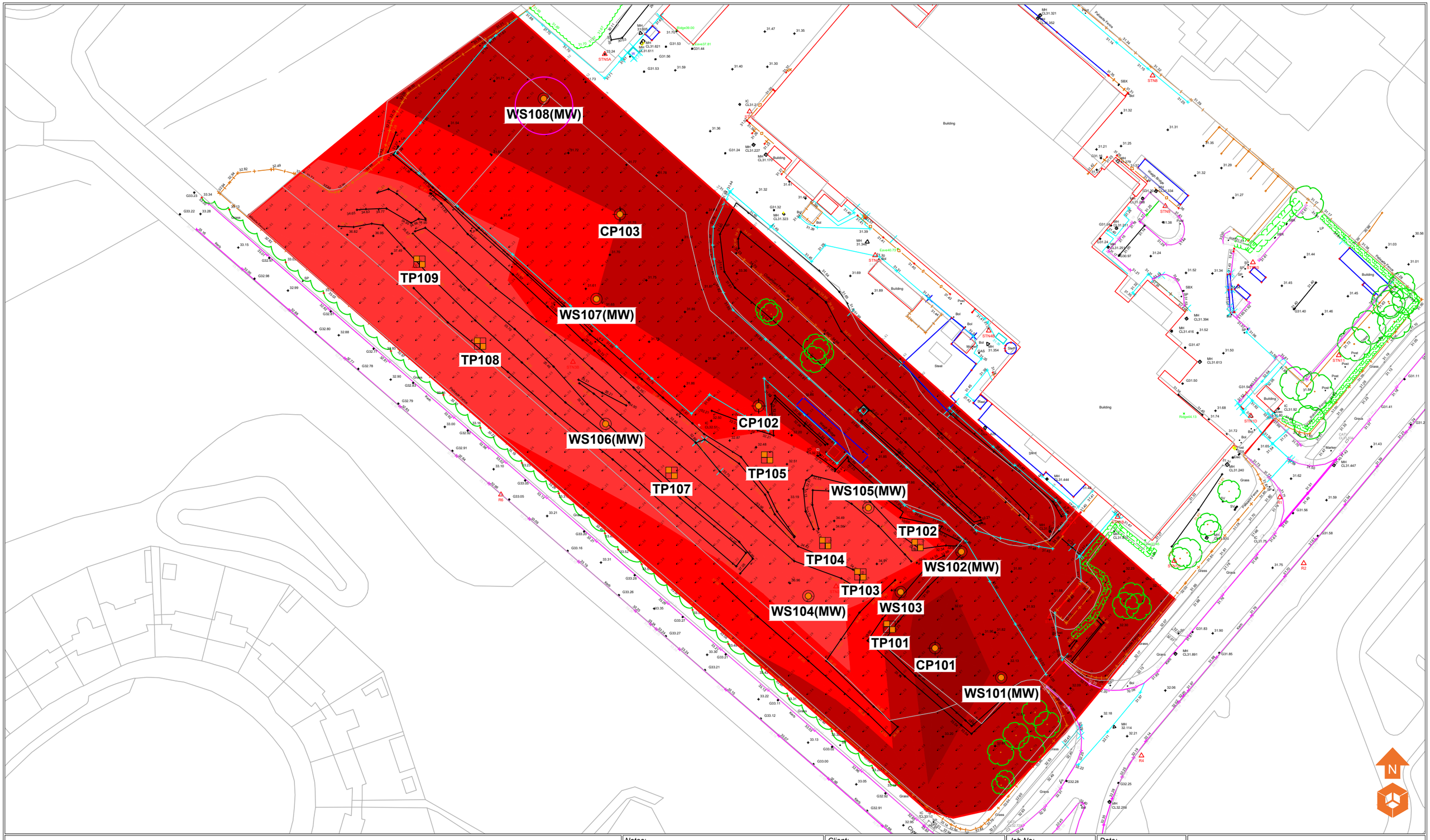
Phase	Issue	Date	Drawn	Checked
P1	REVC	13.03.2023	LM	JB
P1	REVB	27.02.2023	HM	BH
P1	REVA	22.02.2023	EB	BH

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Exploratory Hole Location Plan

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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Cable Percussive Borehole Location
- Full Depth of Made Ground not Identified

Made Ground Depth (m)

- Depth of Made Ground 0.00 - 0.24m
- Depth of Made Ground 0.25 - 0.49m
- Depth of Made Ground 0.50 - 0.74m
- Depth of Made Ground > 0.75m

Notes:

Client: Pace

Job No: 16-685

Date: 03.04.2023

Drawing No: 006

Scale: NTS@ A3

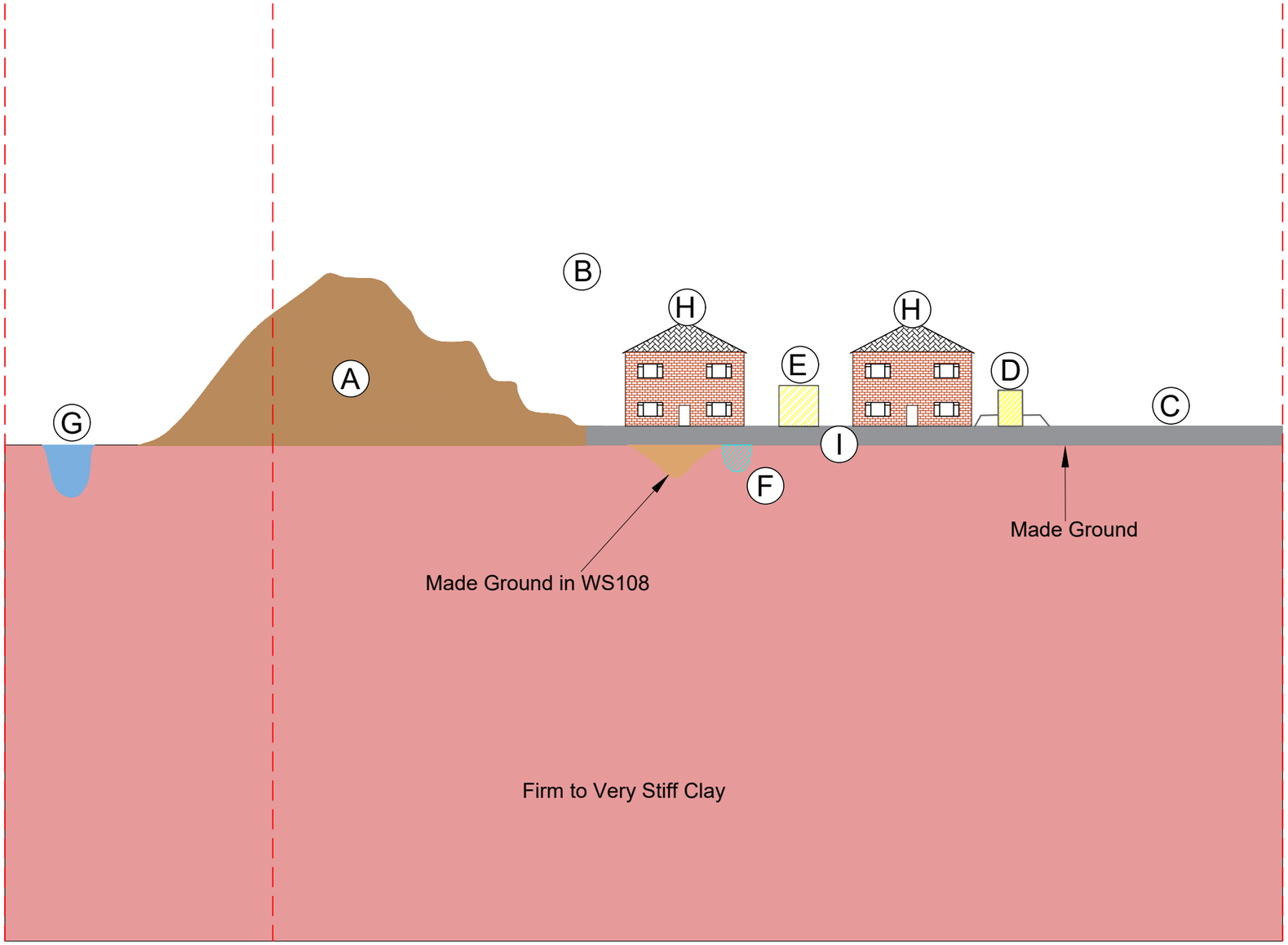
P1	REVA	03.04.2023	OW	JB
Phase	Issue	Date	Drawn	Checked

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Depth of Made Ground Plan

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Geology Key

- (A) Stockpiled Made Ground
- (B) Goods Yard
- (C) Lorry Park
- (D) Weighbridge
- (E) Control Hut
- (F) Historic Infilled Pond
- (G) Off Site Infilled Pond
- (H) Historic Buildings
- (I) Concrete Slab

Notes:

P1	REVA	03.04.2023	OW	JB
Phase	Issue	Date	Drawn	Checked

Client: Pace

Job No: 16-685

Date: 03.04.2023

Drawing No: 010

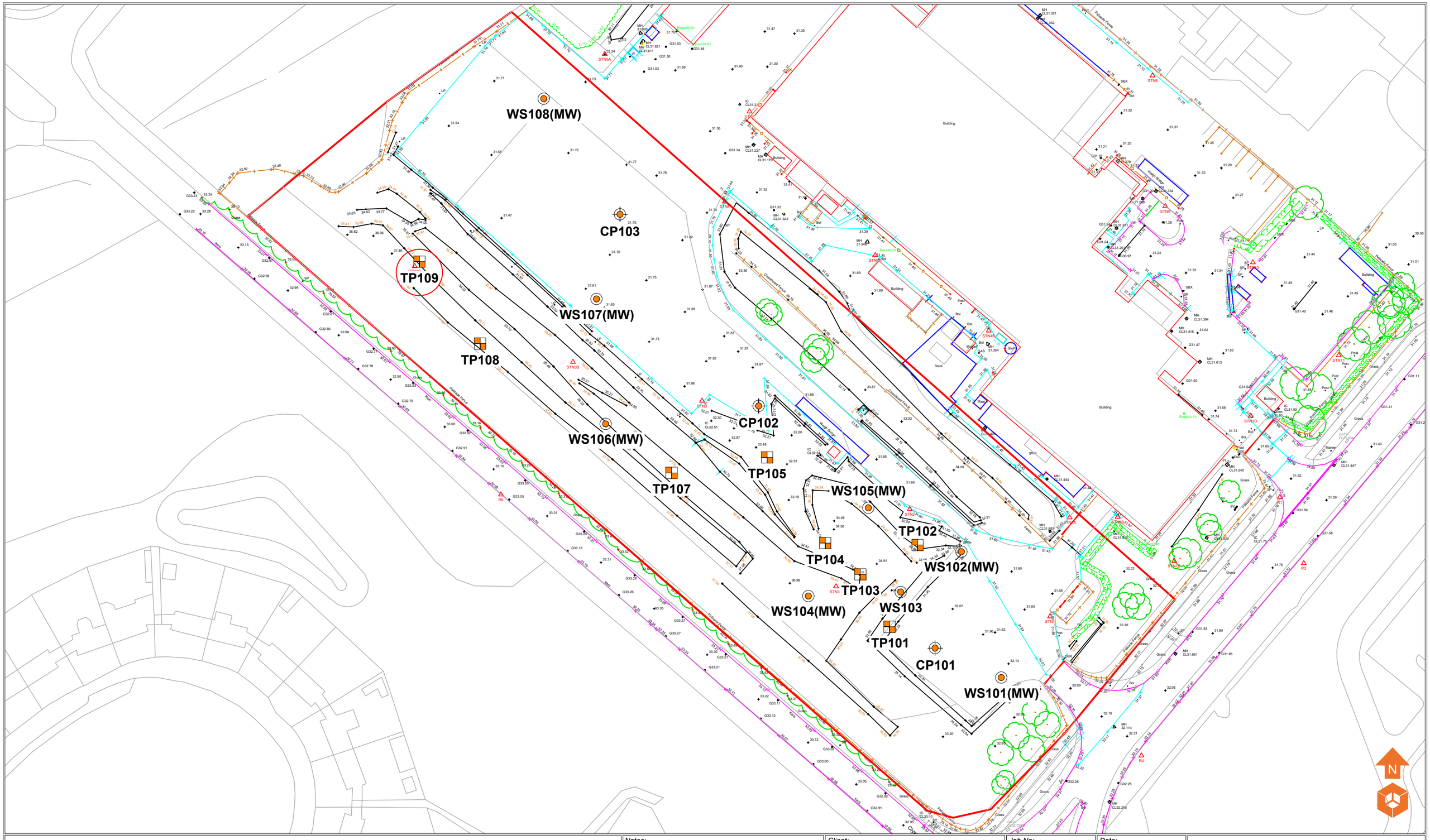
Scale: 1:1000 @ A3

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Conceptual Site Model

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Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Cable Percussive Borehole Location

Contamination Issues

- Heavy Metal Exceedance in Soil

Notes:

Client: Pace

Job No: 16-685

Date: 03.04.2023

Drawing No: 018

Scale: NTS@ A3

P1	REVA	03.04.2023	OW	JB
Phase	Issue	Date	Drawn	Checked

Job Title: Hydro Aluminium Deeside Ltd

Drawing Title: Contamination Issues Plan

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APPENDIX IV
PHOTOGRAPHS

PLATE 1 VIEW OF SITE FROM NORTHWEST FACING SOUTHEAST



PLATE 2 VIEW OF SITE FROM SOUTHEAST FACING NORTHWEST



PLATE 3 REINSTATEMENT OF TRIAL PIT ON SLOPE OF STOCKPILE



PLATE 4 MONITORING WELL INSTALLATION IN LOADING BAY IN NORTH OF SITE



PLATE 5 CABLE PERCUSSIVE RIG SETUP IN LORRY PARK IN THE SOUTH OF SITE



PLATE 6 WINDOW SAMPLE PROBEHOLE CORE



APPENDIX V
E3P EXPLORATORY HOLE LOGS

Trial Pit Log

TrialPit No: TP101
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 1.90	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.40	ES		0.55			MADE GROUND: Grey slightly clayey slightly silty gravel. Gravel is fine to coarse angular to subrounded of mudstone plastic and limestone.
	0.80	HVP	195.7				Very stiff brown mottled grey silty CLAY.
	1.00	ES					
	1.10	B					
	1.10	HVP	195.7	1.90			End of Pit at 1.90m

1
2
3
4

Trial Pit Photographs



Trial Pit 101



Trial Pit 101 Spoil

Remarks: 1. Complete. 2. Hard digging from 1.50 m bgl due to very stiff CLAY.

Stability: Stable

Trial Pit Log

TrialPit No: TP102
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70, Depth 2.60	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			MADE GROUND: Brown slightly sandy gravelly clay with rootlets. Gravel is fine to coarse angular to subangular of mudstone, brick, metal and plastic.
	0.70	ES		0.80			MADE GROUND: Brown slightly gravelly clay. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and plastic.
	1.70	ES		1.80			MADE GROUND: Brown slightly sandy gravelly clay (reworked) with cobbles. Gravel is fine to coarse angular to subrounded of mudstone and brick. Cobbles are subangular of brick.
				2.20			MADE GROUND: Grey sandy very gravelly clay. Gravel is fine to medium subangular of mudstone.
				2.60			MADE GROUND: Grey mottled orange sandy clay (reworked).
							End of Pit at 2.60m

1 2 3 4

Trial Pit Photographs



Trial Pit 102



Trial Pit 102 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP103
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 3.10	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	1.00	ES		1.00			MADE GROUND: Brown sandy very gravelly clay (reworked) with cobbles. Gravel is fine to coarse angular to subrounded of mudstone brick plastic and concrete. Cobbles are subangular of brick.
	2.40 2.40	B ES		3.10			MADE GROUND: Greyish brown slightly silty gravelly clay with cobbles (reworked). Gravel is fine to coarse angular to subrounded of mudstone, brick and plastic. Cobbles are subangular of brick.
							End of Pit at 3.10m

1
2
3
4

Trial Pit Photographs



Trial Pit 103



Trial Pit 103 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP104
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 x 0.70 Depth 3.00	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.60	ES					MADE GROUND: Brown slightly gravelly clay. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and plastic.
	0.80	B					
				2.00			
	2.20	HVP	195.7				Very stiff brown mottled grey silty CLAY.
	2.40	ES					
	2.60	HVP	195.7				
				3.00			End of Pit at 3.00m

1
2
3
4

Trial Pit Photographs



Trial Pit 104



Trial Pit 104 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP105
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): Depth 2.10 — 2.20 × 0.70	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	ES		0.50			MADE GROUND: Brown slightly gravelly clay. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and plastic.
	1.40	HVP	182.2				Very stiff brown mottled grey silty CLAY.
	2.00	HVP	185.5	2.10			End of Pit at 2.10m

1
2
3
4

Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Complete. 2. CLAY friable from 0.50 m to 1.30 m bgl.

Stability: Stable

Trial Pit Log

TrialPit No: TP107
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 2.90	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Brownish grey sandy very clayey gravel. Gravel is fine to coarse angular to subrounded of mudstone, brick, timber and metal.
	0.50	ES		0.50			
				0.80			MADE GROUND: Blackish brown slightly clayey gravelly fine to medium sand. Gravel is fine to coarse angular to subangular of mudstone, brick, concrete and metal.
							MADE GROUND: Brown slightly gravelly clay. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and plastic.
				2.30			MADE GROUND: Greyish brown sandy gravelly clay. Gravel is fine to medium subangular to subrounded of mudstone, brick and timber. Slight organic odour within gravel.
	2.60	ES					
				2.90			End of Pit at 2.90m

1 2 3 4

Trial Pit Photographs



Trial Pit 107



Trial Pit 107 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP107
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 2.90	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Brownish grey sandy very clayey gravel. Gravel is fine to coarse angular to subrounded of mudstone, brick, timber and metal.
	0.50	ES		0.50			
				0.80			MADE GROUND: Blackish brown slightly clayey gravelly fine to medium sand. Gravel is fine to coarse angular to subangular of mudstone, brick, concrete and metal.
							MADE GROUND: Brown slightly gravelly clay. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and plastic.
				2.30			MADE GROUND: Greyish brown sandy gravelly clay. Gravel is fine to medium subangular to subrounded of mudstone, brick and timber. Slight organic odour within gravel.
	2.60	ES					
				2.90			End of Pit at 2.90m

1 2 3 4

Trial Pit Photographs



Trial Pit 107



Trial Pit 107 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP108
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 2.80	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND: Brown mottled grey slightly sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete and metal. Cobbles are subangular of brick and concrete.
	1.50	ES		1.60			MADE GROUND: Grey sandy slightly clayey gravel. Gravel is fine to coarse angular to subangular of mudstone, limestone, brick and metal.
	1.80	ES		2.00			MADE GROUND: Reddish brown sandy gravelly clay (reworked). Gravel is fine to coarse angular to subrounded of mudstone, brick, plastic and metal.
				2.80			End of Pit at 2.80m

1
2
3
4

Trial Pit Photographs



Trial Pit 108



Trial Pit 108 Spoil

Remarks: 1. Complete.

