DD/REP/0013/25

Issue 2

# Site Restoration Programme

# Trawsfynydd Deposit for Recovery Permit Application

## Environmental Setting & Site Design

December 2025

# Trawsfynydd Deposit for Recovery Permit Application - Environmental Setting & Site Design

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**Review/Revision register**

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| 1 | March 2025 | S. Fuller & R. Jones | |
| 2 | November 2025 | S. Fuller | Updated descriptor RCA laydown area.<br>Updated sections 2.1.2, 2.2.3.2, 2.2.5 and 2.4 to account for changes to waste acceptance arrangements, and incorporate more recent groundwater baseline monitoring. Minor updates to other sections. |
| | | | |

# Distribution

Nuclear Restoration Services

## Table of Contents

## 1. Introduction

The NRS Trawsfynydd site is in the Eryri National Park in Gwynedd, on the northern side of Llyn Trawsfynydd. The Nuclear Licenced site contains two Magnox type reactors, and ancillary buildings. The power station ceased electricity generation in 1991 and was permanently shut down in 1993. It is currently undergoing decommissioning and waste management operations.

The work required at Trawsfynydd nuclear licensed site (NLS) is the overall decommissioning, i.e. the removal of buildings and built structures associated with its former use as a nuclear power generation plant, and the restoration of the NLS to enable subsequent re-development or re-use.

The Reactor Building Height Reduction (RBHR) Project will begin in 2025. The current reactor buildings are 55m high. A planning Public Inquiry in 2002 agreed with the proposal to carry out several decommissioning activities, including the height reduction of the two reactor buildings from 55m to 32.5m. RBHR is scheduled to proceed in 2025 as originally planned and approved.

The intention now is to accelerate decommissioning by carrying out Reactor Dismantling (RD), rather than entering an extended period known as Care and Maintenance. Following on from RBHR, the intention is to remove the buildings and internal plant/reactor core, instead of cladding the reactor buildings and leaving them in situ.

The RD programme is a massive undertaking, requiring construction of numerous temporary waste processing buildings, another ILW Store, large office and welfare requirements etc. In addition to dismantling both reactors and eventually demolishing both reactor buildings. The current NLS footprint is relatively small, and therefore, they will require as much space as possible on site, to facilitate the works. The programme of works will be ongoing for decades.

### 1.1 Report Context

The application site (referred to in this report as the the Recycled Concrete Aggregate (RCA) laydown area) relates to land within the northern portion of the wider Nuclear Licensed Site (generally referred to in this report as the NLS).

The application seeks to obtain a bespoke Deposit for Recovery (DFR) permit for the use of site won demolition arisings for the creation of a Recycled Concrete Aggregate (RCA) laydown area.

A Waste Recovery Plan was previously submitted to Natural Resource Wales whom gave an opinion that the works to construct the RCA laydown area are a recovery activity. An updated Waste Recovery Plan is included in the application.

The northern portion of the NLS comprises a laydown area that has been used for storage of materials, plant, and the stationing of containers. It is proposed to extend the laydown area using demolition arisings generated by the planned works to reduce the height of the reactor buildings. The current reactor buildings are 55m high and present an imposing feature within the surrounding landscape of Eryri National Park. A planning Public Inquiry in 2002 agreed with the proposal to carry out several decommissioning activities, including the height reduction of the two reactor buildings from 55m to 32.5m.

This Environment Setting and Site Design (ESSD) report sets out the conceptual model, the environmental setting and site design, and is supported by the environmental risk assessment (ERA) submitted in this application. NRW/EA guidance[1] allows for the use of the relevant Standard Rules permit Generic Risk Assessment to be applied to bespoke permits in a proportionate way. Specifically it states:

*If you are applying for a bespoke permit but most of your activities are covered by standard rules, you only need to do a risk assessment for the activities or risks that are not covered by the generic risk assessment for those standard rules.*

Therefore Standard Rules criterion for *SR2017No1 – Use of Waste in a Deposit for Recovery Activity* are compared against in the ESSD, and more detailed assessment taken forward where criterion do not apply.

## 1.2 Site Details

### 1.2.1 Site Location and Access

The proposed RCA laydown area is centred on grid reference SH 689 384, the development area is 12,260m$^2$ in size and is located at the northern end of the NLS. Lake Trawsfynydd is located directly south of the NLS. The total size of the NLS is 15 hectares.

Part of the RCA laydown area is a previously licenced asbestos disposal facility. It operated from 1972 – 1993, after which the licence was surrendered. The nearest residential property, Ty Gwyn, is situated 500m north of the site at the nearest point.

Access to the NLS is gained from the east of the Site from the A470. Within the NLS, the RCA laydown area is accessed via site roadways.

The location of Trawsfynydd Site is illustrated below in **Figure 1**. The specific area within the site subject to the Deposit for Recovery (DfR) permit application (the RCA laydown area) is shown in **Figure 2**.