Stability: Stable

Trial Pit Log

TrialPit No: TP109
Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: - Level:	Date 06/03/2023
Location: Deeside		Dimensions (m): 2.20 × 0.70 Depth 3.00	Scale 1:30
Client: Pace			Logged J. BEER

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50	ES					MADE GROUND: Brown mottled grey slightly sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete plastic and metal. Cobbles are subangular of brick and concrete.
	0.80	B					
				2.00			
	2.20	ES					MADE GROUND: Blackish brown clayey sandy gravel. Gravel is angular to subangular of mudstone, brick, concrete and ash.
				2.40			MADE GROUND: Brown mottled grey slightly sandy gravelly clay with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, concrete, plastic and metal. Cobbles are subangular of brick and concrete.
				3.00			End of Pit at 3.00m

1 2 3 4

Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Complete.

Stability: Stable

Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.60	ES		0.70			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subangular of mudstone, limestone and brick.
		1.00		N=12 (1,2/2,3,3,4)				Stiff medium strength reddish brown mottled grey slightly silty slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming very stiff high strength at 2.00 m bgl.
		1.50	D					
		2.00		N=20 (2,2/4,5,5,6)				
		2.50 - 3.00	U					
		3.00		N=19 (3,4/4,5,5,5)				
		4.00		N=18 (5,5/4,4,5,5)				
		5.00		N=26 (5,5/6,6,6,8)				
					5.45			End of borehole at 5.45 m

Remarks

1. Complete. 2. Monitoring well installed. Response zone 2.00 m to 5.00 m bgl.

Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.50	ES		0.60			MADE GROUND: Greyish brown gravelly fine to medium sand with cobbles. Gravel is fine to coarse angular to subrounded of mudstone, brick, limestone and concrete. Cobbles are subangular of concrete.
		1.00 1.00	D	N=13 (1,2/2,3,4,4)				Stiff medium strength reddish brown mottled grey slightly silty slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming very stiff high strength at 2.00 m bgl.
		1.50 - 2.00	U					
		2.00 2.00	D	N=22 (2,4/6,6,5,5)				
		3.00 3.00	D	50 (5,9/50 for 295mm)	3.44			End of borehole at 3.44 m

Remarks

1. Terminated due to refusal on cobble in CLAY. 2. Monitoring well installed. Response zone 1.00 m to 3.00 m bgl.

Borehole Log

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -
Location: Deeside		Level:
Client: Pace		Dates: 06/03/2023 -

Borehole No. **WS103**
Sheet 1 of 1
Hole Type WS
Scale 1:50
Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30			MADE GROUND: Brown slightly sandy clayey gravel. Gravel is fine to medium subrounded of mudstone and concrete.
					0.50			MADE GROUND: Concrete cobbles.
					0.60			MADE GROUND: Brown slightly sandy clayey gravel. Gravel is fine to medium subrounded of mudstone and concrete.
		1.00 1.00	D	N=10 (2,2/2,2,3,3)				Reddish brown mottled grey slightly silty slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming very stiff high strength at 2.00 m bgl.
		1.50 - 2.00	U					
		2.00 2.00	D	N=22 (2,4/6,6,6,4)				
		2.50	ES					
		3.00 3.00	D	50 (3,10/50 for 295mm)				
					3.44			End of borehole at 3.44 m

1 2 3 4 5 6 7 8 9 10

Remarks
1. Terminated due to refusal on cobble in CLAY.

Borehole Log

Borehole No. **WS104**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.80	ES					MADE GROUND: Brown sandy gravelly clay (reworked) with occasional cobbles. Gravel is fine to coarse angular to subangular of mudstone brick concrete and plastic. Cobbles are subangular of concrete. Tree debris at 1.20 m bgl.
		1.00		N=9 (5,4/2,2,2,3)				
		2.00		N=4 (1,1/1,1,1,1)				
		2.70	ES		2.50			MADE GROUND: Brown gravelly sandy clay (reworked). Gravel is fine to medium subangular to subrounded of mudstone, concrete and brick.
		3.00		50 (10,13/50 for 180mm)				
					3.33			End of borehole at 3.33 m

Remarks

1. Terminated due to refusal on concrete cobble in Made Ground. 2. Monitoring well installed. Response zone 1.00 m to 3.00 m bgl.

Borehole Log

Borehole No. **WS105**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		1.00		N=1 (1,0/0,1,0,0)				MADE GROUND: Brown slightly sandy gravelly clay (reworked). Gravel is fine to medium angular to subangular of mudstone, brick, ceramic and metal.
		1.50	ES					
		2.00	D					
		2.00		N=16 (2,3/4,4,4,4)	2.30			
		2.80	ES					Very stiff high strength reddish brown mottled grey slightly silty CLAY.
		3.00	D					
		3.00		N=31 (4,7/8,7,8,8)				
		3.50 - 4.00	U					
		4.00	D					
		4.00		N=23 (5,5/6,5,6,6)				
		5.00		N=26 (5,5/5,6,7,8)	5.45			End of borehole at 5.45 m

Remarks

1. Complete. 2. Monitoring well installed. Response zone 1.00 m to 2.00 m bgl.

Borehole Log

Borehole No. **WS106**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.40	ES					MADE GROUND: Brown slightly sandy gravelly clay (reworked). Gravel is fine to coarse angular to subangular of mudstone, brick and concrete. Black ashy tar material at 2.80 m bgl.
		1.00		N=4 (1,1/1,1,1,1)				
		2.00		N=11 (2,3/4,3,2,2)				
		2.80	ES					
		3.00		N=5 (2,1/2,1,1,1)	3.00			MADE GROUND: Greyish brown gravelly sandy clay with rare organic material. Gravel is fine to medium subangular to subrounded of mudstone, brick and concrete.
		4.00	D		4.00			
		4.00		N=25 (7,5/6,5,7,7)				Very stiff high strength reddish brown mottled grey silty CLAY.
					4.45			End of borehole at 4.45 m

Remarks

1. Terminated due to UXO anomoly at 4.45 m bgl. 2. Monitoring well installed. Response zone 1.00 m to 4.00 m bgl.

Borehole Log

Borehole No. **WS107**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.25			MADE GROUND: Concrete slab.
					0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to medium subangular of mudstone and limestone.
		0.90	ES					Stiff medium strength reddish brown slightly gravelly silty CLAY. Gravel is fine subangular of mudstone. Becoming very stiff very high strength at 2.00 m bgl.
		1.00	D					
		1.00		N=14 (2,2/3,3,4,4)				
		1.50 - 2.00	U					
		2.00	D					
		2.00		50 (8,10/50 for 285mm)				
					2.43			End of borehole at 2.43 m

1 2 3 4 5 6 7 8 9 10

Remarks

1. Terminated due to refusal on stiff CLAY. 2. Monitoring well installed. Response zone 1.00 m to 2.00 m bgl.

Borehole Log

Borehole No. **WS108**

Sheet 1 of 1

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type WS
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete slab.
		0.60	ES		0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to medium subangular of mudstone and limestone. Membrane at 0.50 m bgl.
		1.00		N=10 (1,2/1,3,3,3)				MADE GROUND: Brown slightly sandy gravel with cobbles. Gravel is fine to coarse angular to subangular of mudstone, brick and concrete. Cobbles are subangular of concrete.
					2.00			End of borehole at 2.00 m

Remarks

1. Terminated due barrel bouncing in Made Ground and UXO anomoly at 2.00 m bgl. 2. Monitoring well installed. Response zone 1.00 m to 2.00 m bgl.

Borehole Log

Borehole No. **CP101**

Sheet 1 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			MADE GROUND: Concrete.
		0.50	B					MADE GROUND: Grey gravel with cobbles. Gravel is coarse of limestone and mudstone. Cobbles are angular of limestone (Ballast).
		1.00 1.00	D	N=18 (3,2/4,4,5,5)	1.00			Very stiff high strength reddish brown mottled grey slightly silty slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of mudstone. Becoming stiff medium strength at 3.00 m bgl.
		2.00 2.00	D	N=19 (3,3/4,5,5,5)				
		3.00 3.00	D	N=14 (2,2/4,3,4,3)				
		4.00 4.00	D	N=17 (3,3/4,4,5,4)				
		5.00 5.00	D	N=18 (2,2/4,4,4,6)	5.00			Stiff medium strength reddish brown CLAY. Firm low strength at 14.00m to 15.50 m bgl.
		5.50	B					
		6.50 - 6.95	U					
		8.00 8.00	D	N=14 (3,4/3,3,4,4)				
		9.50 - 9.95	U					
								Continued on next sheet

Remarks
1. Complete.

Borehole Log

Borehole No. **CP101**

Sheet 2 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 11.00	D	N=16 (4,3/3,4,4,5)					11
		12.50 - 12.95	U						12
		14.00 14.00	D	N=10 (3,3/2,3,2,3)					13
		15.50 - 15.95	U						14
		16.00	B						15
		17.00 17.00	D	N=13 (3,3/4,3,3,3)					16
		17.50	B						17
		18.50 - 18.95	U						18
		20.00	D		20.00				19
								Continued on next sheet	20

Remarks
1. Complete.

Borehole Log

Borehole No. **CP101**

Sheet 3 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 06/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		20.00		N=14 (3,2/3,3,4,4)				End of borehole at 20.00 m

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Remarks
1. Complete.

Borehole Log

Borehole No. **CP102**

Sheet 1 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 09/09/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.25			MADE GROUND: Concrete slab.
					0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to medium subangular of mudstone and limestone.
		1.00 1.00	D	N=10 (2,2/3,2,3,2)	1.20			Reddish brown slightly gravelly silty CLAY. Gravel is fine subangular of mudstone.
		2.00 2.00	D	N=11 (2,2/2,3,3,3)				Stiff medium strength reddish brown CLAY.
		3.00 3.00	D	N=11 (2,3/2,2,3,4)				
		4.00 4.00	D	N=14 (2,2/3,3,4,4)				
		5.00 5.00	D	N=13 (2,3/3,4,3,3)				
		5.50	B					
		6.50 - 6.95	U					
		8.00 8.00	D	N=15 (2,2/4,4,3,4)				
		9.50 - 9.95	U					

Continued on next sheet

Remarks
1. Complete.

Borehole Log

Borehole No. **CP102**
Sheet 2 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 09/09/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		11.00 11.00	D	N=15 (2,3/3,4,4,4)				
		12.50 - 12.95	U					
		14.00 14.00	D	N=15 (3,3/4,3,4,4)				
		15.50 - 15.95	U		15.50			Stiff medium strength reddish brown CLAY.
		16.00	B					
		17.00 17.00	D	N=15 (2,3/3,4,4,4)				
		17.50	B					
		18.50 - 18.95	U					
		20.00	D		20.00			Continued on next sheet

11 12 13 14 15 16 17 18 19 20

Remarks
1. Complete.

Borehole Log

Borehole No. **CP102**

Sheet 3 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 09/09/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		20.00		N=15 (3,3/3,4,4,4)				End of borehole at 20.00 m

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Remarks
1. Complete.

Borehole Log

Borehole No. **CP103**

Sheet 1 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 13/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.25			MADE GROUND: Concrete slab.
					0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to medium subangular of mudstone and limestone.
		1.00 1.00	D	N=12 (2,2/3,3,3,3)	1.20			Reddish brown slightly gravelly silty CLAY. Gravel is fine subangular of mudstone.
		2.00 2.00	D	N=13 (2,2/3,4,3,3)				Stiff medium strength reddish brown CLAY. Firm low strength at 14.00m to 15.50 m bgl.
		3.00 3.00	D	N=11 (2,2/2,3,3,3)				
		4.00 4.00	D	N=10 (2,3/3,2,2,3)				
		5.00 5.00	D	N=11 (2,2/3,2,3,3)				
		5.50	B					
		6.50 - 6.95	U					
		8.00 8.00	D	N=14 (2,3/3,4,4,3)				
		9.50 - 9.95	U					

Continued on next sheet

Remarks
1. Complete.

Borehole Log

Borehole No. **CP103**

Sheet 2 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 13/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 11.00	D	N=13 (3,2/3,3,3,4)					11
		12.50 - 12.95	U						12
		14.00 14.00	D	N=10 (2,2/3,2,3,2)					13
		15.50 - 15.95	U						14
		16.00	B						15
		17.00 17.00	D	N=16 (3,3/4,4,4,4)					16
		18.50 - 18.95	U						17
		20.00	D		20.00				18
									19
								Continued on next sheet	20

Remarks
1. Complete.

Borehole Log

Borehole No. **CP103**

Sheet 3 of 3

Project Name: Hydro Aluminium	Project No. 16685	Co-ords: -	Hole Type CP
Location: Deeside		Level:	Scale 1:50
Client: Pace		Dates: 13/03/2023 -	Logged By J. BEER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		20.00		N=16 (3,3/4,4,4,4)				End of borehole at 20.00 m

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Remarks
1. Complete.

APPENDIX VI
CHEMICAL TESTING RESULTS

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Analytical Report Number : 23-22056

Project / Site name:	Hydro	**Samples received on:**	08/03/2023
Your job number:	16-658	**Samples instructed on/ Analysis started on:**	09/03/2023
Your order number:	004306	**Analysis completed by:**	22/03/2023
Report Issue Number:	1	**Report issued on:**	22/03/2023
Samples Analysed:	2 leachate samples - 16 soil samples		

Signed:

Anna Goc
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611519	2611520	2611521	2611522	2611523
Sample Reference				TP101	TP101	TP102	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	1.70	0.60	2.40
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	53	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	3.3	16	23	16	16
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	1.4	0.3
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	ASE	N/A	ASE	ASE	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.5	8.5	-	8.4	8.3
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	520	230	-	300	160
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.015	0.028	-	0.024	0.029
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	29	56	-	47	57
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	14.5	27.9	-	23.5	28.7
Sulphide	mg/kg	1	MCERTS	45	68	-	21	18
Total Sulphur	mg/kg	50	MCERTS	1700	110	-	210	140
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.5	0.4	-	0.7	0.4

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	0.37	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.47	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.19	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.2	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.18	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	0.06	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	0.84	< 0.80	< 0.80	< 0.80	< 0.80

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611519	2611520	2611521	2611522	2611523
Sample Reference				TP101	TP101	TP102	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	1.70	0.60	2.40
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	5.5	11	11	10	10
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	120	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	1.2	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	0.4	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	11	38	-	37	41
Copper (aqua regia extractable)	mg/kg	1	MCERTS	15	27	23	29	34
Lead (aqua regia extractable)	mg/kg	1	MCERTS	24	21	34	51	25
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12	42	38	36	45
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	39	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	45	70	81	140	72
Petroleum Hydrocarbons								
TPH (C5 - C6) $_{HS_1D_TOTAL}$	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) $_{HS_1D_TOTAL}$	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) $_{HS_1D_TOTAL}$	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) $_{EH_CU_1D_TOTAL}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) $_{EH_CU_1D_TOTAL}$	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) $_{EH_CU_1D_TOTAL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C21 - C35) $_{EH_CU_1D_TOTAL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C35 - C40) $_{EH_CU_1D_TOTAL}$	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total C5 - C40 $_{EH_CU+HS_1D_TOTAL}$	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
VOCs								
Chloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Chloroethane	µg/kg	5	NONE	-	-	-	-	-
Bromomethane	µg/kg	5	ISO 17025	-	-	-	-	-
Vinyl Chloride	µg/kg	5	NONE	-	-	-	-	-
Trichlorofluoromethane	µg/kg	5	NONE	-	-	-	-	-
1,1-Dichloroethene	µg/kg	5	NONE	-	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	-	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-	-
1,1-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
2,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Trichloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,2-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,1-Dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	5	NONE	-	-	-	-	-
Benzene	µg/kg	5	MCERTS	-	-	-	-	-
Tetrachloromethane	µg/kg	5	NONE	-	-	-	-	-
1,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Trichloroethene	µg/kg	5	ISO 17025	-	-	-	-	-
Dibromomethane	µg/kg	5	ISO 17025	-	-	-	-	-
Bromodichloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Toluene	µg/kg	5	MCERTS	-	-	-	-	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611519	2611520	2611521	2611522	2611523
Sample Reference				TP101	TP101	TP102	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	1.70	0.60	2.40
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,3-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Dibromochloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Tetrachloroethene	µg/kg	5	NONE	-	-	-	-	-
1,2-Dibromoethane	µg/kg	5	ISO 17025	-	-	-	-	-
Chlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-	-
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-	-
Styrene	µg/kg	5	ISO 17025	-	-	-	-	-
Tribromomethane	µg/kg	5	NONE	-	-	-	-	-
o-Xylene	µg/kg	5	MCERTS	-	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
Isopropylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Bromobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
n-Propylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
2-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	-
4-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
tert-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
sec-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,3-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
p-Isopropyltoluene	µg/kg	5	ISO 17025	-	-	-	-	-
1,2-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,4-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Butylbenzene	µg/kg	5	NONE	-	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Hexachlorobutadiene	µg/kg	5	NONE	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Hexachloroethane	mg/kg	0.05	ISO 17025	-	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	-
2-Nitrophenol	mg/kg	0.3	NONE	-	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611519	2611520	2611521	2611522	2611523
Sample Reference				TP101	TP101	TP102	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	1.70	0.60	2.40
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Nitroaniline	mg/kg	0.2	NONE	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Azobenzene	mg/kg	0.3	NONE	-	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	NONE	-	-	-	-	-
Anthraquinone	mg/kg	0.3	NONE	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007	-	-	-	-

Subcontracted Analysis

Explosives	Type	N/A	NONE	-	-	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611524	2611525	2611526	2611527	2611528
Sample Reference				TP105	TP107	TP107	TP108	TP109
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.50	2.60	1.80	2.20
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	-	-	< 0.1	93	< 0.1
Moisture Content	%	0.01	NONE	-	-	14	5.4	13
Total mass of sample received	kg	0.001	NONE	-	-	0.3	0.9	0.3
Asbestos in Soil	Type	N/A	ISO 17025	-	-	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	N/A	N/A	ASE	ASE	ASE
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	-	-	8.2	9	7.6
Total Cyanide	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	-	-	420	430	750
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	0.026	0.096	0.051
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	51	190	100
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	25.5	96.1	50.8
Sulphide	mg/kg	1	MCERTS	-	-	130	46	23
Total Sulphur	mg/kg	50	MCERTS	-	-	360	740	600
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	-	1.3	0.3	0.9
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	0.21	< 0.05	-
Anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	0.49	< 0.05	-
Pyrene	mg/kg	0.05	MCERTS	-	-	0.44	< 0.05	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	0.27	< 0.05	-
Chrysene	mg/kg	0.05	MCERTS	-	-	0.25	< 0.05	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	0.32	< 0.05	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	0.18	< 0.05	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	0.25	< 0.05	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-	2.41	< 0.80	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611524	2611525	2611526	2611527	2611528
Sample Reference				TP105	TP107	TP107	TP108	TP109
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.50	2.60	1.80	2.20
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	11	3.8	29
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	1.4	0.9	10
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	22	9.8	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	49	12	230
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	230	68	1900
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	23	8.3	41
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	480	120	17000
Petroleum Hydrocarbons								
TPH (C5 - C6) HS_1D_TOTAL	mg/kg	1	NONE	-	-	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_1D_TOTAL	mg/kg	0.1	NONE	-	-	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_1D_TOTAL	mg/kg	0.1	NONE	-	-	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	-	-	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	-	-	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	-	-	2.5	< 1.0	< 1.0
TPH (C21 - C35) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	-	-	31	< 1.0	< 1.0
TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	-	-	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	-	-	35	< 10	< 10
VOCs								
Chloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Chloroethane	µg/kg	5	NONE	-	-	-	-	< 5.0
Bromomethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Vinyl Chloride	µg/kg	5	NONE	-	-	-	-	< 5.0
Trichlorofluoromethane	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1-Dichloroethene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	-	-	-	-	< 5.0
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-	< 5.0
1,1-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
2,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trichloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1-Dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trans-1,2-dichloroethene	µg/kg	5	NONE	-	-	-	-	< 5.0
Benzene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
Tetrachloromethane	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trichloroethene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Dibromomethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Bromodichloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Toluene	µg/kg	5	MCERTS	-	-	-	-	< 5.0

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611524	2611525	2611526	2611527	2611528
Sample Reference				TP105	TP107	TP107	TP108	TP109
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.50	2.60	1.80	2.20
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Dibromochloromethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Tetrachloroethene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2-Dibromoethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Chlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
Styrene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Tribromomethane	µg/kg	5	NONE	-	-	-	-	< 5.0
o-Xylene	µg/kg	5	MCERTS	-	-	-	-	< 5.0
1,1,2,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Isopropylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Bromobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
n-Propylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
2-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
4-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
tert-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
sec-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,3-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
p-Isopropyltoluene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,4-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Butylbenzene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0
Hexachlorobutadiene	µg/kg	5	NONE	-	-	-	-	< 5.0
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	< 5.0

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	< 0.1
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Hexachloroethane	mg/kg	0.05	ISO 17025	-	-	-	-	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
2-Nitrophenol	mg/kg	0.3	NONE	-	-	-	-	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	< 0.1

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611524	2611525	2611526	2611527	2611528
Sample Reference				TP105	TP107	TP107	TP108	TP109
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.50	2.60	1.80	2.20
Date Sampled				06/03/2023	06/03/2023	06/03/2023	06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	-	-	-	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	-	-	-	< 0.1
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
4-Nitroaniline	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Azobenzene	mg/kg	0.3	NONE	-	-	-	-	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	0.11
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Dibutyl phthalate	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Anthraquinone	mg/kg	0.3	NONE	-	-	-	-	< 0.3
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	0.12
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	0.1
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	-	-	-	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	0.07
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	0.07
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	0.06
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 52	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 101	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 118	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 138	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 153	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 180	mg/kg	0.001	MCERTS	-	-	-	-	-

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	-	-	-	-	-

Subcontracted Analysis

Explosives	Type	N/A	NONE	See Attached	See Attached	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611529	2611530	2611531	2611532	2611533
Sample Reference				WS101	WS102	WS106	WS107	WS107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.50	0.40	0.30	0.90
Date Sampled				06/03/2023	06/03/2023	07/03/2023	07/03/2023	07/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	74	-	93	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	3.6	-	17	4.6	17
Total mass of sample received	kg	0.001	NONE	0.9	-	0.3	0.3	0.3
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	ASE	N/A	ASE	ASE	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	8.4	8.8	8.6
Total Cyanide	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	-	-	370	750	300
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	0.033	0.17	0.072
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	66	340	140
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	33.2	172	72.3
Sulphide	mg/kg	1	MCERTS	-	-	4.6	38	4.7
Total Sulphur	mg/kg	50	MCERTS	-	-	280	2000	140
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	-	1.4	0.3	0.5

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	1.6	-	< 0.05	0.31	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.93	-	< 0.05	0.28	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	0.15	0.06	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	-	0.17	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	-	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	-	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.57	-	< 0.80	< 0.80	< 0.80

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611529	2611530	2611531	2611532	2611533
Sample Reference				WS101	WS102	WS106	WS107	WS107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.50	0.40	0.30	0.90
Date Sampled				06/03/2023	06/03/2023	07/03/2023	07/03/2023	07/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.3	-	8.8	4.6	12
Barium (aqua regia extractable)	mg/kg	1	MCERTS	45	-	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.5	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	0.6	0.3	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	-	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	27	16	33
Copper (aqua regia extractable)	mg/kg	1	MCERTS	20	-	25	9.5	28
Lead (aqua regia extractable)	mg/kg	1	MCERTS	31	-	79	13	26
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	-	26	8.2	40
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	11	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	27	-	200	20	69
Petroleum Hydrocarbons								
TPH (C5 - C6) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH (C6 - C8) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	-	< 0.1	< 0.1	< 0.1
TPH (C8 - C10) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	-	< 0.1	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	-	< 2.0	< 2.0	< 2.0
TPH (C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	-	< 4.0	< 4.0	< 4.0
TPH (C16 - C21) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH (C21 - C35) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	-	< 10	< 10	< 10
TPH Total C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	< 10	-	< 10	< 10	< 10
VOCs								
Chloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Chloroethane	µg/kg	5	NONE	-	-	-	-	-
Bromomethane	µg/kg	5	ISO 17025	-	-	-	-	-
Vinyl Chloride	µg/kg	5	NONE	-	-	-	-	-
Trichlorofluoromethane	µg/kg	5	NONE	-	-	-	-	-
1,1-Dichloroethene	µg/kg	5	NONE	-	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	-	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-	-	-	-
1,1-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
2,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Trichloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,2-Dichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,1-Dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	5	NONE	-	-	-	-	-
Benzene	µg/kg	5	MCERTS	-	-	-	-	-
Tetrachloromethane	µg/kg	5	NONE	-	-	-	-	-
1,2-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Trichloroethene	µg/kg	5	ISO 17025	-	-	-	-	-
Dibromomethane	µg/kg	5	ISO 17025	-	-	-	-	-
Bromodichloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	-	-	-	-	-
Toluene	µg/kg	5	MCERTS	-	-	-	-	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611529	2611530	2611531	2611532	2611533
Sample Reference				WS101	WS102	WS106	WS107	WS107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.50	0.40	0.30	0.90
Date Sampled				06/03/2023	06/03/2023	07/03/2023	07/03/2023	07/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
1,3-Dichloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
Dibromochloromethane	µg/kg	5	ISO 17025	-	-	-	-	-
Tetrachloroethene	µg/kg	5	NONE	-	-	-	-	-
1,2-Dibromoethane	µg/kg	5	ISO 17025	-	-	-	-	-
Chlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	-	-	-
p & m-Xylene	µg/kg	5	MCERTS	-	-	-	-	-
Styrene	µg/kg	5	ISO 17025	-	-	-	-	-
Tribromomethane	µg/kg	5	NONE	-	-	-	-	-
o-Xylene	µg/kg	5	MCERTS	-	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/kg	5	ISO 17025	-	-	-	-	-
Isopropylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Bromobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
n-Propylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
2-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	-
4-Chlorotoluene	µg/kg	5	ISO 17025	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
tert-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
sec-Butylbenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,3-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
p-Isopropyltoluene	µg/kg	5	ISO 17025	-	-	-	-	-
1,2-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
1,4-Dichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Butylbenzene	µg/kg	5	NONE	-	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-
Hexachlorobutadiene	µg/kg	5	NONE	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	-	-	-	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Hexachloroethane	mg/kg	0.05	ISO 17025	-	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	-
2-Nitrophenol	mg/kg	0.3	NONE	-	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611529	2611530	2611531	2611532	2611533
Sample Reference				WS101	WS102	WS106	WS107	WS107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	0.50	0.40	0.30	0.90
Date Sampled				06/03/2023	06/03/2023	07/03/2023	07/03/2023	07/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Nitroaniline	mg/kg	0.2	NONE	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Azobenzene	mg/kg	0.3	NONE	-	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	NONE	-	-	-	-	-
Anthraquinone	mg/kg	0.3	NONE	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 52	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 101	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 118	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 138	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 153	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 180	mg/kg	0.001	MCERTS	-	-	-	-	-

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	-	-	-	-	-

Subcontracted Analysis

Explosives	Type	N/A	NONE	-	See Attached	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611534
Sample Reference				WS108
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				07/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	12
Total mass of sample received	kg	0.001	NONE	0.7

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	ASE

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	10.4
Total Cyanide	mg/kg	1	MCERTS	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	3800
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.54
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	1100
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	539
Sulphide	mg/kg	1	MCERTS	32
Total Sulphur	mg/kg	50	MCERTS	2400
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.6

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.14
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.19
Pyrene	mg/kg	0.05	MCERTS	0.22
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611534
Sample Reference				WS108
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				07/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.4
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.6
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	32
Lead (aqua regia extractable)	mg/kg	1	MCERTS	69
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160
Petroleum Hydrocarbons				
TPH (C5 - C6) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0
TPH (C6 - C8) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1
TPH (C8 - C10) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1
TPH (C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	3
TPH (C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	5.4
TPH (C16 - C21) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	14
TPH (C21 - C35) EH_CU_1D_TOTAL	mg/kg	1	MCERTS	190
TPH (C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	42
TPH Total C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	250
VOCs				
Chloromethane	µg/kg	5	ISO 17025	-
Chloroethane	µg/kg	5	NONE	-
Bromomethane	µg/kg	5	ISO 17025	-
Vinyl Chloride	µg/kg	5	NONE	-
Trichlorofluoromethane	µg/kg	5	NONE	-
1,1-Dichloroethene	µg/kg	5	NONE	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	5	NONE	-
Cis-1,2-dichloroethene	µg/kg	5	ISO 17025	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-
1,1-Dichloroethane	µg/kg	5	ISO 17025	-
2,2-Dichloropropane	µg/kg	5	ISO 17025	-
Trichloromethane	µg/kg	5	ISO 17025	-
1,1,1-Trichloroethane	µg/kg	5	ISO 17025	-
1,2-Dichloroethane	µg/kg	5	ISO 17025	-
1,1-Dichloropropene	µg/kg	5	ISO 17025	-
Trans-1,2-dichloroethene	µg/kg	5	NONE	-
Benzene	µg/kg	5	MCERTS	-
Tetrachloromethane	µg/kg	5	NONE	-
1,2-Dichloropropane	µg/kg	5	ISO 17025	-
Trichloroethene	µg/kg	5	ISO 17025	-
Dibromomethane	µg/kg	5	ISO 17025	-
Bromodichloromethane	µg/kg	5	ISO 17025	-
Cis-1,3-dichloropropene	µg/kg	5	ISO 17025	-
Trans-1,3-dichloropropene	µg/kg	5	ISO 17025	-
Toluene	µg/kg	5	MCERTS	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611534
Sample Reference				WS108
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				07/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
1,1,2-Trichloroethane	µg/kg	5	ISO 17025	-
1,3-Dichloropropane	µg/kg	5	ISO 17025	-
Dibromochloromethane	µg/kg	5	ISO 17025	-
Tetrachloroethene	µg/kg	5	NONE	-
1,2-Dibromoethane	µg/kg	5	ISO 17025	-
Chlorobenzene	µg/kg	5	ISO 17025	-
1,1,1,2-Tetrachloroethane	µg/kg	5	ISO 17025	-
Ethylbenzene	µg/kg	5	MCERTS	-
p & m-Xylene	µg/kg	5	MCERTS	-
Styrene	µg/kg	5	ISO 17025	-
Tribromomethane	µg/kg	5	NONE	-
o-Xylene	µg/kg	5	MCERTS	-
1,1,2,2-Tetrachloroethane	µg/kg	5	ISO 17025	-
Isopropylbenzene	µg/kg	5	ISO 17025	-
Bromobenzene	µg/kg	5	ISO 17025	-
n-Propylbenzene	µg/kg	5	ISO 17025	-
2-Chlorotoluene	µg/kg	5	ISO 17025	-
4-Chlorotoluene	µg/kg	5	ISO 17025	-
1,3,5-Trimethylbenzene	µg/kg	5	ISO 17025	-
tert-Butylbenzene	µg/kg	5	ISO 17025	-
1,2,4-Trimethylbenzene	µg/kg	5	ISO 17025	-
sec-Butylbenzene	µg/kg	5	ISO 17025	-
1,3-Dichlorobenzene	µg/kg	5	ISO 17025	-
p-Isopropyltoluene	µg/kg	5	ISO 17025	-
1,2-Dichlorobenzene	µg/kg	5	ISO 17025	-
1,4-Dichlorobenzene	µg/kg	5	ISO 17025	-
Butylbenzene	µg/kg	5	NONE	-
1,2-Dibromo-3-chloropropane	µg/kg	5	ISO 17025	-
1,2,4-Trichlorobenzene	µg/kg	5	ISO 17025	-
Hexachlorobutadiene	µg/kg	5	NONE	-
1,2,3-Trichlorobenzene	µg/kg	5	ISO 17025	-

SVOCs

Aniline	mg/kg	0.1	NONE	-
Phenol	mg/kg	0.2	ISO 17025	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-
2-Methylphenol	mg/kg	0.3	MCERTS	-
Hexachloroethane	mg/kg	0.05	ISO 17025	-
Nitrobenzene	mg/kg	0.3	MCERTS	-
4-Methylphenol	mg/kg	0.2	NONE	-
Isophorone	mg/kg	0.2	MCERTS	-
2-Nitrophenol	mg/kg	0.3	NONE	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-
Naphthalene	mg/kg	0.05	MCERTS	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-
4-Chloroaniline	mg/kg	0.1	NONE	-

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Analytical Report Number: 23-22056
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2611534
Sample Reference				WS108
Sample Number				None Supplied
Depth (m)				0.60
Date Sampled				07/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-
Acenaphthylene	mg/kg	0.05	MCERTS	-
Acenaphthene	mg/kg	0.05	MCERTS	-
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-
Dibenzofuran	mg/kg	0.2	MCERTS	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	MCERTS	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-
4-Nitroaniline	mg/kg	0.2	NONE	-
Fluorene	mg/kg	0.05	MCERTS	-
Azobenzene	mg/kg	0.3	NONE	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-
Phenanthrene	mg/kg	0.05	MCERTS	-
Anthracene	mg/kg	0.05	MCERTS	-
Carbazole	mg/kg	0.3	MCERTS	-
Dibutyl phthalate	mg/kg	0.2	NONE	-
Anthraquinone	mg/kg	0.3	NONE	-
Fluoranthene	mg/kg	0.05	MCERTS	-
Pyrene	mg/kg	0.05	MCERTS	-
Butyl benzyl phthalate	mg/kg	0.3	NONE	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-
Chrysene	mg/kg	0.05	MCERTS	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007

Subcontracted Analysis

Explosives	Type	N/A	NONE	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 23-22056
Project / Site name: Hydro

Your Order No: 004306

Lab Sample Number				2611535	2611536
Sample Reference				TP107	WS01
Sample Number				None Supplied	None Supplied
Depth (m)				2.60	0.60
Date Sampled				06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
General Inorganics					
pH (automated)	pH Units	N/A	ISO 17025	8.1	8.5
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0
Total Phenols					
Total Phenols (monohydric)	µg/l	1	ISO 17025	1.9	1.4
Speciated PAHs					
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01
Total PAH					
Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2
Heavy Metals / Metalloids					
Arsenic (dissolved)	µg/l	1	ISO 17025	4	2.4
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	< 0.4	2.3
Copper (dissolved)	µg/l	0.7	ISO 17025	14	5.6
Lead (dissolved)	µg/l	1	ISO 17025	1.7	4.6
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	2.3	2.4
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	9.7	6.7
Monoaromatics & Oxygenates					
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10	< 10
Petroleum Hydrocarbons					
TPH1 (C10 - C40) $_{EH_1D_TOTAL_MS}$	µg/l	10	NONE	< 10	< 10

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Analytical Report Number: 23-22056
Project / Site name: Hydro

Your Order No: 004306

Lab Sample Number				2611535	2611536
Sample Reference				TP107	WS01
Sample Number				None Supplied	None Supplied
Depth (m)				2.60	0.60
Date Sampled				06/03/2023	06/03/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
TPH-CWG - Aliphatic >C5 - C6 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C5 - C7 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 23-22056
Project / Site name: Hydro

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2611519	TP101	None Supplied	0.4	Brown clay and sand with gravel and stones.
2611520	TP101	None Supplied	1	Brown clay.
2611521	TP102	None Supplied	1.7	Brown clay.
2611522	TP104	None Supplied	0.6	Brown clay.
2611523	TP104	None Supplied	2.4	Brown clay.
2611526	TP107	None Supplied	2.6	Brown clay and sand with gravel and vegetation.
2611527	TP108	None Supplied	1.8	Brown clay and sand with stones.
2611528	TP109	None Supplied	2.2	Brown clay and sand with gravel and brick.
2611529	WS101	None Supplied	0.6	Brown clay and sand with gravel and stones.
2611531	WS106	None Supplied	0.4	Brown clay with vegetation and stones.
2611532	WS107	None Supplied	0.3	Brown clay and sand with gravel.
2611533	WS107	None Supplied	0.9	Brown clay with gravel.
2611534	WS108	None Supplied	0.6	Brown clay and sand with gravel and vegetation.