[1] Risk assessments for your environmental permit - GOV.UK


**Figure 1 Location of Site**

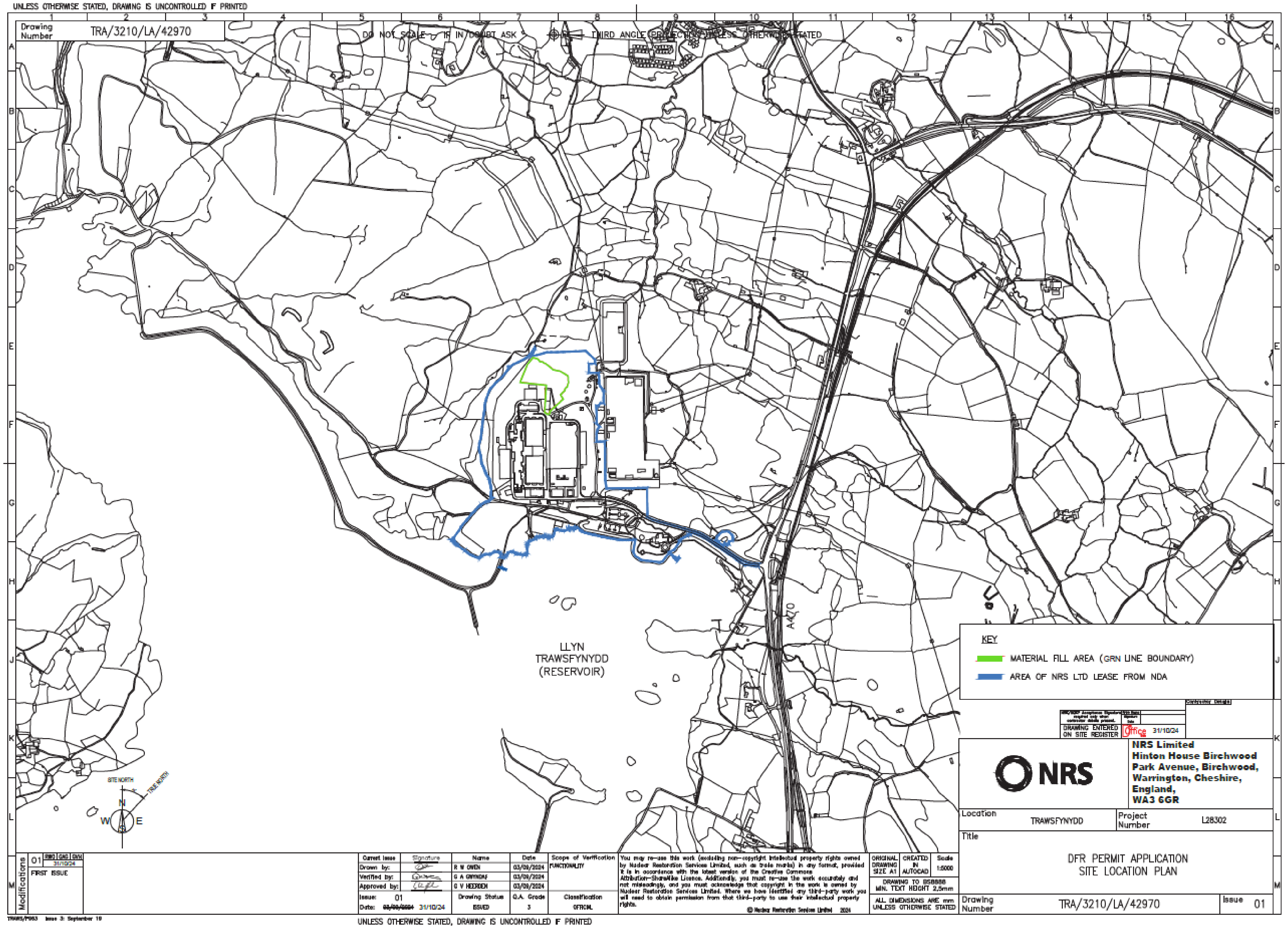



**Figure 2 DfR permit application area (green boundary), Drawing TRA/3210/LA/42970**

UNLESS OTHERWISE STATED, DRAWING IS UNCONTROLLED IF PRINTED

Drawing Number TRA/3210/LA/42973

DO NOT SCALE – IF IN DOUBT ASK
THIRD ANGLE PROJECTION UNLESS OTHERWISE STATED

GENERAL FINISH: 3,2 UNLESS STATED OTHERWISE

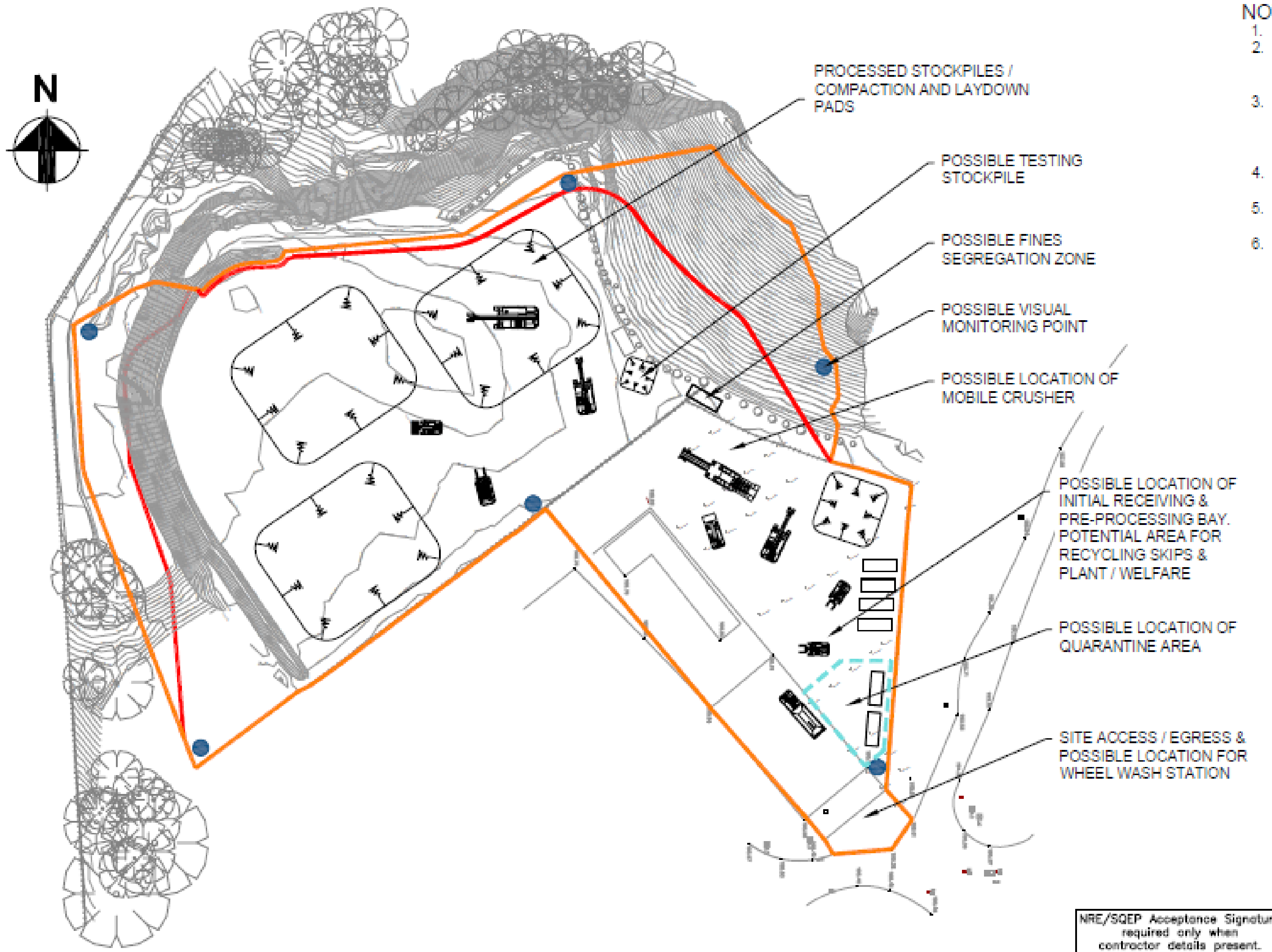
| TOLERANCES (unless stated otherwise) | 0 | 0,0 | 0,00 |
|---|---|---|---|
| BELOW 150 | ±0,5 | ±0,25 | ±0,125 |
| 150–1000 | ±1,0 | ±0,5 | ±0,25 |
| OVER 1000 | ±2,0 | ±1,0 | ±0,5 |

Angular Tolerance ± 0,5 degree

NOTES:

1. DO NOT SCALE - IF IN DOUBT ASK.
2. DRAWINGS TO BE READ IN CONJUNCTION WITH TRA/3210/LA/42971, TRA/3210/LA/42972 AND ALL OTHER DOCUMENTS SUBMITTED IN SUPPORT FOR THE PERMIT.
3. THESE DETAILS ARE INDICATIVE ONLY AND SUBJECT TO FULL DEVELOPMENT BY THE PRINCIPAL CONTRACTOR. LAYOUT CHANGES MAY OCCUR TO SUIT THE PRINCIPAL CONTRACTORS METHODOLOGY AND PROGRAM.
4. POTENTIAL ILLUSTRATED LAYOUT FOR FIRST CAMPAIGN ONLY AND SUBJECT TO CHANGE AS WORKS PROCEED.
5. ALL LEVELS AND DIMENSIONS IN METERS UNLESS OTHERWISE STATED.
6. TOLERANCES:

| | |
|---|---|
| FORMATION LEVELS: | +20MM and -30MM (AS PER MCHW SERIES 600 OR OTHER LEVEL OF TOLERANCE DEFINED IN CONTRACT) |
| SURFACE REGULARITY: | ± 20MM (UNDER 3.0M STRAIGHTEDGE FOR CAPPING OR ENGINEERED FORMATION). ± 50MM (MASS FILL NOT INTENDED AS FINAL FORMATION). |
| HORIZONTAL EXTENT: | ± 100MM FOR GENERAL EARTHWORKS. |




LEGEND:

- TOTAL PLAN AREA OF FILL PLACEMENT
- POSSIBLE LOCATION OF QUARANTINE AREA
- EXISTING TOPOGRAPHIC SURVEY CONTOUR
- PROPOSED MAJOR EARTHWORKS PLATEAU
- POSSIBLE MONITORING POINTS
- POSSIBLE PLANT ITEMS TO BE DEPLOYED
- POSSIBLE STOCKPILE LOCATIONS

| Rev | Drawn | Checked | Approved | Date | Description |
|---|---|---|---|---|---|
| 02 | GVH | GG | NW | 17/11/25 | WORKING AREA UPDATED TO INCLUDE QUARANTINE AREA |
| 01 | GVH | GG | NW | 09/10/25 | FIRST ISSUE |

Modifications

Contractor Details

NRS/SQEP Acceptance Signature required only when contractor details present. Print Name / Signature / Date

DRAWING ENTERED ON SITE REGISTER



Location: TRAWSFYNYDD

Project No: 28302

Title: DFR PERMIT APPLICATION POTENTIAL OPERATIONAL PLAN FIRST CAMPAIGN

| Current Issue | Signature | Name | Date |
|---|---|---|---|
| Drawn by: | | G. VAN HEERDEN | 29/09/25 |
| Verified by: | | G. AP GWYNDAF | 29/09/25 |
| Approved by: | | N. WRIGHT | 29/09/25 |

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DRAWING TO BS8888 MIN. TEXT HEIGHT 2,5mm

ALL DIMENSIONS ARE mm UNLESS OTHERWISE STATED

Drawing Number TRA/3210/LA/42973 — Issue 02

TRAWS/F966 Issue 4: June 24

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**Figure 3 Site Layout, Drawing TRA/3210/LA/42973**

### 1.2.2 Site Classification

The permit application is for the recovery of waste on land for the construction of a lay down area. The permit will therefore be for the following activities:

- R5: Recycling /reclamation of inorganic materials; and
- R13: Storage of waste pending any of the operations numbered R5 and R10.

It is not proposed to include recovery operation code R10 as there is no requirement to place a surface layer of material for agriculture or ecological benefit.

### 1.2.3 Application Boundaries and Site Security

The Site Layout and proposed permit boundary (the RCA laydown area) is illustrated in **Figures 2 and 3**. The RCA laydown area will be fully contained inside the secure perimeter of the nuclear licenced site.

### 1.2.4 Site Context

The RCA laydown area to be developed is existing hardstanding, containing storage containers, which in turn overlays the former asbestos tip (see section 2.1.1 below). The layout of the whole NLS, showing location of site drainage infrastructure, is shown in Appendix A.1 ). The immediate surrounding land uses are identified in **Table 1** below.

**Table 1 Immediate Surrounding Land Uses**

| Boundary | Description |
|---|---|
| North | Nuclear site licence perimeter boundary, beyond this lies a small band of woodland and grassland used for grazing. |
| East | A small band of woodland separates the application area from the Nuclear Licenced Site sewage treatment works and the nuclear site licence boundary, beyond which lies the National Grid substation compound. |
| South | The main nuclear site (reactors, ponds, storage facilities, and ancillary equipment/buildings) lie to the south of the application site, beyond which is Llyn Trawsfynydd. |
| West | The nuclear site licence boundary lies immediately to the west. There is a narrow band of woodland, where a public footpath runs through, and beyond this is the lower slopes of Craig Gyfynys. |

A summary of the potential environmental receptors located in the vicinity of the site are presented below.

**Ecology**

*European/International Designated Sites*

A review of the NRW *Designated site screening for permit applications* website[2] confirms the following European Sites, Sites of Special Scientific Interest (SSSI) or National Nature Reserves within 2km of the application site. The threshold for a

[2] URL: Natural Resources Wales / Working in protected areas, accessed 27 January 2025

standard rules permit is 500m, there are no relevant sites within 500m. The site lies within Eryri (Snowdonia) National Park.

**Table 2 Designated Sites within 2km**

| Designation Type | Name | Reference | Proximity |
|---|---|---|---|
| **Special Protection Areas** | Migneint-Arenig-Dduallt | UK9013131 | 1.9km E |
| **Special Areas of Conservation** | Migneint-Arenig-Dduallt | UK0030205 | 1.9km E |
| | Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites | UK0014789 | 1.5km W |
| **Sites of Special Scientific Interest** | Coed y Rhygen | | 1.2km SW |
| | Coedydd De Dyffryn Maentwrog | | 1.5km W and N |
| | Migneint-Arenig-Dduallt | | 1.9km E |
| **National Nature Reserves** | COED Y RHYGEN | 00055 | 1.2km SW |
| | CEUNANT LLENNYRCH | 00001 | 1.5km W |
| **National Parks** | Eryri (Snowdonia) National Park | | On site |

*Other Receptors*

There are no Local Nature Reserves or Local Wildlife Sites[3] within 1km of the application boundary (threshold for standard rules permit is 50m). There is a Plantation on a former Ancient Woodland Site (PAWS), reference 47395[4], immediately adjacent to the western boundary of the application site (see **Figure 5**), which is within 50m (Standard rules 50m threshold). The wooded areas immediately adjacent to the RCA laydown area are also likely to be considered a habitat of principal importance for the conservation of biodiversity as listed on Section 7 of the

[3] URL: Local Nature Reserves (LNR) | DataMapWales, accessed 28 January 2025
[4] URL: Interactive Map Viewer, accessed 28 January 2025

Environment (Wales) Act 2016 (Semi-natural broadleaved woodland)[5]. There are no Air Quality Management Areas in Gwynedd.

*Protected Species*

There are no records of Great Crested Newts within 250m of the application site, neither are there records of BAP protected species present within 50m[6] (compliant with Standard Rules Criteria), however it should be noted protected species are noted within the wider NLS and surrounding areas, and the habitats on the NLS are considered to be able to support a variety of protected species[7]. One BAP habitat (a parcel of semi-broadleaved woodland) is located north of the area adjacent to the NLS. Details of all BAP habitats within 1km can be found in the **Dust Management Plan**.

**Cultural Heritage**

The closest Scheduled Monument is *Enclosed Hut Group at Nurse Cae Du*[8] 600m north of the site (threshold for standard rules permit is 50m). There are no other Scheduled Monuments in close proximity, however there is one registered historical park and garden within the NLS boundary, comprising Dragon Square and Dame Sylvia Crowe Garden. Dragon Square is situated to the east of the administrative block, at the south end of the former turbine hall area (250m SE from the RCA laydown area).The Dame Sylvia Crowe Garden is situated on the south edge of the NLS, to the south of the reactor buildings (290m S from the RCA laydown area).

[5] Arup (November 2023) Preliminary Ecological Appraisal
[6] Checked for Protected SPP within 50m at UR.L Species search | NBN Atlas Wales, and Priority Habitats within 50m at URL Home | DataMapWales, accessed 06 February 2025
[7] Arup (November 2023) Preliminary Ecological Appraisal
[8] http://cadwpublic-api.azurewebsites.net/reports/sam/FullReport?lang=en&id=1003 , accessed 28 January 2025

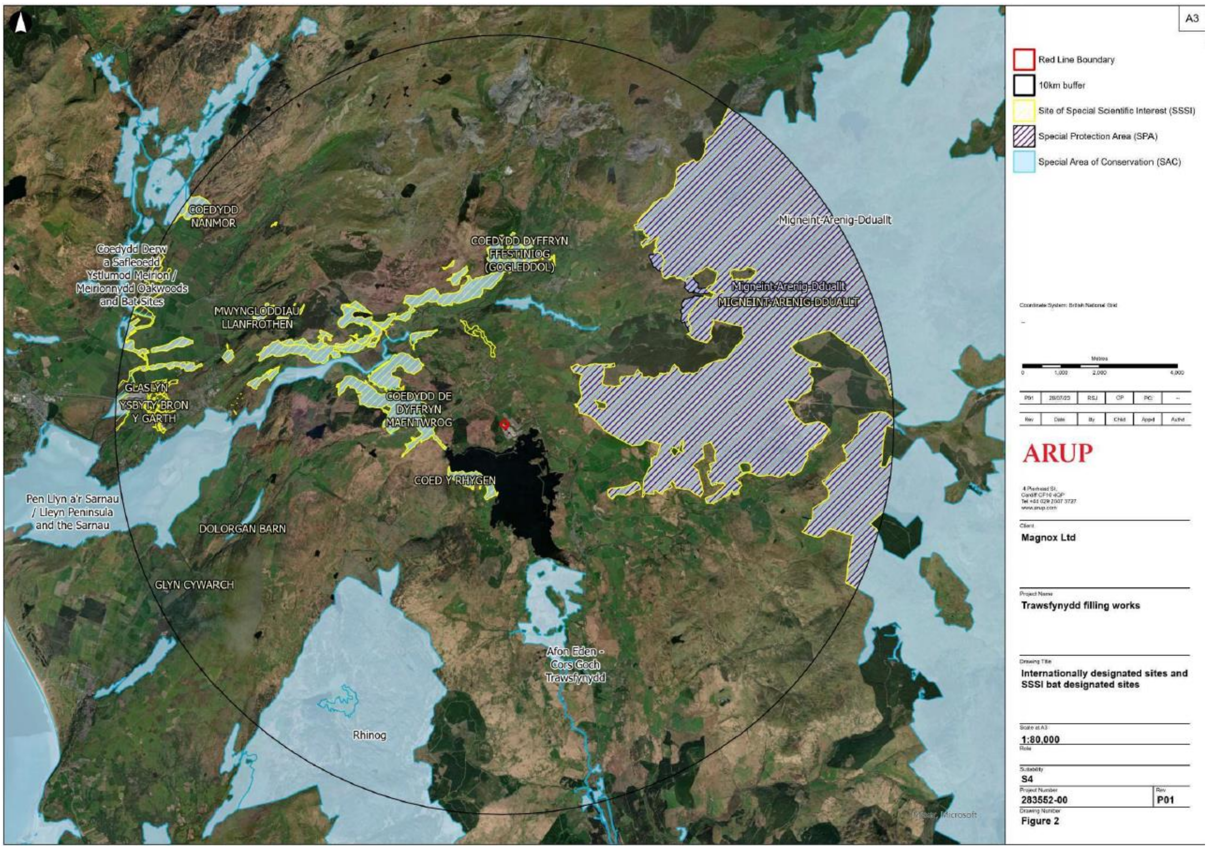



**Figure 4 – Site Setting with respect to Designated Sites (from Arup Preliminary Ecological Appraisal, November 2023)**

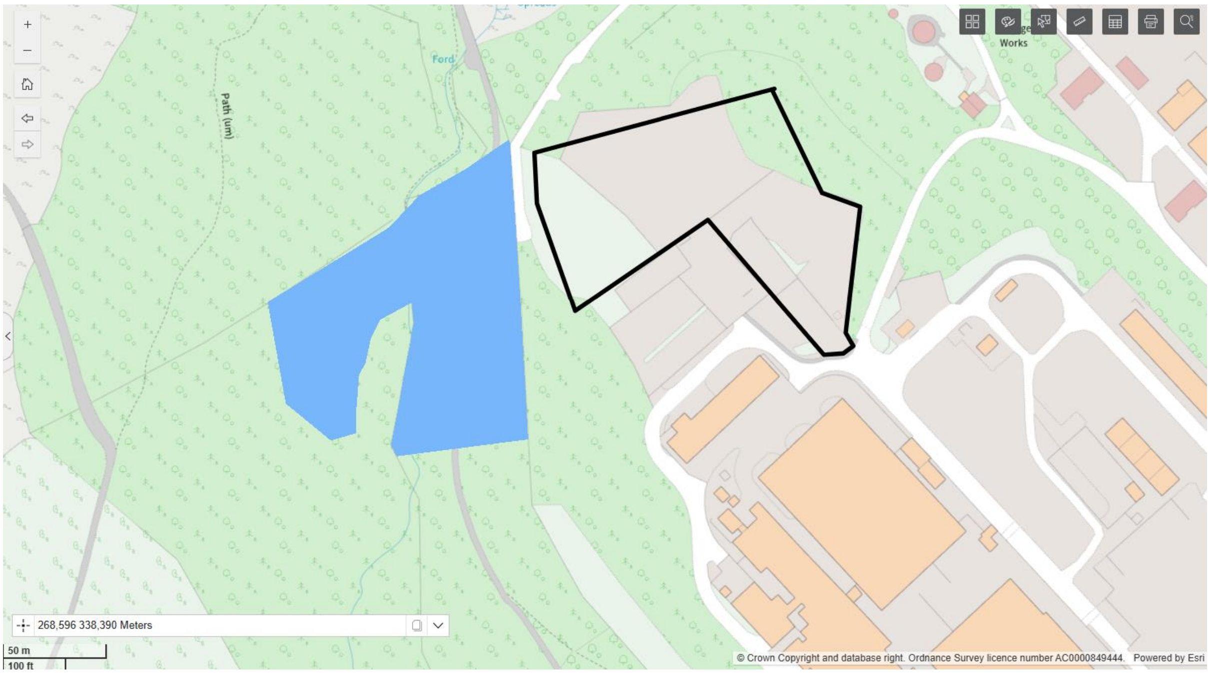



**Figure 5 – Ancient Woodland (blue) within 50m of DfR Area**

# 2. Conceptual Site Model

## 2.1 Source

### 2.1.1 Historical Development

The lower slopes of Craig Gyfynys were levelled to enable the construction of the power station when construction of the nuclear power station commenced in the 1950s. This was achieved by creating two main platforms or terrace levels; one for the power station (elevation 195.5m AOD) and one for the adjacent National Grid sub-station (elevation 181.8m AOD). The terraces were created through excavation of glacial till and where required, rock blasting into the hillside with subsequent use of the material removed as made ground to extend the terrace down the natural slope. Final placement of made ground followed construction of the major built structures which were founded on bedrock. Electricity generation ceased in 1991 and decommissioning commenced.