Analytical Report Number : 23-22056
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS

Analytical Report Number : 23-22056
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	ISO 17025
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Explosives to BAE in Soil - Subcon	Explosives analysis in Soil - Subcontracted to BAE Systems.	Subcontracted Analysis - See Attached Subcon Report.		W	NONE
Total cyanide in leachate - 1µg/l	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC

Analytical Report Number : 23-22056
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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Analytical Report Number : 23-22497

Project / Site name:	Hydro	**Samples received on:**	08/03/2023
Your job number:	16-658	**Samples instructed on/ Analysis started on:**	14/03/2023
Your order number:	004306	**Analysis completed by:**	17/03/2023
Report Issue Number:	1	**Report issued on:**	17/03/2023
Samples Analysed:	1 soil sample		

Signed:

Elżbieta Suchy
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-22497
Project / Site name: Hydro
Your Order No: 004306

Lab Sample Number				2614046
Sample Reference				WS104
Sample Number				None Supplied
Depth (m)				0.80
Date Sampled				07/03/2023
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	18
Total mass of sample received	kg	0.001	NONE	0.9

PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	< 0.001

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	< 0.007

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 23-22497
Project / Site name: Hydro

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2614046	WS104	None Supplied	0.8	Brown clay and sand with gravel.

Analytical Report Number : 23-22497
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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Analytical Report Number : 23-37253

Project / Site name:	Hydro Aluminium	**Samples received on:**	02/06/2023
Your job number:	16-685	**Samples instructed on/ Analysis started on:**	02/06/2023
Your order number:	4394	**Analysis completed by:**	09/06/2023
Report Issue Number:	1	**Report issued on:**	09/06/2023
Samples Analysed:	5 water samples		

Signed:

Dominika Warjan
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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Analytical Report Number: 23-37253
Project / Site name: Hydro Aluminium

Your Order No: 4394

Lab Sample Number				2700509	2700510	2700511	2700787	2700788
Sample Reference				WS101	WS102	WS107	BROOK UPSTREAM	BROOK DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH (L005B)	pH Units	N/A	ISO 17025	7.6	7.5	7.4	7.8	7.8
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	4.8	3.25	2.27	5.7	4.66
Total Phenols								
Total Phenols (monohydric)	µg/l	1	ISO 17025	1.5	1.1	1.2	1.2	< 1.0
Heavy Metals / Metalloids								
Calcium (dissolved)	mg/l	0.012	ISO 17025	92	67	200	46	52
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.43	0.46	0.58	2.07	1.8
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.03	0.02	0.05	0.02	0.06
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.3	0.4	0.3	< 0.2	0.5
Copper (dissolved)	µg/l	0.5	ISO 17025	5.9	3.5	2.3	2.1	2.3
Lead (dissolved)	µg/l	0.2	ISO 17025	0.4	0.2	< 0.2	0.6	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	32	43	58	170	0.66
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.9	1.4	3.1	1.6	0.7
Selenium (dissolved)	µg/l	0.6	ISO 17025	4.8	2.3	5.8	< 0.6	< 0.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	4.6	3.8	4.9	12	11
Monoaromatics & Oxygenates								
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Petroleum Hydrocarbons								
TPH1 (C10 - C40) $_{EH_1D_TOTAL_MS}$	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C5 - C6 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0#	< 1.0
TPH-CWG - Aliphatic >C6 - C8 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0#	< 1.0
TPH-CWG - Aliphatic >C8 - C10 $_{HS_1D_AL}$	µg/l	1	ISO 17025	< 1.0	< 1.0##	< 1.0##	< 1.0#	< 1.0##
TPH-CWG - Aliphatic >C10 - C12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 $_{HS_1D_AR}$	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

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Analytical Report Number: 23-37253
Project / Site name: Hydro Aluminium

Your Order No: 4394

Lab Sample Number				2700509	2700510	2700511	2700787	2700788
Sample Reference				WS101	WS102	WS107	BROOK UPSTREAM	BROOK DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/l	3	ISO 17025	< 3.0^	< 3.0##	< 3.0##	< 3.0##	< 3.0##
Chloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Bromomethane	µg/l	3	ISO 17025	< 3.0^	< 3.0##	< 3.0##	< 3.0##	< 3.0##
Vinyl Chloride	µg/l	3	NONE	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Trichlorofluoromethane	µg/l	3	NONE	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
Cis-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
2,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Trichloromethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	40.6	< 3.0
1,1,1-Trichloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloropropene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloromethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
Trichloroethene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Dibromomethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Bromodichloromethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Cis-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0^	< 3.0##	< 3.0##	< 3.0##	< 3.0##
Toluene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2-Trichloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,3-Dichloropropane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Dibromochloromethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloroethene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromoethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Chlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1,1,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
p & m-Xylene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Styrene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Tribromomethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
o-Xylene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Isopropylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Bromobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
n-Propylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
2-Chlorotoluene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
4-Chlorotoluene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,3,5-Trimethylbenzene	µg/l	3	NONE	< 3.0^	< 3.0#	< 3.0#	< 3.0#	< 3.0#
tert-Butylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trimethylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
sec-Butylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
1,3-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
p-Isopropyltoluene	µg/l	3	NONE	< 3.0^	< 3.0#	< 3.0#	< 3.0#	< 3.0^
1,2-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,4-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0

Analytical Report Number: 23-37253
Project / Site name: Hydro Aluminium

Your Order No: 4394

Lab Sample Number				2700509	2700510	2700511	2700787	2700788
Sample Reference				WS101	WS102	WS107	BROOK UPSTREAM	BROOK DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Butylbenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
1,2-Dibromo-3-chloropropane	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
Hexachlorobutadiene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0##
1,2,3-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0^	< 3.0	< 3.0	< 3.0	< 3.0
SVOCs								
Aniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-37253
Project / Site name: Hydro Aluminium

Your Order No: 4394

Lab Sample Number				2700509	2700510	2700511	2700787	2700788
Sample Reference				WS101	WS102	WS107	BROOK UPSTREAM	BROOK DOWNSTREAM
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 23-37253
Project / Site name: Hydro Aluminium

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 23-37253
Project / Site name: Hydro Aluminium

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	ISO 17025

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

#Data reported unaccredited due to quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and therefore may be compromised.
##Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.
^ Data reported unaccredited due to quality control parameter failure associated with this result; The result should be considered as being deviating and may be compromised.

Sample Deviation Report

Analytical Report Number : 23-37253

Project / Site name: Hydro Aluminium

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis.Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
BROOK DOWNSTREAM	None Supplied	W	2700788	c	pH at 20oC in water (automated)	L099-PL	c
BROOK UPSTREAM	None Supplied	W	2700787	c	pH at 20oC in water (automated)	L099-PL	c
WS101	None Supplied	W	2700509	c	pH at 20oC in water (automated)	L099-PL	c
WS102	None Supplied	W	2700510	c	pH at 20oC in water (automated)	L099-PL	c
WS107	None Supplied	W	2700511	c	pH at 20oC in water (automated)	L099-PL	c

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Analytical Report Number : 23-23287

Project / Site name:	Hydro	**Samples received on:**	16/03/2023
Your job number:	16685	**Samples instructed on/ Analysis started on:**	16/03/2023
Your order number:	004394	**Analysis completed by:**	23/03/2023
Report Issue Number:	1	**Report issued on:**	23/03/2023
Samples Analysed:	4 water samples		

Signed:

Joanna Wawrzeczko
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 23-23287
Project / Site name: Hydro

Your Order No: 004394

Lab Sample Number				2619193	2619194	2619195	2619196
Sample Reference				WS101	WS102	WS107	Downstream
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				16/03/2023	16/03/2023	16/03/2023	16/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
General Inorganics							
pH (L005B)	pH Units	N/A	ISO 17025	7.7	7.9	7.5	8
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	10.7	4.07	3.03	9.58
Total Phenols							
Total Phenols (monohydric)	µg/l	10	ISO 17025	140	120	98	84
Heavy Metals / Metalloids							
Calcium (dissolved)	mg/l	0.012	ISO 17025	120	110	260	100
Chromium (hexavalent)	µg/l	5	ISO 17025	U/S	U/S	< 5.0	U/S
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.42	0.49	0.38	1.07
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.07	0.04	0.12	0.42
Chromium (dissolved)	µg/l	0.2	ISO 17025	1.4	4	0.8	0.6
Copper (dissolved)	µg/l	0.5	ISO 17025	7.8	4.2	3.4	6.5
Lead (dissolved)	µg/l	0.2	ISO 17025	0.7	< 0.2	0.3	0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	34	12	140	55
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	3.2	1.4	3.9	1.5
Selenium (dissolved)	µg/l	0.6	ISO 17025	23	16	4.7	0.7
Zinc (dissolved)	µg/l	0.5	ISO 17025	7.3	5.2	6.4	140
Monoaromatics & Oxygenates							
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p & m-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
o-xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Petroleum Hydrocarbons #							
TPH1 (C10 - C40) $_{EH_1D_TOTAL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C5 - C6 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 $_{HS_1D_AL}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 $_{EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) $_{HS+EH_1D_AL_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 $_{HS_1D_AR}$	µg/l	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 $_{EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) $_{HS+EH_1D_AR_MS}$	µg/l	10	NONE	< 10	< 10	< 10	< 10

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Analytical Report Number: 23-23287
Project / Site name: Hydro

Your Order No: 004394

Lab Sample Number				2619193	2619194	2619195	2619196
Sample Reference				WS101	WS102	WS107	Downstream
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				16/03/2023	16/03/2023	16/03/2023	16/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
VOCs							
Chloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Chloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Vinyl Chloride	µg/l	3	NONE	< 3.0	< 3.0	< 3.0	< 3.0
Trichlorofluoromethane	µg/l	3	NONE	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Cis-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
2,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trichloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,1-Trichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1-Dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,2-dichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Benzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trichloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Dibromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromodichloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Cis-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Trans-1,3-dichloropropene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Toluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2-Trichloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3-Dichloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Dibromochloromethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tetrachloroethene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromoethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Chlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,1,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Ethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p & m-Xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Styrene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Tribromomethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
o-Xylene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,1,2,2-Tetrachloroethane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Isopropylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Bromobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
n-Propylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
2-Chlorotoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
4-Chlorotoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3,5-Trimethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
tert-Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trimethylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
sec-Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,3-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
p-Isopropyltoluene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,4-Dichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0

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Analytical Report Number: 23-23287
Project / Site name: Hydro

Your Order No: 004394

Lab Sample Number				2619193	2619194	2619195	2619196
Sample Reference				WS101	WS102	WS107	Downstream
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				16/03/2023	16/03/2023	16/03/2023	16/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Butylbenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromo-3-chloropropane	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,4-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
Hexachlorobutadiene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
1,2,3-Trichlorobenzene	µg/l	3	ISO 17025	< 3.0	< 3.0	< 3.0	< 3.0
SVOCs							
Aniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01

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Analytical Report Number: 23-23287
Project / Site name: Hydro

Your Order No: 004394

Lab Sample Number				2619193	2619194	2619195	2619196
Sample Reference				WS101	WS102	WS107	Downstream
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				16/03/2023	16/03/2023	16/03/2023	16/03/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	< 0.10	< 0.10	< 0.10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 23-23287
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025

Analytical Report Number : 23-23287
Project / Site name: Hydro

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	ISO 17025

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Data reported unaccredited due to quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and therefore may be compromised.

BAE Systems
Properties Ltd
10-11 Adlington South
Business Park
Adlington
Lancashire
PR7 4JR, England
Telephone: 03300 488680

TEST CERTIFICATE

Certificate No: BC0016/23

Site : **i2 Analytical: Project 23-22056** **Ref :** **43X10485**

Client :	I2 Analytical	**Date Received :**	15/03/2023
Address :	7 Woodshots Meadow Croxley Green Business Park Watford	**Date Completed :**	21/03/2023
		Date Of Report :	21/03/2023
	WD18 8YS	**Attention :**	Project Manager

Accreditation Key: **U** = UKAS **M** = UKAS & MCERTS **S** = Subcontracted Tests

Test Methods

Standard Explosives Suite	using ESAL/QC/4 parts a, j, k, HPLCsoils, NC by l or m

Approved :



Mr D.C. Poole
Laboratory manager

Mr P.D. Hart
Senior Analyst

1764

BAE SYSTEMS

TABLE OF RESULTS

Lab Code	20230264			20230265			20230266		
Client Ref A	2611524			2611525			2611530		
Client Ref B	TP105 0.3m			TP107 0.5m			WS102 0.5m		
Client Ref C	06/03/23			06/03/23			06/03/23		
Sample Type	Soil			Soil			Soil		
Soil Type	Clay - Brown			Made Ground (>50% Clay)			Clay - Brown		
NC Colour	**-ve**		U	**-ve**		U	**-ve**		U
NC Colourimetric	**<5000**	**mg/kg**	U	**<5000**	**mg/kg**	U	**<5000**	**mg/kg**	U
HMX	**<2**	**mg/kg**	M	**<2**	**mg/kg**	M	**<2**	**mg/kg**	M
RDX	**<2**	**mg/kg**	M	**<2**	**mg/kg**	M	**<2**	**mg/kg**	M
EGDN	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M
Tetryl	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M
NG	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M
TNT	**<0.1**	**mg/kg**	M	**<0.1**	**mg/kg**	M	**<0.1**	**mg/kg**	M
2,6-DNT	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M
2,4-DNT	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M	**<1**	**mg/kg**	M
PETN	**<5**	**mg/kg**	M	**<5**	**mg/kg**	M	**<5**	**mg/kg**	M
HNS	**<0.5**	**mg/kg**	M	**<0.5**	**mg/kg**	M	**<0.5**	**mg/kg**	M
Picrite	**<0.25**	**mg/kg**	M	**<0.25**	**mg/kg**	M	**<0.25**	**mg/kg**	M
Picric Acid	**<0.1**	**mg/kg**	M	**<0.1**	**mg/kg**	M	**<0.1**	**mg/kg**	M

COMMENTS AND DEPARTURES FROM STANDARD PROCEDURES

Lab ID	Client Descriptions	Notes

There were no comments or departures from standard procedures

NOTES

1. This test report shall not be reproduced except in full, without written approval of the laboratory.

2. All results for soil samples are reported based on dry weight of soil which has been air-dried in open, shallow trays at temperatures below 30°C and subsequently ground and sieved to pass through a nominal 710µm aperture sieve. Prior to grinding, any material which is retained on a sieve of mesh size 4.5mm is discarded. Analysis is carried out directly on these prepared soils with the exception of petrol range organic compounds. These analyses are carried out on the soil "As Received" and corrected for the dry weight (at 105 °C) prior to reporting.

3. BAE Systems does not correct results for analytical recoveries.

4. All samples were received in good condition unless otherwise stated. Results provided by the Laboratory are based on samples submitted by clients.The Laboratory cannot be held responsible for the storage, condition or preservation of samples prior to arrival.

5. Validation studies indicate that the concentration of nitrocellulose in high organic content soils may be overestimated.

6. Results stated in this test report relate only to the samples tested.

7. Soil descriptions are given in order to provide a log of sample matrices submitted and are not intended as full geological descriptions.

8. The initials or common names used for reporting explosives relate to the following compounds: Nitrocellulose(NC); Cyclotetramethylene Tetranitramine (HMX); Cyclo-1,3,5-Trimethylene-2,4,6-Trinitramine (RDX); Ethylene Glycol Dinitrate (EGDN); 2,4,6-Trinitro-Phenylmethyl Nitramine (Tetryl); Glycerol Trinitrate (NG); 2,4,6-Trinitrotoluene (TNT); Pentaeryhritol Tetranitrate (PETN); Hexanitro-Stilbene (HNS); Nitroguanidine (Picrite); 2,4,6-Trinitro Phenol (Picric Acid); 2,4-Dinitrotoluene (2,4-DNT); 2,6-Dinitrotoluene (2,6-DNT), 2-Amino-4,6-Dinitrotoluene (2-Amino-4,6-DNT), 4-Amino-4,6-Dinitrotoluene (4-Amino-2,6-DNT).

9. Some reporting limits may be raised due to poor recovery of internal standard or dilution of highly contaminated samples.

10. In unacidified waters Tetryl, 1,3,5-TNB, 1,3-DNB and TNT are unstable decaying rapidly over a few days or less depending on the sample matrix. 2-Amino-4,6-DNT, 2,6-DNT and 2,4-DNT are generally more stable depending on the sample matrix, but are likely to show significant loss after three weeks. HMX, RDX, EGDN, PETN, NB, MNT isomers, 4-Amino-2,6-DNT, Picrite and Picric acid are relatively stable after three weeks in unpreserved water samples. These comments are based on laboratory in house trials in surface and ground waters and results from literature searches.

11. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

End of Report BC0016/23

APPENDIX VII
ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	PROVISIONAL C4SL
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene [iii]	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C_5-C_6 (aliphatic)	
TPH C_6-C_8 (aliphatic)	
TPH C_8-C_{10} (aliphatic)	
TPH C_{10}-C_{12} (aliphatic)	
TPH C_{12}-C_{16} (aromatic)	
TPH C_{16}-C_{21} (aromatic)	
TPH C_{21}-C_{35} (aromatic)	

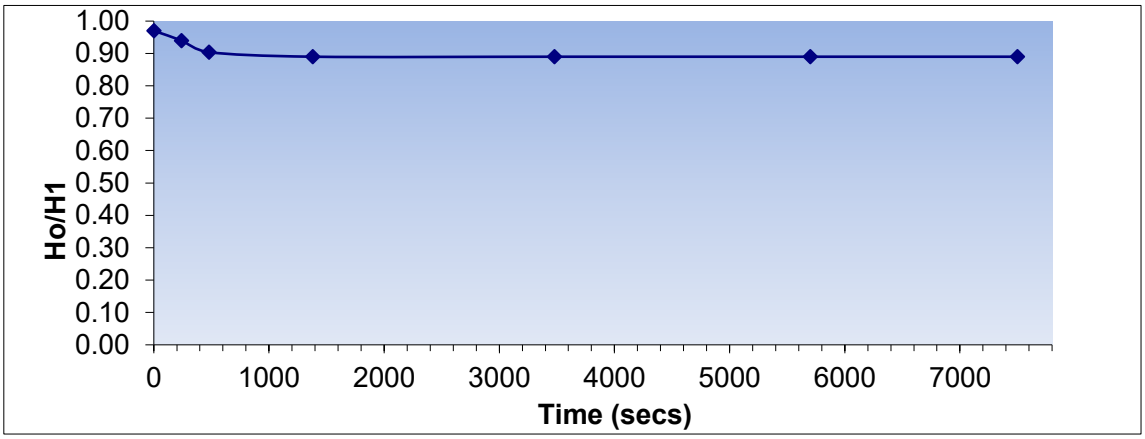
APPENDIX VIII
FALLING HEAD PERMEABILITY TEST CERTIFICATES

Falling Head Test

Borehole: WS101 **Test No:** 1

Contract No:	16-685	Casing Diameter: (m)	0.05
Contract Title:	Hydro Aluminium Deeside	Height of Casing:	0
Date of Test:	04/04/2023	Depth of Borehole: (m)	5.00

Recorded Time			Total Time			H/Ho
Hours	Minutes	Seconds	(secs)	Depth (m)		
0	0		0	0.15	0	0.9700
0	4		240	0.3	240	0.9400
0	8		480	0.48	480	0.9040
0	23		1380	0.55	1380	0.8900
0	58		3480	0.55	3480	0.8900
0	95		5700	0.55	5700	0.8900
0	125		7500	0.55	7500	0.8900



General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

k = permeability of soil

F = Intake Factor (figures 6 &7, BS5930:1999)

H_1 = variable head measured at time t_1 after commencement of test

H_2 = variable head measured at time t_2 after commencement of test

A = Cross sectional area of borehole casing or standpipe as appropiate.

H_1 =	0.3	t_1 =	240
H_2 =	0.55	t_2 =	7500
		F=	3.94

A = 0.00196349 m^2

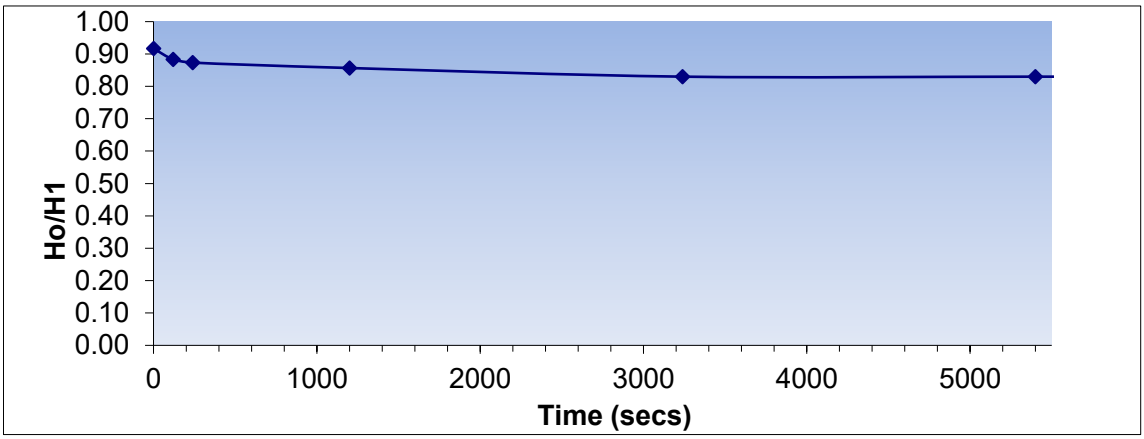
Coefficient of Permeability, k = **1.02E-07** m/s

Falling Head Test

Borehole: WS102 **Test No:** 1

Contract No:	16-685	Casing Diameter: (m)	0.05
Contract Title:	Hydro Aluminium Deeside	Height of Casing:	0
Date of Test:	04/04/2023	Depth of Borehole: (m)	3.00

Recorded Time			Total Time			H/Ho
Hours	Minutes	Seconds	(secs)	Depth (m)		
0	0		0	0.25	0	0.9167
0	2		120	0.35	120	0.8833
0	4		240	0.38	240	0.8733
0	20		1200	0.43	1200	0.8567
0	54		3240	0.51	3240	0.8300
0	90		5400	0.51	5400	0.8300
0	120		7200	0.51	7200	0.8300



General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

k = permeability of soil

F = Intake Factor (figures 6 &7, BS5930:1999)

H_1 = variable head measured at time t_1 after commencement of test

H_2 = variable head measured at time t_2 after commencement of test

A = Cross sectional area of borehole casing or standpipe as appropiate.

H_1 =	0.35	t_1 =	120
H_2 =	0.51	t_2 =	7200
		F=	2.87

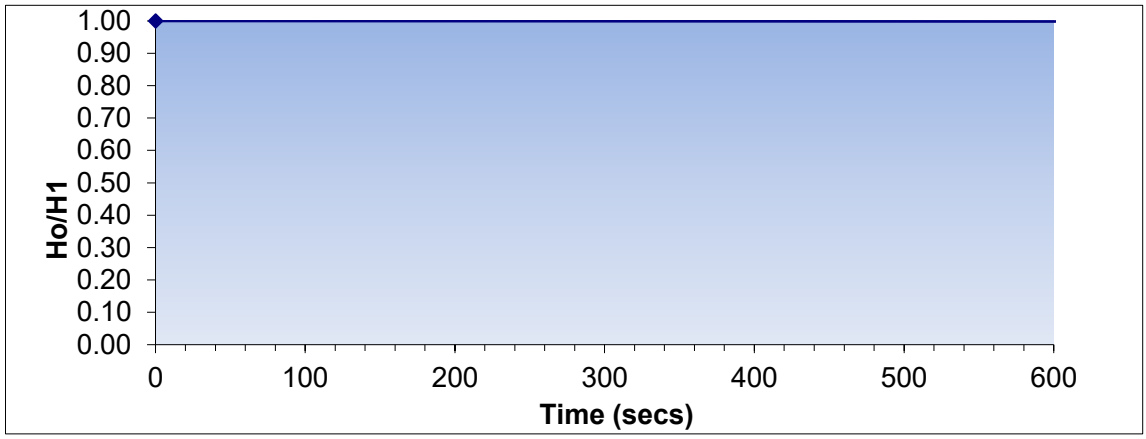
A = 0.00196349 m^2

Coefficient of Permeability, k = **1.8E-07** m/s

Falling Head Test Borehole: WS107 Test No: 1

Contract No:	16-685	Casing Diameter: (m)	0.05
Contract Title:	Hydro Aluminium Deeside	Height of Casing:	0
Date of Test:	04/04/2023	Depth of Borehole: (m)	2.00

Recorded Time			Total Time			H/Ho
Hours	Minutes	Seconds	(secs)	Depth (m)		
0	0		0	0	0	1.0000
0	30		1800	0.01	1800	0.9950
0	60		3600	0.02	3600	0.9900
0	90		5400	0.02	5400	0.9900
0						
0						
0						
0						
0						
0						
0						
0						
0						



General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

k = permeability of soil

F = Intake Factor (figures 6 &7, BS5930:1999)

H_1 = variable head measured at time t_1 after commencement of test

H_2 = variable head measured at time t_2 after commencement of test

A = Cross sectional area of borehole casing or standpipe as appropiate.

H_1 =	0.01	t_1 =	1800
H_2 =	0.02	t_2 =	5400
		F=	1.7

A = 0.00196349 m^2

Coefficient of Permeability, k = **4.36E-07** m/s

APPENDIX IX
GEOTECHNICAL TESTING CERTIFICATES

LABORATORY REPORT

Contract Number: PSL23/2248

Report Date: 10 May 2023

Client's Reference: 16-685

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Jonny Beer

Contract Title: Hydro

Date Received: 31/3/2023
Date Commenced: 31/3/2023
Date Completed: 10/5/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

L Knight
(Assistant Laboratory Manager)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

A Watkins
(Managing Director)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP104		B	0.80		Brown gravelly sandy CLAY.
WS102		D	1.00		Brown slightly gravelly sandy CLAY.
WS102		U	1.50	2.00	Brown slightly sandy CLAY.
WS105		D	2.00		Brown slightly sandy CLAY.
WS105		U	3.50	4.00	Very stiff brown slightly gravelly slightly sandy CLAY.
WS107		D	1.00		Brown slightly gravelly slightly sandy CLAY.
WS107		U	1.50	2.00	Stiff brown slightly gravelly slightly sandy CLAY.
WS107		D	2.00		Brown slightly gravelly sandy CLAY.
CP102		U	6.50		Soft brown slightly gravelly sandy CLAY.
CP103		D	1.00		Brown slightly gravelly slightly sandy CLAY.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
WS102		D	1.00		21			45	23	22	98	Intermediate Plasticity CI
WS105		D	2.00		22			56	25	31	100	High Plasticity CH
WS107		D	1.00		20			52	24	28	96	High Plasticity CH
WS107		D	2.00		17			41	21	20	97	Intermediate Plasticity CI
CP103		D	1.00		51			51	24	27	99	High Plasticity CH

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Hydro

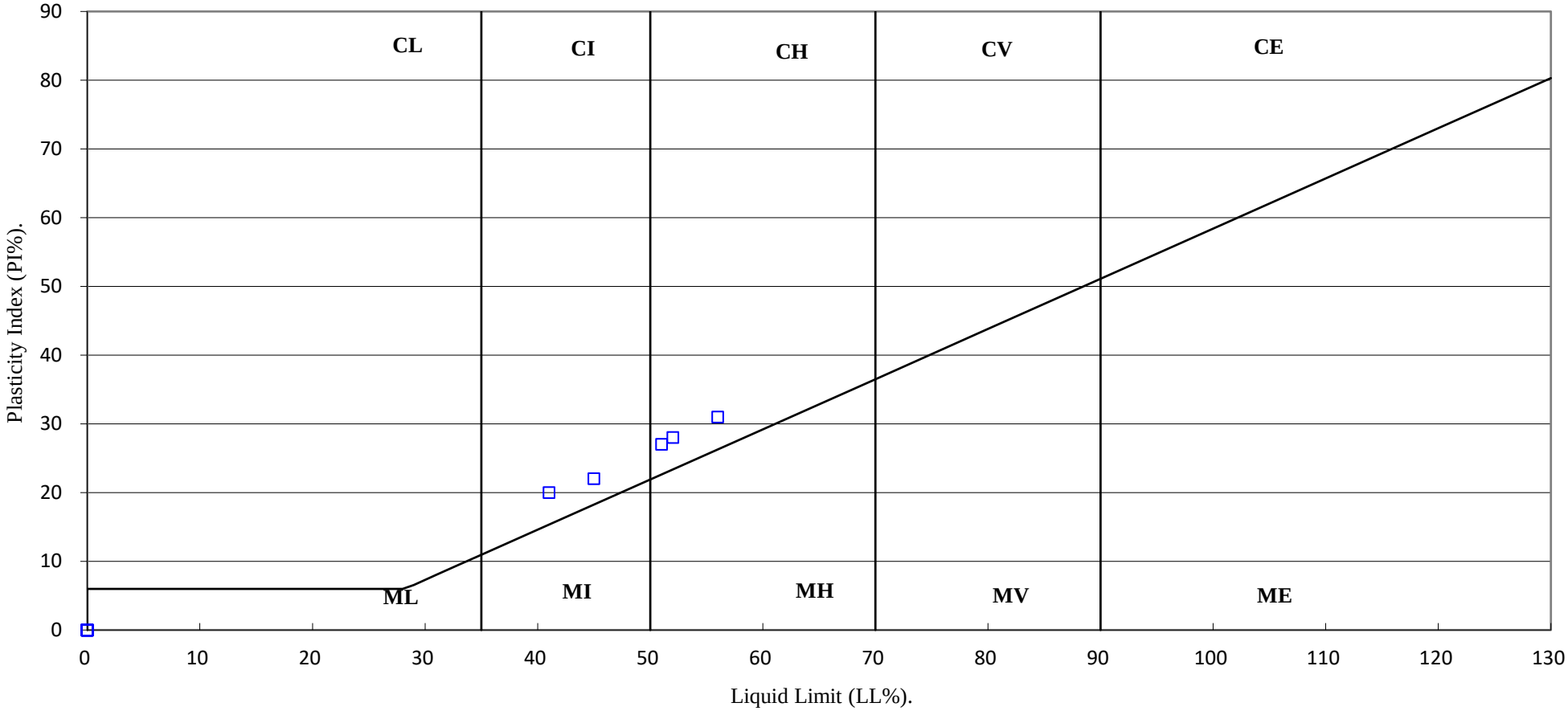
Contract No:

PSL23/2248

Client Ref:

16-685

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043 / PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Hydro**	**Contract No:**
		PSL23/2248
		Client Ref:
		16-685

PARTICLE SIZE DISTRIBUTION TEST

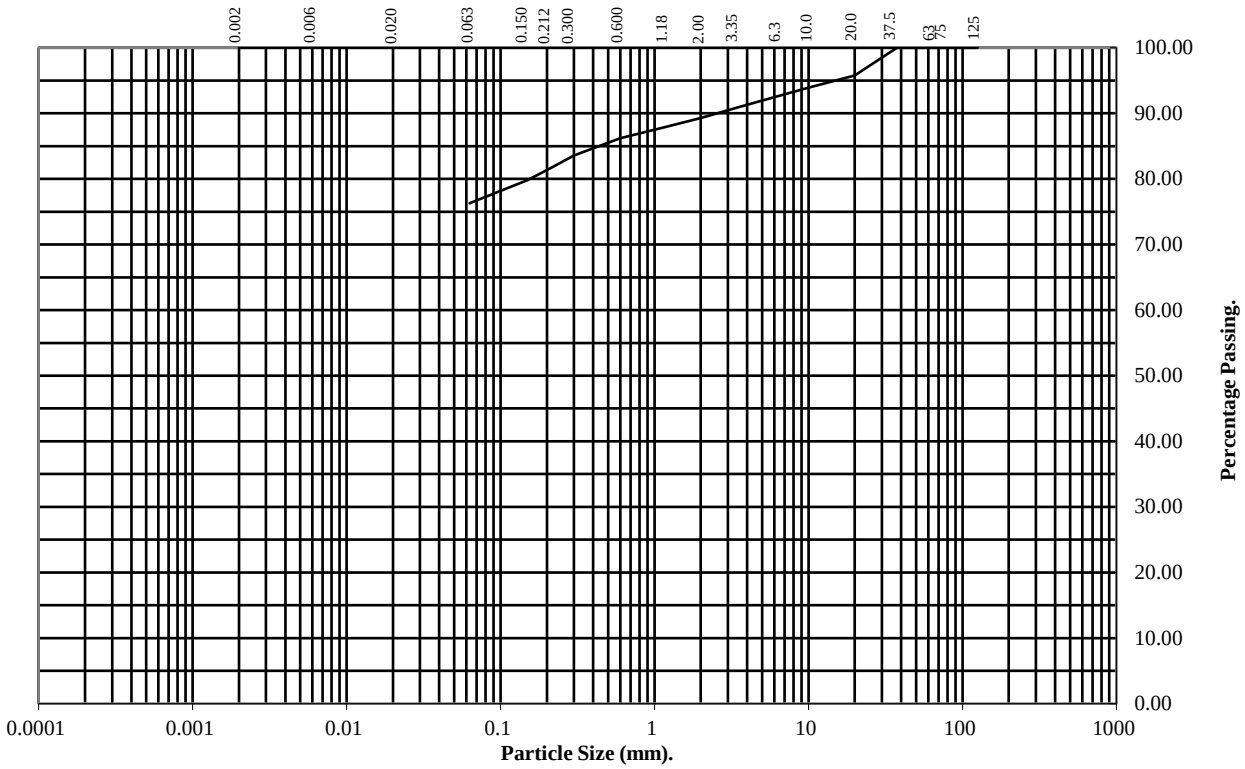
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP104** **Top Depth (m):** **0.80**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	96
10	94
6.3	93
3.35	91
2	89
1.18	88
0.6	86
0.3	84
0.212	82
0.15	80
0.063	76

Soil Fraction	Total Percentage
Cobbles	0
Gravel	11
Sand	13
Silt/Clay	76

Remarks:
See Summary of Soil Descriptions

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

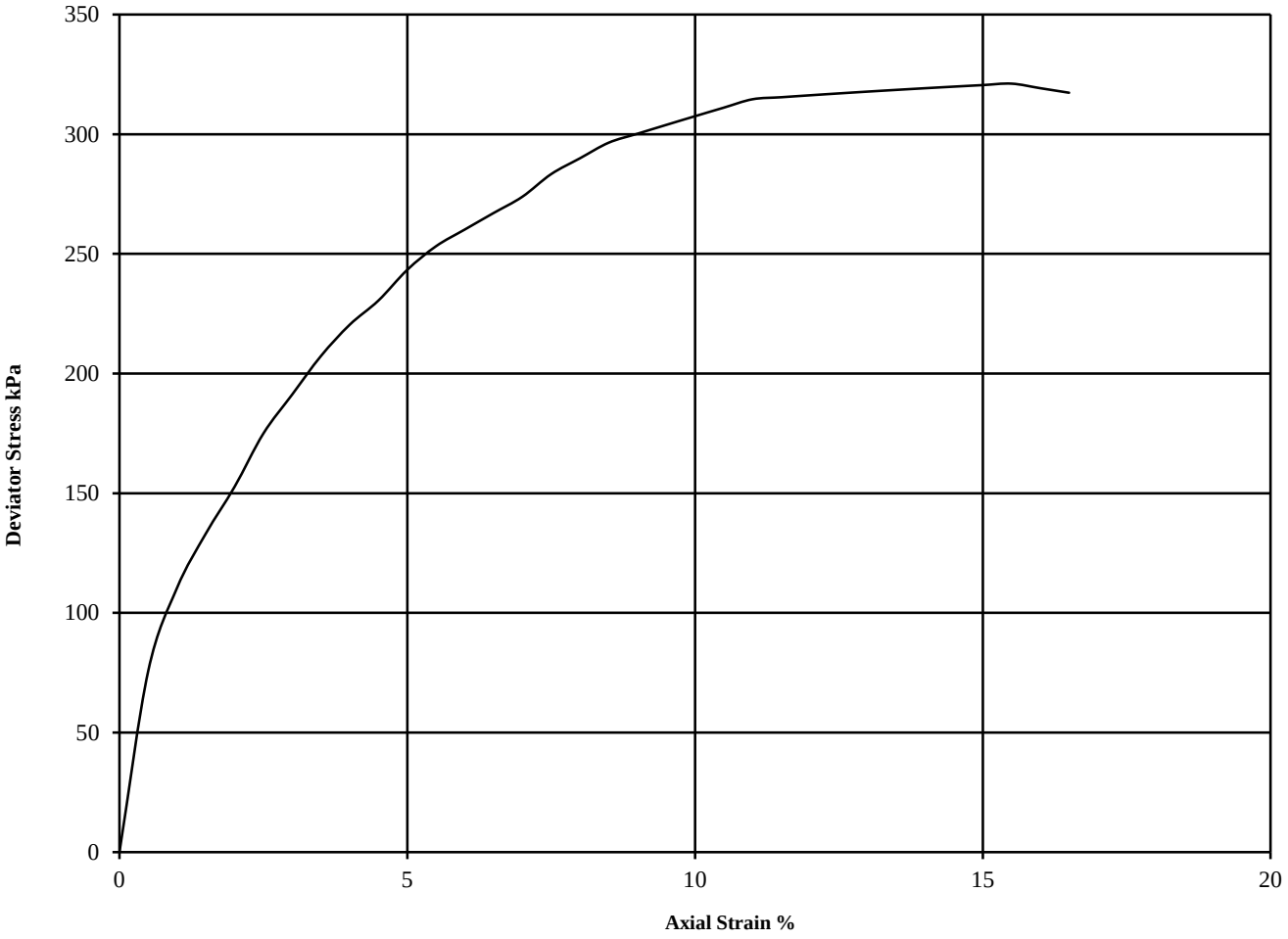
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **WS105** **Top Depth (m):** **3.50**