The area subject to the application was the former site tip (and recorded as a historic landfill), constructed in the 1950's and used to dispose of waste materials generated during the construction phase. Subsequently, it was used to dispose of Asbestos Containing Materials, neutralised waste acid and methylated spirits. It has also been used for storage of scrap metal, hydrocarbons and organic acids. That asbestos, which was disposed of some decades ago and permitted at the time, is reported to be bagged and covered by a minimum of 2m soil, and in some cases records claim that this cover was closer to 7 metres[9]. The eastern portion of the RCA laydown area was also historically built up across a 100m by 40m area with excavation spoil from the Intermediate Level Waste (ILW) Store construction. Compared to pre-development levels, the level of the application site has been built up by 6 metres or more[10]. The proposed development will not disturb the existing, buried asbestos. **Figure 6** shows the indicative layout of the historic deposits.

[9] SKM Enviros (November 2011): Assessment of Land-Raise Area Containing Licences Asbestos Disposals, Ref TRAWS/28-22005/DOC/8

[10] SKM Enviros (November 2011): Assessment of Land-Raise Area Containing Licences Asbestos Disposals, Ref TRAWS/28-22005/DOC/8

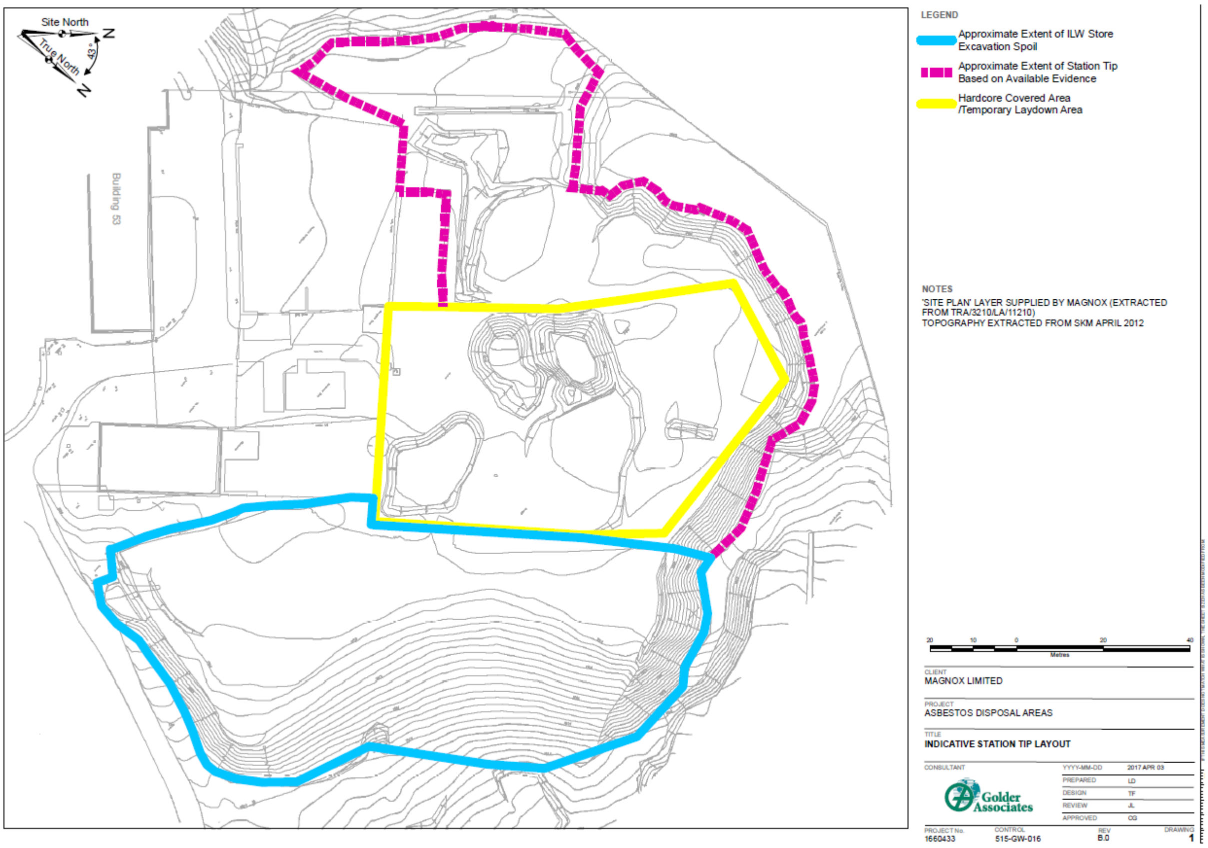



**Figure 6 Historic deposits (indicative) in the DfR area (from Golder, 2017[11])**

NRS has developed a Land Quality programme to ensure that each NLS can demonstrate and maintain a 'Satisfactory Land Condition' for the period of Care & Maintenance (C&M) Preparations and for the duration of C&M. A 'Satisfactory Land Condition' is defined as land condition such that there are no reasonable grounds for formal regulatory action compelling the Company to eliminate or mitigate the effects of any particular aspect of land quality. This requires a higher standard than marginal compliance. As part of the programme, NRS maintains a Land Quality Register and map, which provides an index of Areas of Potential Concern (an APC is defined as an area of land subject to a past or current use that may have given rise to contamination of the ground or groundwater, or where contamination is known to be present (Magnox, 2020), and used to inform a risk assessment in accordance with the Nuclear Industry Group for Land Quality (NIGLQ) 2012 methodology.

The Site has been subject to previous contaminated land desk studies via the Land Quality programme, including intrusive site investigations in relation to radioactive[12] and chemical contamination, and the conceptual site model (CSM) identifying potential contaminants (sources) and pathways to receptors is therefore relatively well understood. Within the proposal area are three APC's, which all cover the same area (see **figure 7**), these are summarised in **Table 3** below:

[11] Golder (2017): SE5: Asbestos Disposal Area, Visual Survey, Geotechnical Appraisal and Review of Existing Information.

[12] Radioactive risks are not assessed with this submission. The site is subject to an EPR RSR permit, the boundary of which includes the application area. Regulation of any radioactive discharges is covered by the RSR permit. It should be noted however that there no radioactive APC's within the application area.

## Table 3 Relevant Site Areas of Potential Concern (APCs)

| APC Reference | APC Title | Location | Potential contaminants of concern | Summary of APC |
|---|---|---|---|---|
| TRA-APC-51 | Site Tip (construction disposal area) beneath the RCA laydown area | Site Tip (construction disposal area) beneath the RCA laydown area | ACM, Waste acid, Methylated sprit, Scrap metal & fluids (hydrocarbons), Organic acid & petrol distillates (Scaffeze & Scaffbrite), Oil & diesel | Oil and diesel – potential spillages during power station construction. Anecdotal reference to use of area for disposal of waste by open burning during site construction phase and later. This is beneath part of the RCA laydown area<br><br>Former contractors' areas now partly occupied by this area. See APCs 52 and 53 for other past uses of this area.<br><br>Several boreholes (BH406 to BH409) were drilled downgradient. For more information, see the design document (Golder, 2016a) and the factual report (Golder, 2017e).<br><br>Golder carried out a site walkover to assess the geotechnical stability of the Site Tip and the presence of asbestos containing material in December 2016 (Golder, 2017a). Isolated instances of asbestos containing material were found on the flanks (side slopes) of the Station Tip, however these instances were rare and cement-bound. The flanks of the tip were considered to be geotechnically stable. |
| TRA-APC-52 | Asbestos Burial Area beneath the RCA laydown area | Asbestos Burial Area beneath the RCA laydown area | Asbestos, acid, lime, solvents. | Authorised disposal of asbestos containing waste from 1972 until approximately 1989 (beneath part of the RCA laydown area). Disposal in pits between 10' and 20' deep. Known disposal of acid and lime. Sulphuric acid neutralised (with lime) and disposed of in a pit, then covered with earth. Asbestos later disposed in same pit. Known incineration of solvents – disposed of in a pit and then burned under supervision. For more information, see Golder (2001a).<br>Several boreholes (BH406 to BH409) were drilled downgradient. For more information, see the design document (Golder, 2016a) and the factual report (Golder, 2017e).<br>Golder undertook a site walkover to look for evidence asbestos containing material in the Asbestos Burial Area in December 2016 (Golder, 2017a). No evidence of asbestos containing materials were observed on the surface of the site or on the flanks (side slopes) of the area. Asbestos burial records suggest that asbestos material is buried at a depth greater than 2 m bgl.<br>An updated sentencing of this APC is detailed in Golder (2018c), which includes an options assessment for managing the risk of bringing asbestos to the surface and becoming exposed to the environment. |
| TRA-APC-53 | Waste Storage Area | Waste Storage Area | Metals, acid, hydrocarbons. | The Site of the asbestos burial area has been used for the storage of scrap metal (stored on unsealed ground). A large number of small (approximately 30 litre) containers of organic acid and petrol distillates have previously been stored on unsealed ground, without secondary containment. For more information, see Golder (2001a).<br>Several boreholes (BH406 to BH409) were drilled downgradient. For more information, see the design document (Golder, 2016a) and the factual report (Golder, 2017e). |