Sample Number: **Base Depth (m):** **4.00**

Sample Type **U**



Diameter (mm):		60	Height (mm):		120	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.55
1	20	2.09	1.73	75	321	161	15.5	Intermediate	See summary of soil descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Hydro

Contract No: **PSL23/2248**

Client Ref: **16-685**

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

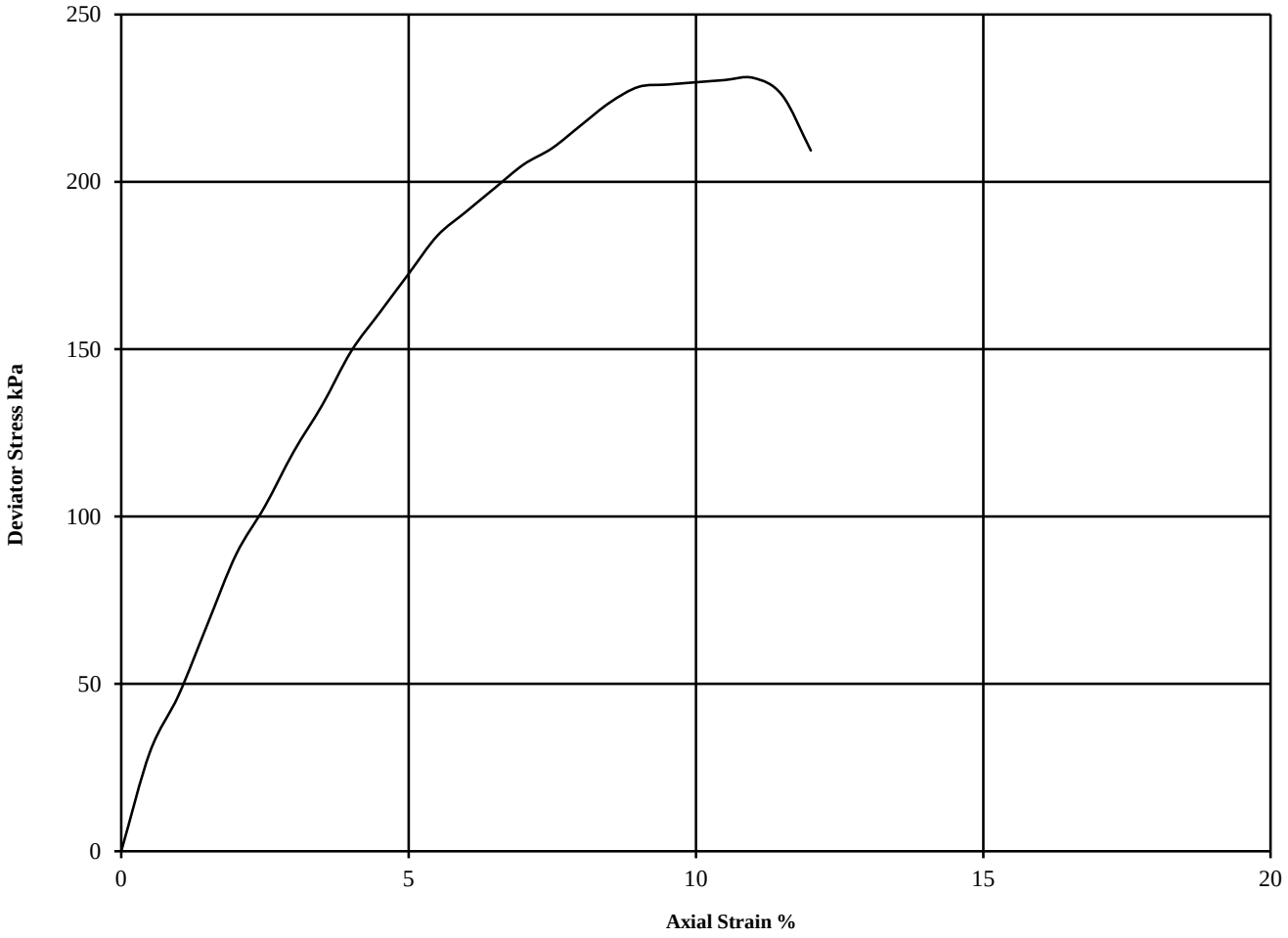
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **WS107** **Top Depth (m):** **1.50**

Sample Number: **Base Depth (m):** **2.00**

Sample Type **U**



Diameter (mm):		70	Height (mm):		140	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.50
1	21	2.10	1.74	35	231	116	11.0	Brittle	See summary of soil descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Hydro

Contract No: **PSL23/2248**

Client Ref: **16-685**

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

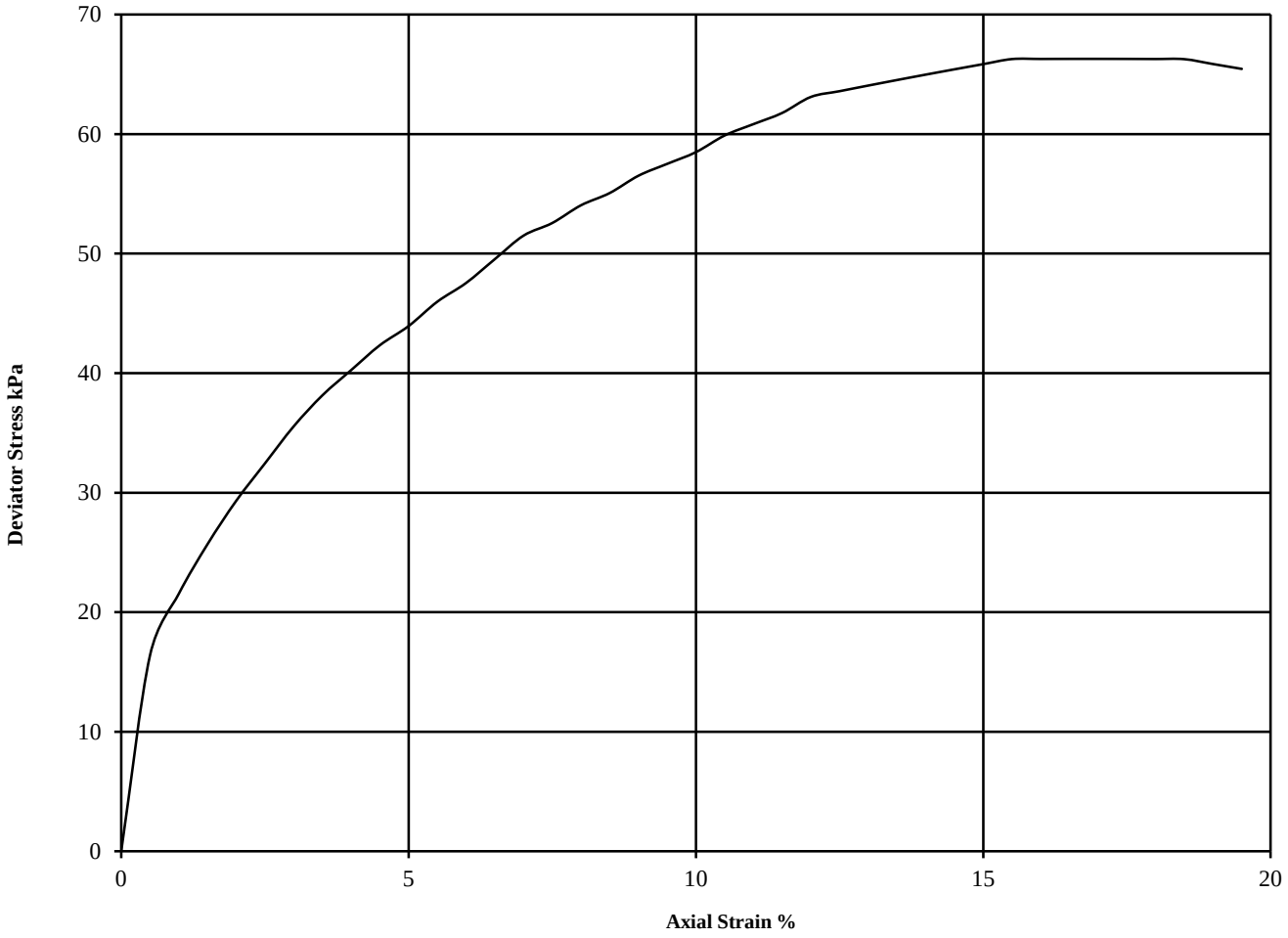
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: CP102 **Top Depth (m):** 6.50

Sample Number: **Base Depth (m):**

Sample Type U



Diameter (mm):		103	Height (mm):		206	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.34
1	25	2.04	1.63	135	66	33	17.0	Plastic	See summary of soil descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Hydro

Contract No: PSL23/2248

Client Ref: 16-685

ONE DIMENSIONAL CONSOLIDATION TEST

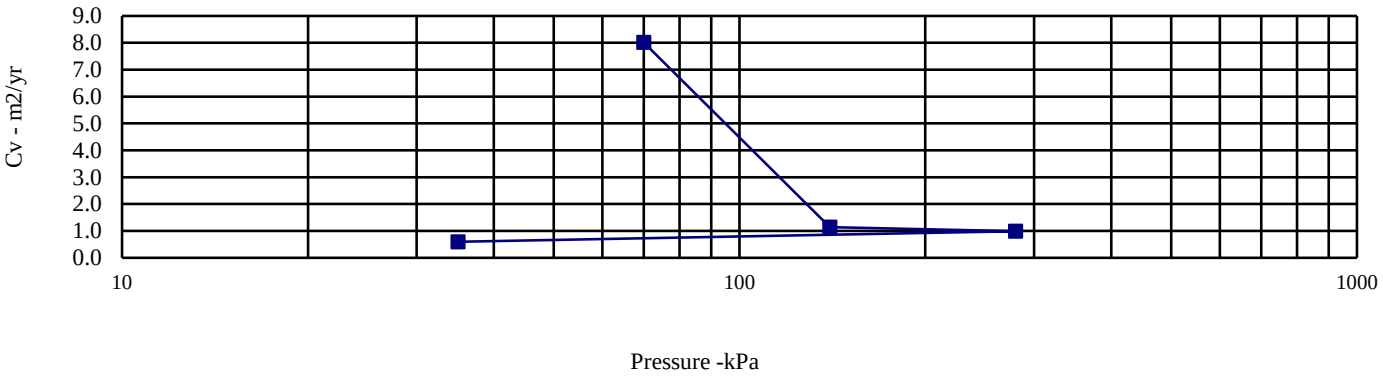
BS 1377: Part 5: 1990: Clause 3

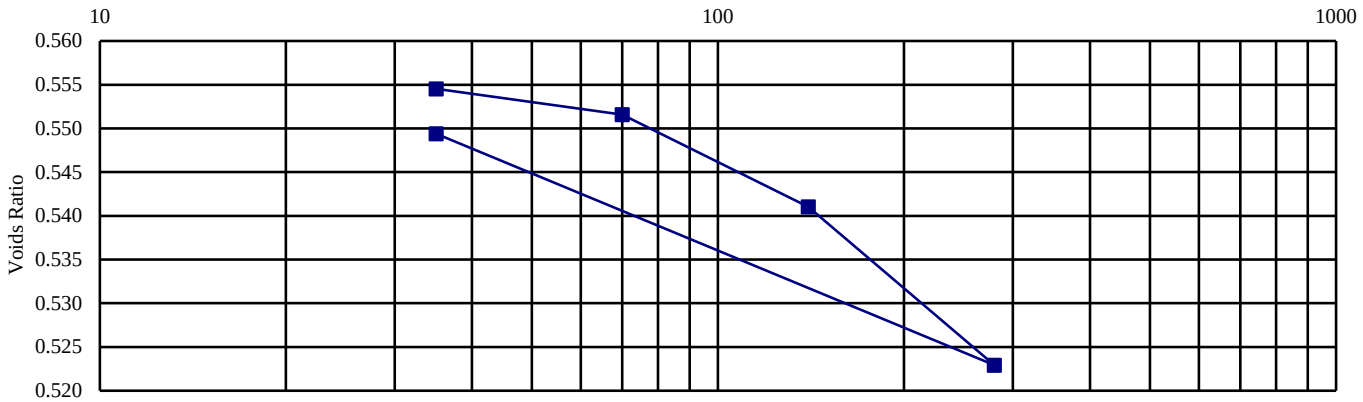
Hole Number: **WS102** **Top Depth (m):** **1.50**

Sample Number: **Base Depth (m) :** **2.00**

Sample Type: **U**

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	22						
Bulk Density (Mg/m3):	2.07	0	35	Swelling	Swelling	Method used to determine CV:	T90
Dry Density (Mg/m3):	1.70	35	70	0.054	8.012		
Voids Ratio:	0.561	70	140	0.097	1.146	Nominal temperature during test ' C:	20
Degree of saturation:	104.8	140	280	0.084	0.991		
Height (mm):	20.004	280	35	0.071	0.598	Remarks: See summary of soil descriptions	
Diameter (mm)	75.028						
Particle Density (Mg/m3): Assumed	2.65						





UKAS TESTING 4043	PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Hydro**	**Contract No:** PSL23/2248 **Client Ref:** 16-685

ONE DIMENSIONAL CONSOLIDATION TEST

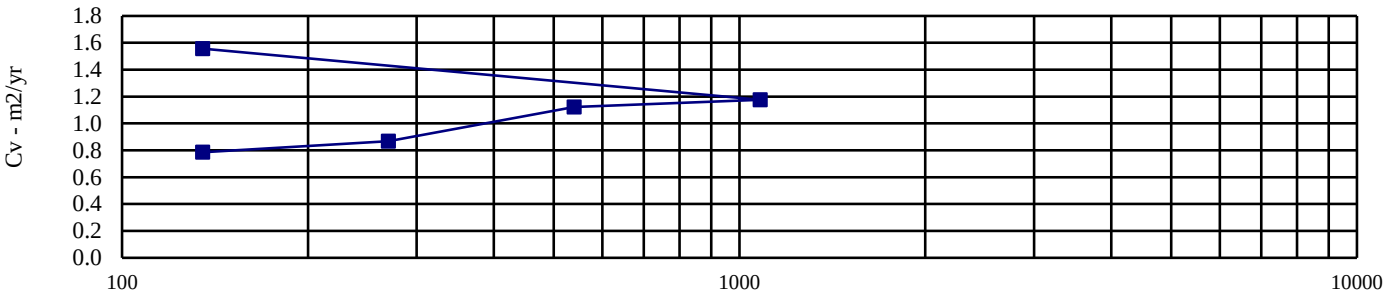
BS 1377: Part 5: 1990: Clause 3

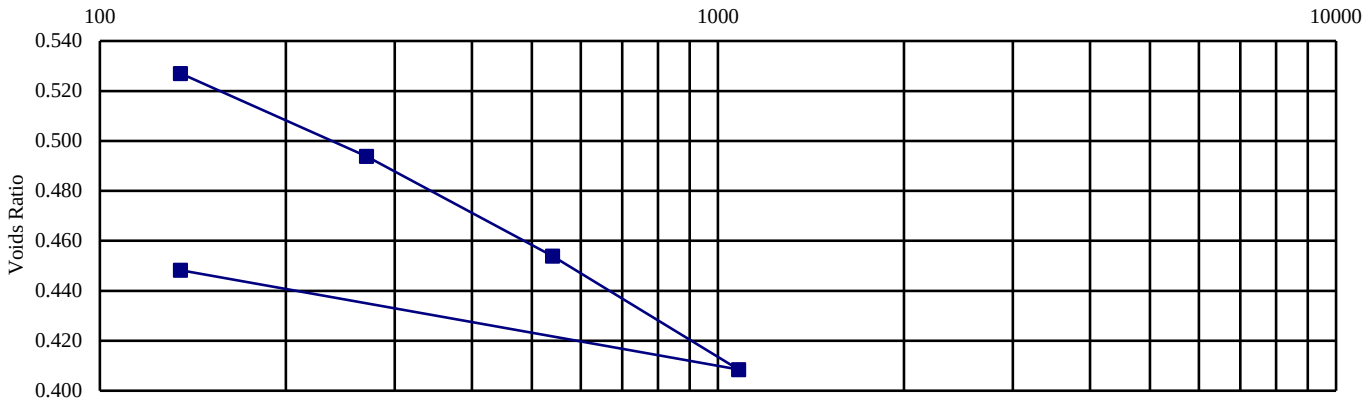
Hole Number: **CP102** **Top Depth (m):** **6.50**

Sample Number: **Base Depth (m) :**

Sample Type: **U**

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	24						
Bulk Density (Mg/m3):	2.03	0	135	0.448	0.786	Method used to determine CV:	T90
Dry Density (Mg/m3):	1.63	135	270	0.161	0.868		
Voids Ratio:	0.625	270	540	0.099	1.123	Nominal temperature during test ' C:	20
Degree of saturation:	102.7	540	1080	0.058	1.176		
Height (mm):	20.018	1080	135	0.030	1.557	Remarks: See summary of soil descriptions	
Diameter (mm)	74.988						
Particle Density (Mg/m3): Assumed	2.65						





UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Hydro

Contract No:
PSL23/2248
Client Ref:

Appendix G Micro Drainage Print Outs

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	2.344	Urban	0.370
SAAR (mm)	785	Region Number	Region 9

Results l/s

QBAR Rural 16.5
QBAR Urban 27.9

Q1 year 24.5

Q1 year	24.5
Q2 years	27.3
Q5 years	34.3
Q10 years	38.9
Q20 years	42.9
Q25 years	44.1
Q30 years	45.0
Q50 years	47.4
Q100 years	51.3
Q200 years	56.2
Q250 years	57.9
Q1000 years	67.8

Warning: It is unusual to use the IH124 method with an area < 50ha. The Interim Code of Practice recommends that the IH124 method is applied with 50ha and the resulting discharge is linearly interpolated for the required area. The ICP SUDS tab will do this automatically.