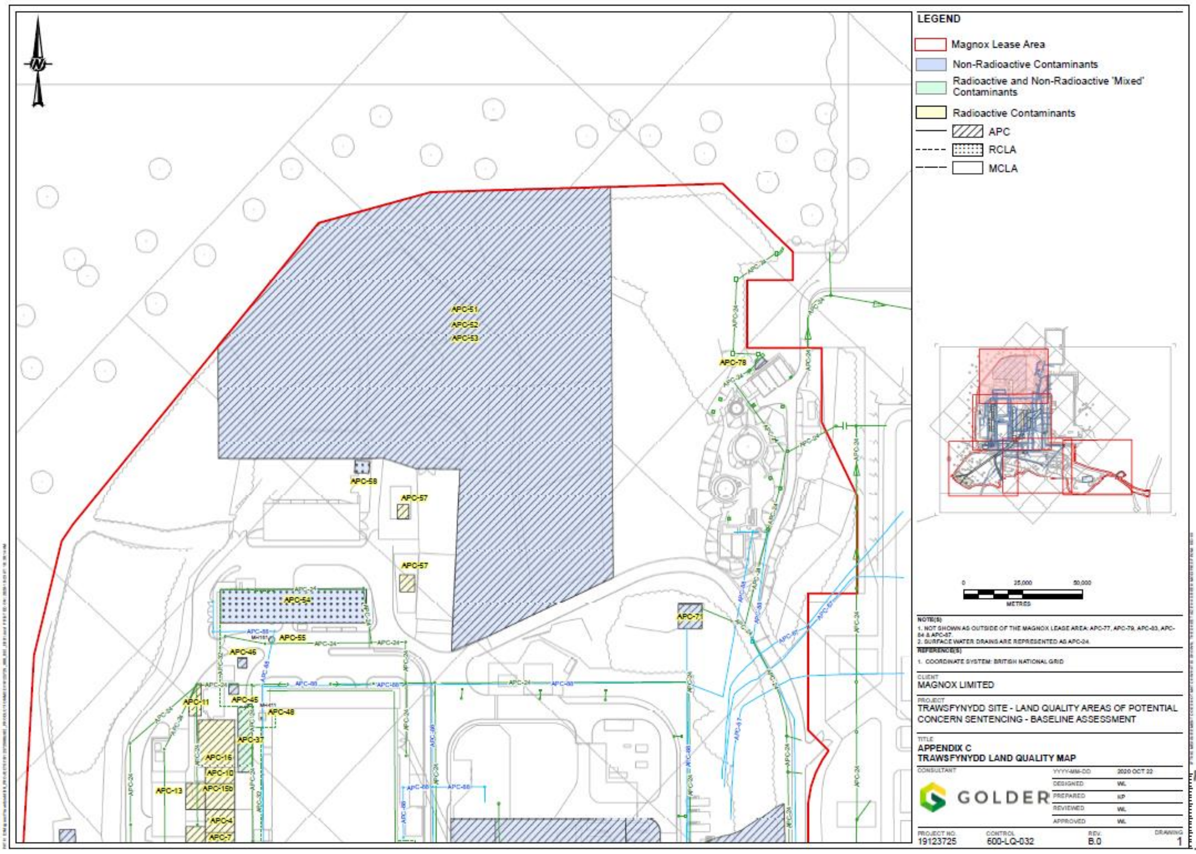



**Figure 7 Location of APCs within the Application site**

Previous studies, notably SKM Enviros (2011)[13] and Golder (2017)[14] have characterised the area (see summary of contaminants in **Figure 8**), and concluded that disturbance of the area is to be minimised going into Care & Maintenance (C&M), recommending increasing the thickness of cover material, and ensuring that the surface be maintained as a no grow granular surface to discourage vegetation growth and burrowing animals, and determining that a low permeability cap was not required as *a reduction in rainfall ingress is not technically required in view of the lack of biodegradable waste within the deposits.* (SKM Report, 2011). **The planned extension of the RCA laydown area is consistent with these recommendations.**

[13] SKM Enviros (November 2011): Assessment of Land-Raise Area Containing Licences Asbestos Disposals, Ref TRAWS/28-22005/DOC/8
[14] Golder (May 2017): SE5: Asbesos Disposal Area, Visual Survey, Geotechnical Appraisal and Review of Existing Information

| Data Source | Identified Potential Contaminants | Risk to Groundwater? |
|---|---|---|
| 1976 Memo | Acid / lime | Low potential from acids or lime due to passage of time and neutralisation. However, potential from any contaminants of acid. |
| | Methylated spirits | Yes, as spirits are described as being poured into pits prior to burning. The pits appear to be unlined holes in the made ground meaning methylated spirits could have seeped away prior to ignition. In addition other solvents which are less biodegradable may also have been disposed of in this way posing great groundwater risks. |
| | Asbestos | None. |
| 1986 Sketch Plan | 'Rubbish' | Potentially, depending upon the nature of the rubbish deposited. |
| | Scrap | Yes, depending upon presence of oil and grease on scrap metal. |
| | Asbestos | None. |
| | Rubble and concrete blocks | None. |
| 1989 Asbestos Deposit Plan | Drum storage area | Yes, depending upon drum contents and length of storage time. |
| | Asbestos | None. |
| 1992 Letter<br>(Burning of paper, etc.) | No identified contaminants, however, ash likely to be deposited on site | Low potential as biodegradable wastes should have been mostly destroyed by the fire. |
| 2001 Golder Report | Asbestos | None. |
| | Scrap Metal | Some, although scrap is reported to have been cleaned prior to storage in the area, there is the potential for residual hydrocarbons to be present. |
| | Non-rad waste | Yes since it is not clear what material this may have been |
| 2002 Golder Report | Fire practice training | Yes, based upon findings from other sites fire training areas, although this depends on both what was used for training and how this was carried out. |
| 2003 George Courderoy and Co Report | Asbestos | None. |

**Figure 8 – Summary of contaminants in historic deposits**

The area was partially covered with 6F2 aggregate in 2017, with a further 3000t of 6F2 aggregate (which had been stockpiled on the area between 2017 and 2023) also used to improve the lay-down area in 2023 (see **Figure 2**).

Asbestos fibres do not dissolve in water[15]. It is long established that the process of filtration prevents migration of asbestos fibres in porous media such as soils[16]. A measure of its low risk to groundwater is the absence of an asbestos drinking water standard in the UK. Likewise, the World Health Organisation (WHO) has not set a guideline value for asbestos in drinking water[17]. Asbestos is a respiratory hazard and as such not a groundwater contaminant of concern.

The site wide risk assessment was updated in 2020[18], a summary of the risks to controlled waters from the relevant APC's in the application area is presented in Table 4. Risks to human health from inhalation of asbestos were also assessed in the 2020 QLRA and judged to be 'moderate' severity (as there  is no safe level for exposure to asbestos fibres via inhalation) and likelihood of consequence as 'extremely unlikely' with the mitigation measures mentioned above in place.

### Table 4 (taken from Golder QLRA Update, 2020)

**Table 6: Summary of Risk Estimation and Risk Evaluation – Controlled Waters**

| | Severity of the Consequence | Likelihood of the Consequence Occurring | Significance of Risk – Short-term | Significance of Risk – Long-term | Confidence Short-term | Confidence Long-term | Comment on Confidence |
|---|---|---|---|---|---|---|---|
| Infiltration of rain, leaching and subsequent vertical and horizontal migration of contaminants within groundwater | Mild | Unlikely | **Low** | **Low** | Medium | Medium | Further targeted groundwater sampling and assessment may result in decreased risk. |
| Vertical and horizontal migration of NAPL in groundwater | Moderate | Extremely Unlikely | **Very Low** | **Very Low** | High | High | Current conditions well understood. |
| Mobilisation of contaminants via drainage and non-permitted outfalls. | Negligible | Likely | **Very Low** | **Very Low** | High | High | Current conditions well understood. |

Risks from historic contaminants are well understood, and classed as either low or very low. The proposed development will not alter the existing risk assessment covering this area as there will be no disturbance of the historic deposits, and the development will not increase the infiltration of rain through the deposits (see 2.1.2).

[15] UKHSA, 2024. Asbestos: general information. 29 January 2025. Asbestos: general information - GOV.UK .
[16] Gronow, JR., 1986. Mechanisms of particle movement in porous media. Clay Minerals (1986) 21, 753-767.
[17] WHO, 2017. Guidelines for drinking-water quality. Fourth edition incorporating the first addendum.
[18] Golder (September 2020): 2020 Update of the Land Quality Qualitative Risk Assessment.

### 2.1.2 Proposed Development

A total of 14,622m$^3$ (31,492 tonnes) of demolition arisings (concrete and brick) from the Reactor Building Height Reduction (RBHR) project will be used to extend and improve a laydown area to the north of the Nuclear Licensed Site over a period of 2-3 years. This will create a free-draining, level plateau area of 7735m$^2$. The sides will be sloped to create stable embankments extending to a total area of 12,260m$^2$. The design plans and cross sections can be found in the submitted **Waste Recovery Plan**. Planning permission (reference NP5/73/287T[19]) was granted 25/11/2024.

Demolition wastes arising from the RBHR project will be stockpiled prior to processing. It is anticipated that within several months that there will be sufficient volume to begin a campaign of crushing and screening the materials to form 6F2 (or similar). Processing will take place at a rate of approximately 50 tonnes/hr and will be managed under a separate mobile plant/part B permit.
The recycled aggregate will then be stockpiled within the permitted RCA laydown area. When deposited for recovery, each lift (layer) of recycled aggregate will be approximately 125mm deep. A continuous bund will be formed of the material at the west, north and east edges of the area. The area is designed to be free draining. The proposed works will not increase the amount of water infiltrating to ground [20].

**Figure 9** shows the construction of the original laydown area, which included the use of 3,000 tonnes of RCA previously produced under the WRAP – aggregates from inert waste protocol in 2016[21]. The stockpile in Figure 7 was spread in 2024 and the area (**figure 10).** The management and processing of the recycled aggregate from the RBHR project will be subject to testing. Details on the layout, including cross sections, can be found in the **Waste Recovery Plan** which accompanies this application.

[19] Citizen Portal Planning, accessed 6 March 2025
[20] Magnox (August 2023): North Laydown Area Improvement – Drainage assessment. TRAWS-EAN-23-027
[21] LIT_8709_c60600.pdf (publishing.service.gov.uk), accessed 6 March 2025

**Figure 9 - Work to construct the original RCA laydown area (which now requires extension and improvement)**

**Figure 10 – RCA laydown area (2024)**

#### 2.1.2.1 Waste acceptance arrangements

Only inert waste will be accepted. The materials to be demolished are from a single source, the RBHR project, and has been subject to characterisation in accordance with NRS Company Standard S-100 *Management of Controlled Wastes,* and S-324 *Characterisation Management.* Further details are provided in **EMS Summary Appendix 6 (Waste Acceptance)**. When waste is generated, the characterisation information will support waste classification in accordance with WM3 guidance[22] and ensure that the arisings do not contain contaminants exceeding thresholds in WM3. The NRS Company Standard also includes a waste tracking system to provide a robust audit trail to confirm the nature, quantity and location of waste arisings.

Details are provided in **EMS Summary Appendix 6 (Waste Acceptance)**, waste acceptance arrangements can be summarised as follows:

- Pre-acceptance checks, including basic characterisation data provided by the RBHR project to support non-hazardous classification in accordance with WM3.
- Waste acceptance checks upon delivery to the permitted area to ensure that the wastes are as described, and as permitted within the Environmental Permit.
- Actions to be taken if waste not permitted by the Environmental Permit is delivered to the RCA laydown or stockpiling areas.
- Prior to the acceptance of waste **for final deposit,** testing will take place following crushing of wastes to provide a basic characterisation in accordance with the **Council Directive**, consisting of inert WAC testing, testing to satisfy engineering requirements, and limited compliance testing for WM3 of any contaminants identified in the WM3 basic characterisation at pre-acceptance.

The waste to be used will be limited to the EWC codes listed in **Table 5**. Provided pre-acceptance checks at source confirm suitability, waste arisings will be stockpiled on the RCA laydown area both before crushing and screening and prior to recovery. The processed material will be 6F2[23] (or similar) specification, the crushing activity will be subject to a Part B mobile plant permit and does not form part of the DfR activity.

[22] Waste classification technical guidance - GOV.UK (www.gov.uk)
[23] www.standardsforhighways.co.uk/tses/attachments/471049cb-7dd8-452a-81e6-fc8af7d31b91

**Table 5 Waste types for inclusion in the permit**

| List of Waste Codes | Description | Restrictions |
|---|---|---|
| **17 01** | **Concrete, Bricks, Tiles and Ceramics** | |
| 17 01 01 | Concrete | |
| 17 01 02 | Bricks | |
| 17 01 03 | Tiles and Ceramics | |
| 17 01 07 | Mixtures of Concrete, Bricks, Tiles and Ceramics | Metal from reinforced concrete must be removed |

#### 2.1.2.2 Engineering properties

The processed material will be 6F2[24] (or similar specification) recycled aggregate. Crushed material will undergo typical testing required for unbound aggregates (6F2 or similar) and will only be used where it satisfactorily meets these testing requirements in addition to the requirements laid out in section 2.1.2.1.

The processed 6F2 shall be laid in accordance with the specification for Highway Works, Series 600 earthworks clause 612 and table 6/4. Further details can be found in the **Waste Recovery Plan.**

#### 2.1.2.3 Potential risks to air from Recycled Concrete Aggregate (RCA)

The physical characteristic of RCA which is of potential concern is dust generated from crushing and screening the recycled aggregate, and to a lesser extent dust from stockpiling and placement of materials. Dust will be managed during processing and stockpiling using recognised mitigation measures as described in PGN 3/16 (12) Process Guidance Note for Mobile Crushing and Screening[25], see **Dust & Emissions Management Plan**. The crushing and screening process will be managed under an EPR mobile plant licence (outside the scope of the DfR permit).

A bagwash product, containing low concentrations of chrysotile fibres, was used to remove imperfections in the reinforced concrete superstructure. The material, which is bound within a matrix and not prone to fibre release, is not discernible from the reinforced concrete. Removal is not reasonably practicable. It is possible that the presence of bagwash will contribute to ubiquitous levels of asbestos in the crushed material, however calculations by NRS confirm that prior to acceptance within the laydown area, the concentrations will be several orders of magnitude below hazardous waste limits (i.e. the crushed materials will be non-hazardous). Further information is provided in **Appendix 6 of the EMS Summary**.

Bagwash has not been identified on reinforced concrete cladding panels or non-cementitious masonry. To mitigate the potential mobilisation of ubiquitous asbestos fibres, a capping layer formed from crushed non-cementitious masonry and cladding panels (i.e. materials which do not contain bagwash) will be utilised. This will be delineated by a geotextile membrane separating the upper capping layer from the underlying fill material.

[24] www.standardsforhighways.co.uk/tses/attachments/471049cb-7dd8-452a-81e6-fc8af7d31b91

[25] 1 (publishing.service.gov.uk)

#### 2.1.2.4 Potential risks to water from RCA

Potential pollutants arising are in the waste leachate arising from rainwater percolating through the waste/runoff. Pollutants could consist of leachate/runoff containing elevated pH, dissolved metals in the leachate, and solid particles suspended in runoff. These are discussed in more detail below. Risks are also discussed in this section, with evidence to support claims included in relevant sections of 2.2 (Pathway and Receptor).

**Theory**

Most of the waste arisings from the RBHR project, will be concrete blocks. The original concrete specifications used in the construction of Trawsfynydd power station can be found in **Appendix A2**. Research[26] shows that when concrete is initially processed, the RCA stockpile run-off and drainage (leachate) from in situ RCA can or may be highly alkaline (i.e., high pH due to dissolved calcium hydroxide).
High-pH runoff results primarily from dissolution of exposed calcium hydroxide, a byproduct of the hydration of cement[27]. The typical range of alkaline pH from RCA runoff or leachate is illustrated in **Figure 11**.