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.332	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	200	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	10.000	0.050	200.0	0.867	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.001	10.000	0.050	200.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	44.46	5.13	30.500	0.867	0.0	0.0	0.0	1.28	141.1	104.4
1.001	44.00	5.26	30.450	0.867	0.0	0.0	0.0	1.28	141.1	104.4

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.332	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	200	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	10.000	0.050	200.0	0.867	5.00	0.0	0.600	o	525	Pipe/Conduit	
1.001	10.000	0.050	200.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	130.65	5.11	30.500	0.867	0.0	0.0	0.0	1.58	342.1	306.8
1.001	129.71	5.21	30.450	0.867	0.0	0.0	0.0	1.58	342.1	306.8

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.332	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.458	4-8	0.705	8-12	0.032

Total Area Contributing (ha) = 1.194

Total Pipe Volume (m³) = 82.756

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	83.000	0.083	1000.0	0.128	4.00	0.0	0.600	\/	26	Pipe/Conduit	
2.000	28.825	0.192	150.1	0.062	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	40.486	0.162	250.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	23.588	0.094	250.0	0.073	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.61	31.700	0.128	0.0	0.0	0.0	0.86	206.0	0.0
2.000	0.00	4.45	30.925	0.062	0.0	0.0	0.0	1.06	42.3	0.0
1.001	0.00	6.43	30.733	0.190	0.0	0.0	0.0	0.82	32.7	0.0
1.002	0.00	6.83	30.496	0.263	0.0	0.0	0.0	0.99	70.0	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	15.483	0.062	249.7	0.159	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	62.725	0.063	995.6	0.109	4.00	0.0	0.600	\/	26	Pipe/Conduit	
3.001	23.623	0.094	251.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	43.668	0.044	1000.0	0.080	4.00	0.0	0.600	\/	26	Pipe/Conduit	
3.002	3.000	0.016	187.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	16.403	0.033	497.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	48.251	0.193	250.0	0.097	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	46.840	0.187	250.5	0.076	4.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	32.588	0.130	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	51.304	0.205	250.3	0.075	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	45.840	0.183	250.5	0.076	4.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	32.588	0.130	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	51.340	0.209	245.6	0.075	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.003	9.720	0.064	151.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	0.00	7.09	30.402	0.422	0.0	0.0	0.0	0.99	70.0	0.0
3.000	0.00	5.22	31.050	0.109	0.0	0.0	0.0	0.86	206.4	0.0
3.001	0.00	5.61	30.450	0.109	0.0	0.0	0.0	0.99	69.8	0.0
4.000	0.00	4.85	31.200	0.080	0.0	0.0	0.0	0.86	206.0	0.0
3.002	0.00	5.66	30.356	0.189	0.0	0.0	0.0	1.14	80.9	0.0
1.004	0.00	7.48	30.340	0.611	0.0	0.0	0.0	0.70	49.4	0.0
1.005	0.00	8.29	30.307	0.708	0.0	0.0	0.0	0.99	70.0	0.0
5.000	0.00	4.79	30.700	0.076	0.0	0.0	0.0	0.99	69.9	0.0
5.001	0.00	5.34	30.513	0.076	0.0	0.0	0.0	0.99	70.0	0.0
5.002	0.00	6.20	30.383	0.151	0.0	0.0	0.0	0.99	69.9	0.0
6.000	0.00	4.77	30.700	0.076	0.0	0.0	0.0	0.99	69.9	0.0
6.001	0.00	5.32	30.517	0.076	0.0	0.0	0.0	0.99	70.0	0.0
6.002	0.00	6.18	30.387	0.151	0.0	0.0	0.0	1.00	70.6	0.0
5.003	0.00	6.33	30.178	0.302	0.0	0.0	0.0	1.27	90.0	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
7.000	29.479	0.197	149.6	0.014	4.00	0.0	0.600	o	225	Pipe/Conduit	
7.001	11.723	0.078	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	29.386	0.275	106.9	0.100	4.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	12.956	0.086	150.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	19.545	0.078	250.6	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	21.618	0.086	251.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
7.000	0.00	4.46	30.550	0.014	0.0	0.0	0.0	1.07	42.4	0.0
7.001	0.00	4.64	30.353	0.014	0.0	0.0	0.0	1.07	42.4	0.0
8.000	0.00	4.39	30.550	0.100	0.0	0.0	0.0	1.26	50.3	0.0
7.002	0.00	4.85	30.275	0.114	0.0	0.0	0.0	1.06	42.3	0.0
1.006	0.00	8.62	30.114	1.194	0.0	0.0	0.0	0.99	69.9	0.0
1.007	0.00	8.99	30.036	1.194	0.0	0.0	0.0	0.99	69.8	0.0

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Online Controls for Storm

Orifice Manhole: 19, DS/PN: 1.005, Volume (m³): 2.2

Diameter (m) 0.135 Discharge Coefficient 0.600 Invert Level (m) 30.307

Hydro-Brake® Optimum Manhole: 24, DS/PN: 1.007, Volume (m³): 2.7

Unit Reference	MD-SHE-0299-5200-1050-5200
Design Head (m)	1.050
Design Flow (l/s)	52.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	299
Invert Level (m)	30.036
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	52.0
Flush-Flo™	0.458	51.9
Kick-Flo®	0.818	46.1
Mean Flow over Head Range	-	41.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	1.200	55.4	3.000	86.4	7.000	130.6
0.200	30.7	1.400	59.7	3.500	93.1	7.500	135.1
0.300	50.1	1.600	63.7	4.000	99.4	8.000	139.4
0.400	51.7	1.800	67.4	4.500	105.2	8.500	143.6
0.500	51.8	2.000	71.0	5.000	110.8	9.000	147.7
0.600	51.1	2.200	74.3	5.500	116.1	9.500	151.6
0.800	46.8	2.400	77.5	6.000	121.1		
1.000	50.8	2.600	80.6	6.500	125.9		

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Storage Structures for Storm

Tank or Pond Manhole: 19, DS/PN: 1.005

Invert Level (m) 30.307

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	77.0	0.500	77.0	0.501	0.0

Tank or Pond Manhole: 24, DS/PN: 1.007

Invert Level (m) 30.036

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	160.0	0.800	160.0	0.801	0.0

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.341
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	4	15 Winter	1	+0%					31.790
2.000	5	15 Winter	1	+0%					30.993
1.001	7	30 Winter	1	+0%					30.824
1.002	12	30 Winter	1	+0%					30.600
1.003	17	60 Winter	1	+0%					30.550
3.000	14	15 Winter	1	+0%					31.132
3.001	15	120 Winter	1	+0%					30.539
4.000	17	15 Winter	1	+0%					31.268
3.002	16	120 Winter	1	+0%					30.537
1.004	17	120 Winter	1	+0%					30.539
1.005	19	120 Winter	1	+0%					30.524
5.000	12	15 Winter	1	+0%					30.776
5.001	13	15 Winter	1	+0%					30.589
5.002	14	15 Winter	1	+0%					30.484
6.000	15	15 Winter	1	+0%					30.776
6.001	16	15 Winter	1	+0%					30.593
6.002	17	15 Winter	1	+0%					30.487
5.003	18	15 Winter	1	+0%					30.340
7.000	19	15 Winter	1	+0%					30.580

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	4	-0.272	0.000	0.08			15.7	FLOOD RISK*	
2.000	5	-0.157	0.000	0.20			7.8	OK	
1.001	7	-0.134	0.000	0.34			10.6	OK	
1.002	12	-0.196	0.000	0.23			14.5	OK	
1.003	17	-0.152	0.000	0.36			21.4	OK	
3.000	14	-0.280	0.000	0.06			13.4	FLOOD RISK*	
3.001	15	-0.211	0.000	0.04			2.8	OK	
4.000	17	-0.294	0.000	0.05			10.0	FLOOD RISK*	
3.002	16	-0.119	0.000	0.12			6.3	OK	
1.004	17	-0.101	0.000	0.42			14.4	OK	
1.005	19	-0.083	0.000	0.22			14.7	OK	
5.000	12	-0.224	0.000	0.14			9.2	OK	
5.001	13	-0.224	0.000	0.14			9.1	OK	
5.002	14	-0.199	0.000	0.24			15.8	OK	
6.000	15	-0.224	0.000	0.14			9.2	OK	
6.001	16	-0.224	0.000	0.14			9.1	OK	
6.002	17	-0.199	0.000	0.24			15.8	OK	
5.003	18	-0.138	0.000	0.49			30.9	OK	
7.000	19	-0.195	0.000	0.04			1.8	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.001	20	15 Winter	1	+0%					30.392
8.000	21	15 Winter	1	+0%					30.629
7.002	22	15 Winter	1	+0%					30.373
1.006	23	15 Winter	1	+0%					30.316
1.007	24	60 Winter	1	+0%					30.219

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.001	20	-0.186	0.000	0.05			1.8	OK	
8.000	21	-0.146	0.000	0.27			12.6	OK	
7.002	22	-0.127	0.000	0.39			14.1	OK	
1.006	23	-0.098	0.000	0.79			47.7	OK	
1.007	24	-0.117	0.000	0.43			26.6	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.341
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	4	15 Winter	30	+0%					31.851
2.000	5	15 Winter	30	+0%					31.036
1.001	7	30 Winter	30	+0%					30.917
1.002	12	60 Winter	30	+0%	30/30 Winter				30.850
1.003	17	120 Winter	30	+0%	30/15 Summer				30.837
3.000	14	15 Winter	30	+0%					31.188
3.001	15	120 Winter	30	+0%	30/30 Winter				30.824
4.000	17	15 Winter	30	+0%					31.318
3.002	16	120 Winter	30	+0%	30/15 Winter				30.820
1.004	17	120 Winter	30	+0%	30/15 Summer				30.829
1.005	19	120 Winter	30	+0%	30/15 Summer				30.805
5.000	12	15 Winter	30	+0%					30.824
5.001	13	15 Winter	30	+0%					30.653
5.002	14	15 Winter	30	+0%					30.633
6.000	15	15 Winter	30	+0%					30.824
6.001	16	15 Winter	30	+0%					30.655
6.002	17	15 Winter	30	+0%					30.633
5.003	18	15 Winter	30	+0%	30/15 Summer				30.589
7.000	19	15 Winter	30	+0%					30.599

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	4	-0.211	0.000	0.19			38.9	FLOOD RISK*	
2.000	5	-0.114	0.000	0.48			19.0	OK	
1.001	7	-0.041	0.000	0.85			26.4	OK	
1.002	12	0.054	0.000	0.50			31.0	SURCHARGED	
1.003	17	0.135	0.000	0.62			36.8	SURCHARGED	
3.000	14	-0.224	0.000	0.16			33.6	FLOOD RISK*	
3.001	15	0.074	0.000	0.10			6.4	SURCHARGED	
4.000	17	-0.244	0.000	0.13			24.7	FLOOD RISK*	
3.002	16	0.164	0.000	0.26			13.3	SURCHARGED	
1.004	17	0.189	0.000	0.71			24.2	SURCHARGED	
1.005	19	0.198	0.000	0.36			23.7	SURCHARGED	
5.000	12	-0.176	0.000	0.34			22.5	OK	
5.001	13	-0.160	0.000	0.33			21.0	OK	
5.002	14	-0.050	0.000	0.54			35.7	OK	
6.000	15	-0.176	0.000	0.34			22.5	OK	
6.001	16	-0.162	0.000	0.33			21.2	OK	
6.002	17	-0.053	0.000	0.54			36.0	OK	
5.003	18	0.111	0.000	0.97			61.4	SURCHARGED	
7.000	19	-0.176	0.000	0.11			4.3	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.001	20	15 Winter	30	+0%					30.577
8.000	21	15 Winter	30	+0%					30.684
7.002	22	15 Winter	30	+0%	30/15 Summer				30.573
1.006	23	15 Winter	30	+0%	30/15 Summer				30.537
1.007	24	60 Winter	30	+0%	30/30 Winter				30.381

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.001	20	-0.001	0.000	0.10			3.6	OK	
8.000	21	-0.091	0.000	0.66			30.8	OK	
7.002	22	0.073	0.000	0.74			26.9	SURCHARGED	
1.006	23	0.123	0.000	1.64			99.9	SURCHARGED	
1.007	24	0.045	0.000	0.83			51.1	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.341
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	4	15 Winter	100	+0%					31.876
2.000	5	120 Winter	100	+0%					31.070
1.001	7	120 Winter	100	+0%	100/15 Winter				31.064
1.002	12	120 Winter	100	+0%	100/15 Summer				31.093
1.003	17	120 Winter	100	+0%	100/15 Summer				31.092
3.000	14	15 Winter	100	+0%					31.210
3.001	15	120 Winter	100	+0%	100/15 Winter				31.014
4.000	17	15 Winter	100	+0%					31.334
3.002	16	120 Winter	100	+0%	100/15 Summer				31.019
1.004	17	120 Winter	100	+0%	100/15 Summer				31.077
1.005	19	180 Winter	100	+0%	100/15 Summer				31.148
5.000	12	15 Winter	100	+0%					30.843
5.001	13	15 Winter	100	+0%					30.793
5.002	14	15 Winter	100	+0%	100/15 Summer				30.770
6.000	15	15 Winter	100	+0%					30.843
6.001	16	15 Winter	100	+0%					30.794
6.002	17	15 Winter	100	+0%	100/15 Summer				30.771
5.003	18	15 Winter	100	+0%	100/15 Summer				30.709
7.000	19	15 Winter	100	+0%					30.705

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	4	-0.186	0.000	0.24			50.1	FLOOD RISK*	
2.000	5	-0.080	0.000	0.21			8.1	OK	
1.001	7	0.106	0.000	0.61			18.9	SURCHARGED	
1.002	12	0.297	0.000	0.42			25.9	SURCHARGED	
1.003	17	0.390	0.000	0.77			45.1	SURCHARGED	
3.000	14	-0.202	0.000	0.21			43.4	FLOOD RISK*	
3.001	15	0.264	0.000	0.14			8.9	SURCHARGED	
4.000	17	-0.228	0.000	0.17			31.9	FLOOD RISK*	
3.002	16	0.363	0.000	0.33			16.8	SURCHARGED	
1.004	17	0.437	0.000	0.78			26.6	SURCHARGED	
1.005	19	0.541	0.000	0.40			26.0	SURCHARGED	
5.000	12	-0.157	0.000	0.44			29.1	OK	
5.001	13	-0.020	0.000	0.35			22.7	OK	
5.002	14	0.087	0.000	0.60			39.4	SURCHARGED	
6.000	15	-0.157	0.000	0.44			29.1	OK	
6.001	16	-0.023	0.000	0.36			23.0	OK	
6.002	17	0.084	0.000	0.60			39.9	SURCHARGED	
5.003	18	0.231	0.000	1.12			71.1	SURCHARGED	
7.000	19	-0.070	0.000	0.14			5.4	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.001	20	15 Winter	100	+0%	100/15 Summer				30.696
8.000	21	15 Winter	100	+0%	100/15 Winter				30.809
7.002	22	15 Winter	100	+0%	100/15 Summer				30.690
1.006	23	15 Winter	100	+0%	100/15 Summer				30.631
1.007	24	60 Winter	100	+0%	100/15 Summer				30.494

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.001	20	0.118	0.000	0.15			5.4	SURCHARGED	
8.000	21	0.034	0.000	0.80			37.6	SURCHARGED	
7.002	22	0.190	0.000	0.87			31.7	SURCHARGED	
1.006	23	0.217	0.000	1.97			119.3	SURCHARGED	
1.007	24	0.158	0.000	0.84			51.7	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.341
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	4	15 Winter	100	+40%					31.910
2.000	5	120 Winter	100	+40%	100/15 Winter				31.403
1.001	7	120 Winter	100	+40%	100/15 Summer				31.395
1.002	12	120 Winter	100	+40%	100/15 Summer				31.404
1.003	17	120 Winter	100	+40%	100/15 Summer				31.392
3.000	14	120 Winter	100	+40%					31.314
3.001	15	120 Winter	100	+40%	100/15 Summer				31.314
4.000	17	15 Winter	100	+40%					31.363
3.002	16	120 Winter	100	+40%	100/15 Summer				31.318
1.004	17	120 Winter	100	+40%	100/15 Summer				31.413
1.005	19	120 Winter	100	+40%	100/15 Summer				31.478
5.000	12	15 Winter	100	+40%	100/15 Summer				31.265
5.001	13	15 Winter	100	+40%	100/15 Summer				31.227
5.002	14	15 Winter	100	+40%	100/15 Summer				31.193
6.000	15	15 Winter	100	+40%	100/15 Summer				31.266
6.001	16	15 Winter	100	+40%	100/15 Summer				31.228
6.002	17	15 Winter	100	+40%	100/15 Summer				31.194
5.003	18	30 Winter	100	+40%	100/15 Summer				31.066
7.000	19	15 Winter	100	+40%	100/15 Summer				31.028

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	4	-0.152	0.000	0.34			70.8	FLOOD RISK*	
2.000	5	0.253	0.000	0.28			11.0	SURCHARGED	
1.001	7	0.437	0.000	0.60			18.8	SURCHARGED	
1.002	12	0.608	0.000	0.42			26.1	SURCHARGED	
1.003	17	0.690	0.000	0.87			51.2	SURCHARGED	
3.000	14	-0.098	0.000	0.10			20.0	FLOOD RISK*	
3.001	15	0.564	0.000	0.22			13.5	FLOOD RISK	
4.000	17	-0.199	0.000	0.23			44.7	FLOOD RISK*	
3.002	16	0.662	0.000	0.50			25.7	FLOOD RISK	
1.004	17	0.773	0.000	0.91			30.9	FLOOD RISK	
1.005	19	0.871	0.000	0.43			28.3	FLOOD RISK	
5.000	12	0.265	0.000	0.57			37.5	SURCHARGED	
5.001	13	0.414	0.000	0.44			28.2	SURCHARGED	
5.002	14	0.510	0.000	0.78			51.3	SURCHARGED	
6.000	15	0.266	0.000	0.57			37.5	SURCHARGED	
6.001	16	0.411	0.000	0.44			28.4	SURCHARGED	
6.002	17	0.507	0.000	0.78			51.7	SURCHARGED	
5.003	18	0.588	0.000	1.45			92.0	SURCHARGED	
7.000	19	0.253	0.000	0.17			6.8	SURCHARGED	

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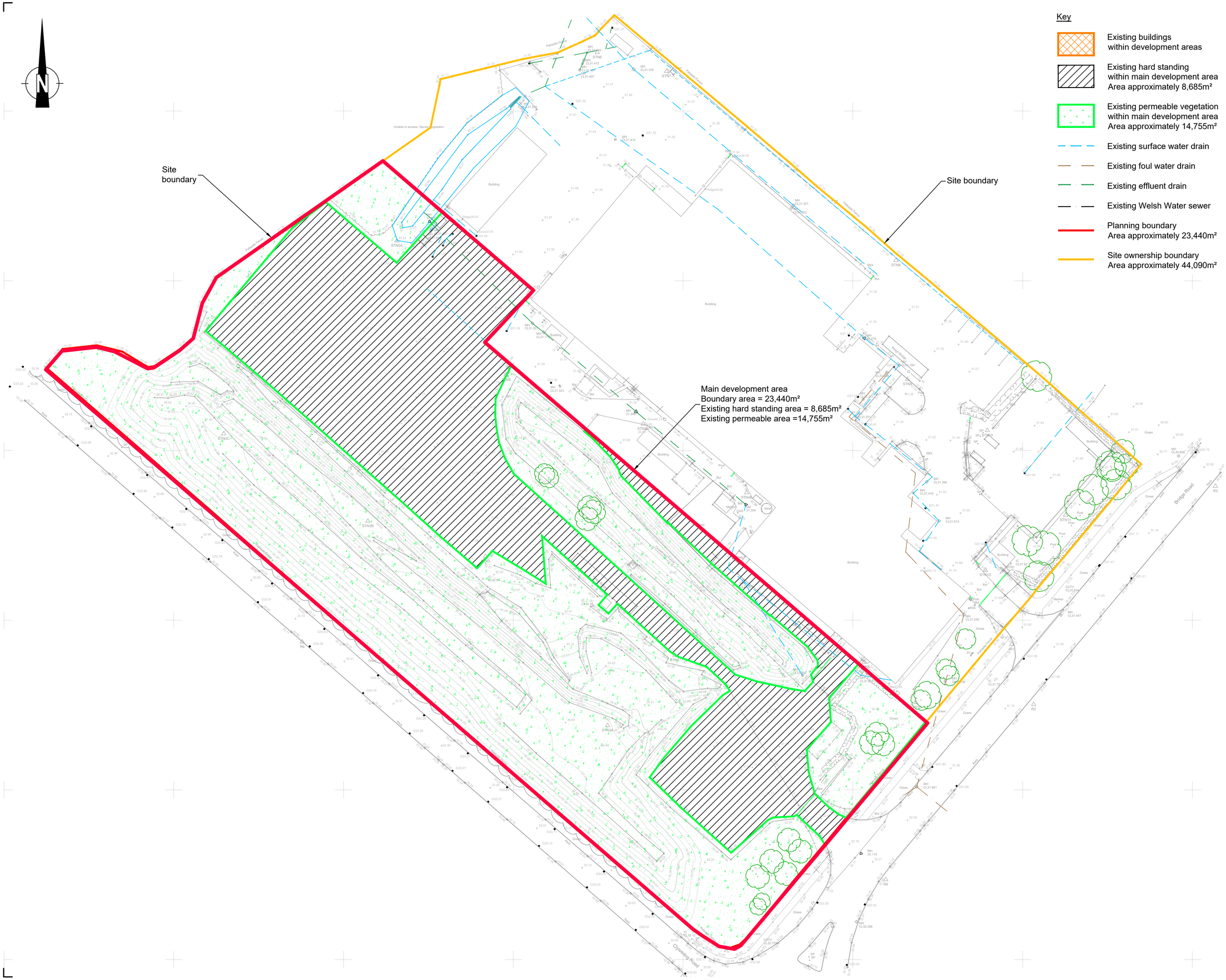
Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.001	20	15 Winter	100	+40%	100/15 Summer				31.016
8.000	21	15 Winter	100	+40%	100/15 Summer				31.252
7.002	22	15 Winter	100	+40%	100/15 Summer				31.010
1.006	23	30 Winter	100	+40%	100/15 Summer				30.934
1.007	24	120 Winter	100	+40%	100/15 Summer				30.738

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.001	20	0.438	0.000	0.16			5.9	SURCHARGED	
8.000	21	0.477	0.000	0.97			45.6	SURCHARGED	
7.002	22	0.510	0.000	1.29			47.0	SURCHARGED	
1.006	23	0.520	0.000	2.64			160.4	SURCHARGED	
1.007	24	0.403	0.000	0.84			51.7	SURCHARGED	

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Appendix H – **Existing Hard Standing Areas**
Proposed Hard Standing Areas
Drainage Strategy Layout Drawing



Key

- Existing buildings within development areas
- Existing hard standing within main development area Area approximately 8,685m²
- Existing permeable vegetation within main development area Area approximately 14,755m²
- Existing surface water drain
- Existing foul water drain
- Existing effluent drain
- Existing Welsh Water sewer
- Planning boundary Area approximately 23,440m²
- Site ownership boundary Area approximately 44,090m²

General Notes:

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4. Dimensions must not be scaled from this drawing.
5. Dimensions marked 'dimension to be site checked' are subject to confirmation by site measurement before construction proceeds.
6. Subcontractor surveys, such as for the purposes of steelwork installation, take precedence over 'site dimensions' indicated on this drawing. All surveys should ensure an accurate fit of components.
7. Temporary works associated with the construction of the project shall be the responsibility of the Principal Contractor.
8. Where any temporary works or scaffolding are required the Principal Contractor shall appoint a competent and suitably experienced Temporary Works Coordinator (TWC). Refer to BS 5975 for guidance on temporary works and the role of a TWC.
9. Calculations and drawings of all Contractor designed structural items associated with NDA's design responsibilities shall be submitted to the Engineer for comment at least 10 days prior to manufacture. Any comments made by NDA do not absolve the Contractor of his design responsibilities.
10. Contractor to refer to the Health and Safety File for identification of hazards, including the existence of underground and overhead utilities.
11. The contractor is to work within any planning restriction including working hours, noise levels etc.

REV	DATE	AMENDMENT	DRW	CHK
P02	29/04/24	Layout updated	AF	ML
P01	12/09/23	For information	AF	ML

CLIENT

Hydro

PROJECT

Hydro Aluminium
Wrexham Industrial Estate
New Sorting Shed

DRAWING TITLE

Existing Development and Hard Standing Areas

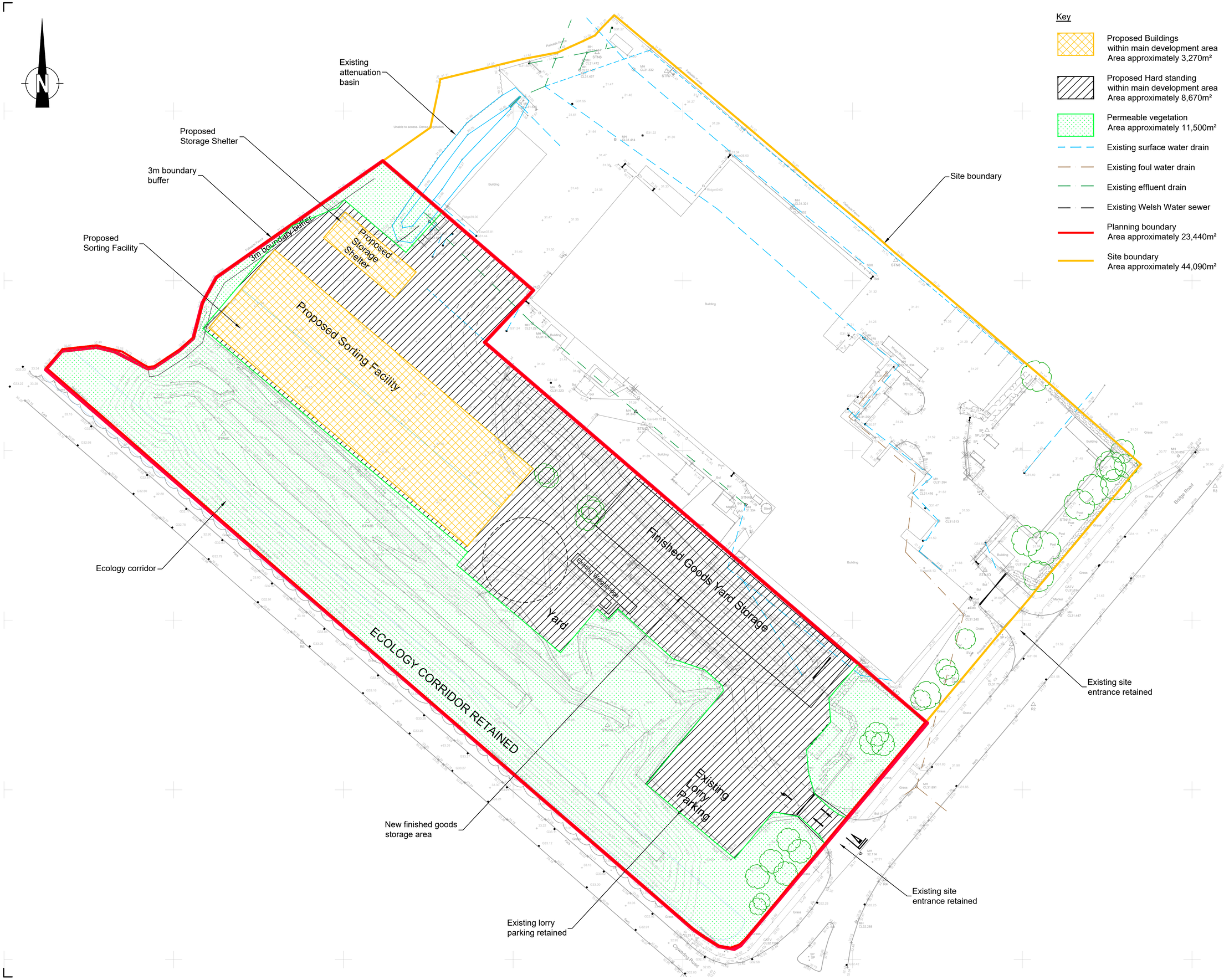
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SCALE	SHEET SIZE	NDA REF
Scale 1 : 500	A1	9059

SUITABILITY

S2 - Suitable for Information

DRAWING NO.	REV
9059-NDA-XX-DR-C-1003	P02



Key

- Proposed Buildings within main development area Area approximately 3,270m²
- Proposed Hard standing within main development area Area approximately 8,670m²
- Permeable vegetation Area approximately 11,500m²
- Existing surface water drain
- Existing foul water drain
- Existing effluent drain
- Existing Welsh Water sewer
- Planning boundary Area approximately 23,440m²
- Site boundary Area approximately 44,090m²

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10. Contractor to refer to the Health and Safety File for identification of hazards, including the existence of underground and overhead utilities.
11. The contractor is to work within any planning restriction including working hours, noise levels etc.
12. Design and drawing information is based on the RPS topographical survey drawing numbers JKK10137_01D & JKK10137_2D. NDA does not accept any liability for any inaccuracies this information may contain.

REV	DATE	AMENDMENT	DRW	CHK
P02	29/04/24	Layout updated	AF	ML
P01	12/09/23	For information	AF	ML

CLIENT

Hydro

PROJECT

Hydro Aluminium
Wrexham Industrial Estate
New Sorting Shed

DRAWING TITLE

Proposed Development and Hard Standing Areas

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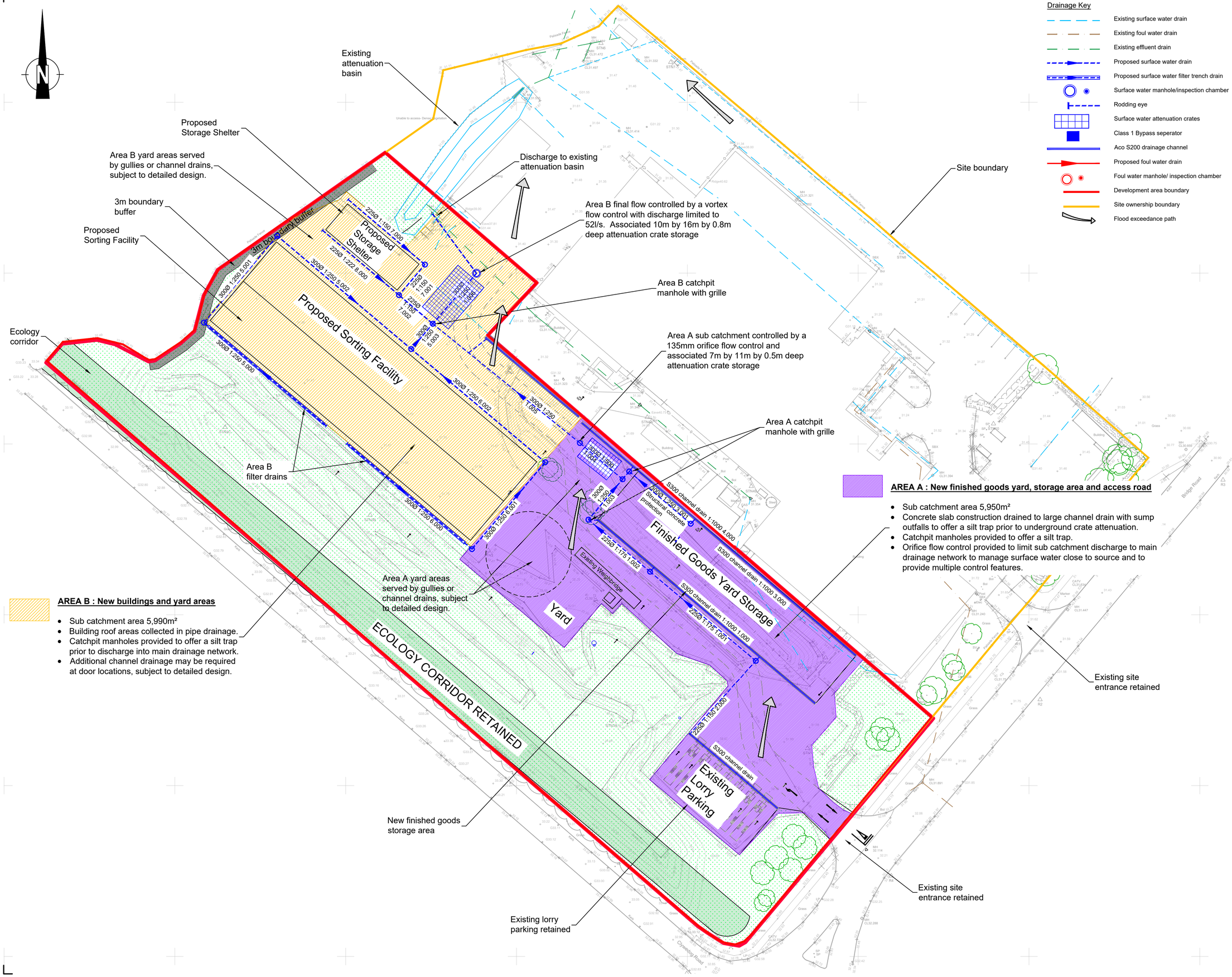
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Scale 1 : 200	A1	9059

SUITABILITY

S2 - Suitable for Information

DRAWING NO. 9059-NDA-XX-DR-C-1004

REV P02



AREA B : New buildings and yard areas

- Sub catchment area 5,990m²
- Building roof areas collected in pipe drainage.
- Catchpit manholes provided to offer a silt trap prior to discharge into main drainage network.
- Additional channel drainage may be required at door locations, subject to detailed design.

AREA A : New finished goods yard, storage area and access road

- Sub catchment area 5,950m²
- Concrete slab construction drained to large channel drain with sump outfalls to offer a silt trap prior to underground crate attenuation.
- Catchpit manholes provided to offer a silt trap.
- Orifice flow control provided to limit sub catchment discharge to main drainage network to manage surface water close to source and to provide multiple control features.

Drainage Key

- Existing surface water drain
- Existing foul water drain
- Existing effluent drain
- Proposed surface water drain
- Proposed surface water filter trench drain
- Surface water manhole/inspection chamber
- Rodding eye
- Surface water attenuation crates
- Class 1 Bypass seperator
- Aco S200 drainage channel
- Proposed foul water drain
- Foul water manhole/ inspection chamber
- Development area boundary
- Site ownership boundary
- Flood exceedance path

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9. Contractor to refer to the Health and Safety File for identification of hazards, including the existence of underground and overhead utilities.
10. The contractor is to work within any planning restriction including working hours, noise levels etc.
11. Design and drawing information is based on the RPS topographical survey drawing numbers JKK10137_01D & JKK10137_2D. NDA does not accept any liability for any inaccuracies this information may contain.

REV	DATE	AMENDMENT	DRW	CHK
P02	29/04/24	Layout updated	AF	ML
P01	12/09/23	For information	AF	ML

CLIENT

Hydro

PROJECT

Hydro Aluminium
Wrexham Industrial Estate
New Sorting Shed

DRAWING TITLE

Proposed Drainage Strategy

Norder
Engineers. Architects. Innovators.
Beech Lawn, Green Lane, Belper, Derby DE56 1BY
Tel: 01773 824414
E-mail: enquiries@norder.co.uk

SCALE	SHEET SIZE	NDA REF
Scale 1 : 200	A1	9059

SUITABILITY

S2 - Suitable for Information

DRAWING NO.	REV
9059-NDA-XX-DR-C-1005	P02