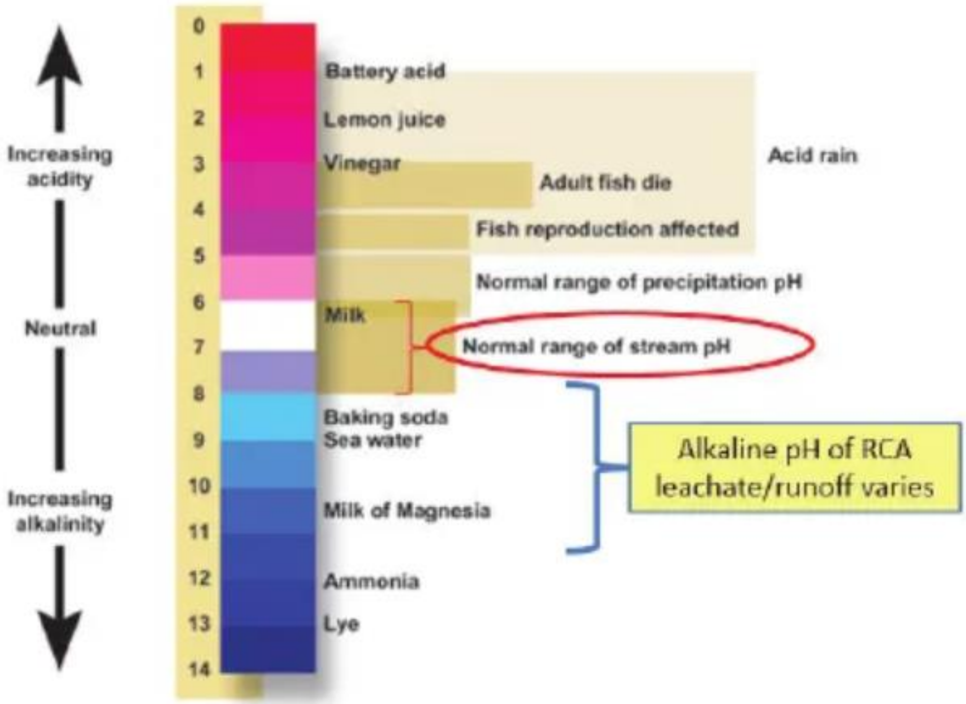





**Figure 11 Scale indicating typical pH range of RCA leachate/run-off and some common liquids.**

Ordinary Portland Cement (OPC) is an active hydraulic cement that is typically used as the binder in concrete; it reacts with water to set without the need for an activation agent such as

[26] State of Washington Dept of Ecology: Recycled concrete Aggregate Leachate: A Literature Review (May 2022). https://apps.ecology.wa.gov/publications/documents/2203003.pdf
[27] intrans.iastate.edu/app/uploads/2018/09/RCA_practioner_guide_w_cvr.pdf

lime. It is composed predominantly of calcium silicates, which react with water to form fine-grained calcium hydroxide (Portlandite).

High pH leachate and run-off is generated from the interaction of water with portlandite ($Ca(OH)_2$) and/or unreacted cement minerals that are exposed during the recycling process. The crushing and handling of RCA will disrupt the protective carbonate layer that limits the direct contact of water with unreacted portlandite and unreacted cement phases. (See **Figure 12)**

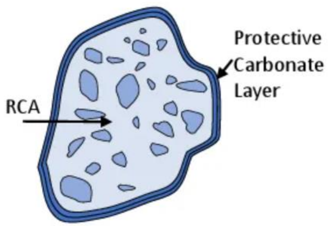



**Figure 12** Schematic of protective calcium carbonate layer formed around RCA.

In simple terms, RCA stockpiled (and subsequently permanently deposited) in the RCA laydown area will undergo repeated cycles of wetting (when it rains) followed by drying (when it stops raining). During the dry periods atmospheric carbon dioxide will act to carbonate the surface of the RCA and begin neutralising the leachate and run-off.

A number of factors limit the impact of elevated pH and other pollutants including:

- Soils with a high Cation Exchange Capacity (e.g., clay minerals) effectively neutralize high pH leachate by the dissolution of clay minerals, within a matter of minutes.
- Field tests have shown the rapid attenuation of high pH run-off or leachate once it meets the underlying naturally occurring soils and made ground. This may limit its migration to less than a meter in 50 years[28].
- The rate of carbonation of unbound RCA used in road pavement construction has been analysed and found to be in the order of 0.83mm/day ie 16mm/year[29]. As carbonation increases, the likelihood of elevated pH decreases.

In regards dissolved metals, these can be leached where pH is elevated. NRS has previously (Magnox Ltd, 2023)[30] tested the composition of stockpiled concrete-based demolition arisings at Winfrith (derived from demolition of buildings with a similar age to Trawsfynydd) and found that the material complied with the criteria for waste requiring testing before acceptance at inert landfills (WAC testing). Notwithstanding this, **in saturated conditions** it was noted that for chromium, if most or all the chromium was present as chromium (VI), then there is potential for chromium (VI) to be released at a concentration greater than the Environmental Quality Standards (EQS).

[28] irp.cdn-website.com/1fa14e81/files/uploaded/ExSum-Factors-Controlling-pH-of-RCA.pdf
[29] https://hal.science/hal-03797104/file/S0950061821031603.pdf
[30] DD/REP/0021/23 TRAWSFYNYDD PONDS COMPLEX DEMOLITION AND DISPOSAL PROJECT: TIERED ASSESSMENT OF RISKS TO GROUNDWATER FROM NON-RADIOLOGICAL POLLUTANTS

**Site specific features**

The RCA laydown area is cited on top of the existing made ground, part of which occupies the former asbestos landfill. The landfill is historic and was covered by a minimum 2m of soils, to prevent contact with the bagged asbestos lying beneath[31]. Below and to the sides of the landfill are naturally occurring soils and aggregate and made ground. The soils underlying the RCA laydown area contain evidence of peat/organic matter and are mainly low permeability, seasonally wet, acid loamy and clayey soils. Details of the underlying soils and made ground can be found in section 3.2 of the **Environmental Risk Assessment** which accompanies this application. These soils have a moderate clay content which will support the neutralisation of any high pH leachate and run-off generated from the freshly crushed RCA.

There is an average attenuation zone of 5m beneath where the newly placed layers of RCA will be recovered and the groundwater within the underlying bedrock (see section 2.2.3).

The rate of carbonation of unbound RCA used in road pavement construction has been analysed and found to be in the order of 0.83mm/day ie 16mm/year[32]. If left undisturbed, RCA will have undergone sufficient carbonation within 6-12 months such that leachate and run-off will generate a pH approaching neutral. Therefore the risk from elevated pH is only in the short term.

Saturated conditions will not occur in the RCA laydown area which will be free draining meaning there will be a short residence time of only a few hours and saturated conditions will therefore not occur[33]. The potential for leaching of dissolved metals (including Cr(VI) is therefore negligible.

It must also be noted that the RCA laydown area will be >10m from the nearest watercourse, not within an SPZ and material will not be placed below the water table. These are the specified criteria for controlling risks to controlled waters in the standard rules permit for this activity, therefore the standard rules generic risk assessment (GRA) is considered applicable in assessing risks to controlled waters. This indicates a quantitative hydrogeological risk assessment is not necessary, however the standard rules GRA emphasises the importance of good waste acceptance procedures to control the risk. Waste will be tested for inert WAC to provide assurance.

It should also be noted that previously 3,000 tonnes of site won RCA of similar provenance was stockpiled on the RCA laydown area in 2016 before being finally deposited and reworked on the RCA laydown area in 2023. During this time, existing groundwater and surface water monitoring points around the Nuclear Licensed site and specifically down gradient of the RCA laydown area have not detected any spike or increase in pH (see 2.2.3.4).

**Summary**

Immediately following crushing and material handling/placement, any rainwater falling on the RCA will generate a high pH leachate or run-off, however this will be rapidly neutralised by common, naturally occurring weak acids, including atmospheric carbon dioxide and soil acidity. Soil acidity represents acid bound to soil minerals, soil $CO_2$, and acid generated by the dissolution of common clay minerals. Independent of contact time (which will only be a

[31] SKM Enviros (November 2011): Assessment of Land-Raise Area Containing Licences Asbestos Disposals, Ref TRAWS/28-22005/DOC/8
[32] https://hal.science/hal-03797104/file/S0950061821031603.pdf
[33] Magnox (August 2023): North Laydown Area Improvement – Drainage assessment. TRAWS-EAN-23-027

few hours as the area will be free draining), atmospheric $CO_2$ rapidly neutralizes leachate and run-off to a pH of 8 within 4-6 hours[34].
After 6-12 months, the likelihood of any elevated pH is significantly reduced due to the effects of carbonation.
Mitigation measures to reduce the risks from high pH leachate and run-off are as follows:

- Material will only be accepted for deposit where testing confirms compliance with inert WAC.

- The stockpiles of freshly crushed RCA will be left undisturbed for as long as possible, prior to placement to encourage the redevelopment of the protective carbonate layer.

- The stockpiles will be shaped and profiled to help shed rainwater and limit water ingress. This will also prevent saturation.

- The RCA laydown area will be free-draining and so any high pH run-off will be rapidly neutralized by common environmental acids in both the air and underlying ground.

- The RCA will be placed and then compacted to ensure stability but without over-working the create excessive fines.

- The surface layer of the RCA laydown area will be composed of non-cementitious materials e.g. brick to reduce the likelihood of rainwater infiltration and to protect the underlying RCA for becoming disturbed by vehicle movement to enable rapid carbonation.

- Located >10m from a watercourse, and no waste deposits below the water table. This is principal protection measure for Standard Rules permit which assures protection of Controlled waters.

## 2.2 Pathway and Receptor

This section outlines the pathways and receptors, and discusses the baseline, noting the impacts detected from historical activities at the facility. S-P-R linkages are tabulated **Table 10**.

### 2.2.1 Geology

The geological maps of the area indicate extensive made ground under the site, reflecting the reprofiling of the site prior to development. Devensian Till Deposits are shown to the north and east of the site (true bearings), extending onto the site where the ground has not been reworked for the construction of the Power Station. Bedrock is shown as the Cambrian Rhinog Formation sandstone and mudstone bedrock with the Hafotty Formation mudstone to the immediate north of the site (see **Figure 13**).

The application area is located at the north end of the site, where the topography dips northwards. Golder (2019) suggests the rockhead topography in the application area dips northward from c. 188mAOD down to 176mAOD (**Figure 14**). Made ground overlays the bedrock, the site 'platform' is at c.195-197mAOD.

[34] irp.cdn-website.com/1fa14e81/files/uploaded/ExSum-Factors-Controlling-pH-of-RCA.pdf

The made ground consists of rock fill (rock from blasting into the hillside during construction which was used to extend the platform on the downslope side. The blasted fill material was augmented with Drift, which is Glacial Till and consists of clayey silty sand and gravel with boulders to sandy silty clay with gravel cobbles and boulders (Aspinwall, 1995). The RCA laydown area also consists of previous waste deposits (C&D wastes, plus the historic asbestos and other waste disposals, see section 2.1.1). The nature of the rock fill varies greatly. Materials encountered in boreholes and other excavations into the rock fill have been observed to range from large boulders to clayey material, occasionally accompanied by waste construction materials such as timber.

There is a below ground structure partially running through the area, which is the Eastern Goliath crane track on pillar and beam construction. The pillars do not present an obstruction to groundwater flow in the rock fill[35].

Soils in the Afon Tafarn-helyg catchment are stagnogley and brown podzolic soils. Soil properties vary across the catchment, with slowly permeable, seasonally wet, acid loamy and clayey soils mapped for the location of the site and much of the catchment. More freely draining acid loamy soils are mapped on the higher ground to the east and west of the site. Peat and acid peaty soils are mapped west of Llyn Trawsfynydd[36] (see **Figure 3** in the submitted **ERA**).

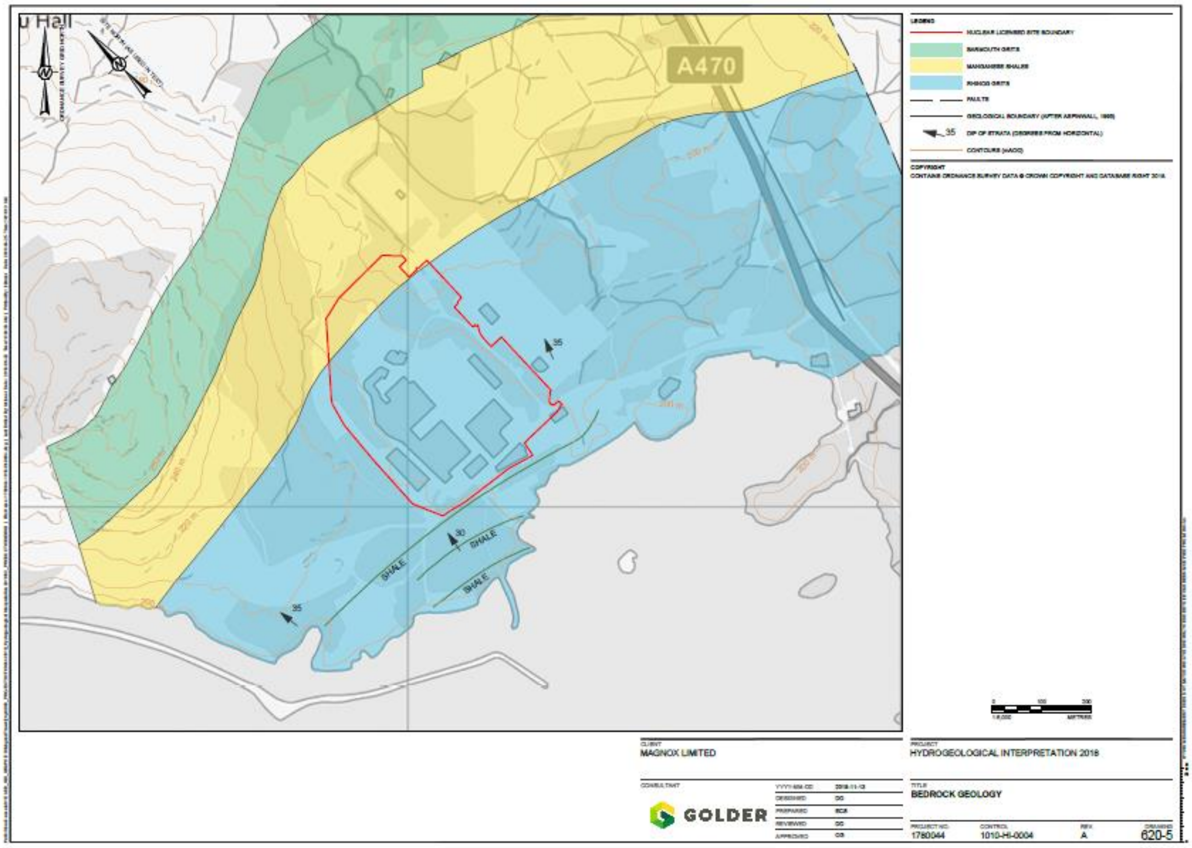



**Figure 13. Bedrock Geology.**

[35] Trawsfynydd Site: Hydrogeological Interpretation 2018 (Golder, Nov 2019). 1780044.620/A.2
[36] Trawsfynydd site Characteristics Summary, Galson Sciences July 2018

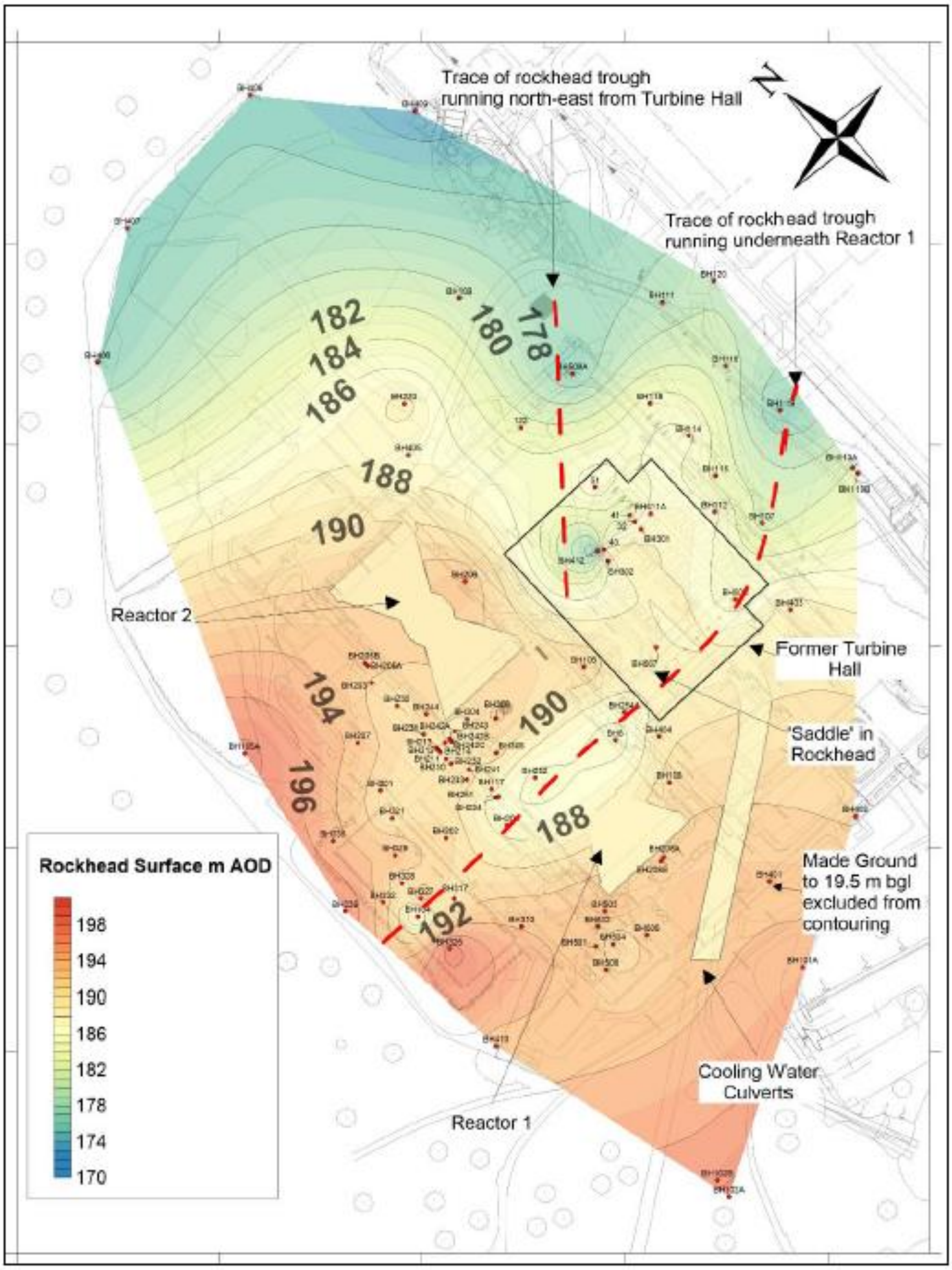



**Figure 14 Rockhead Topography Contour Plan (reproduced from Golder, 2019).**

### 2.2.2 Hydrology and Surface Water Management

#### 2.2.2.1 Catchment

The largest hydrological feature in proximity to the site is Llyn Trawsfynydd which is a man-made reservoir dammed by four structures including Hendre'r Mur Dam and Gyfynys Dam near the southern edge the site and Maentwrog Dam (hydroelectric dam) to the west of the site where the reservoir flows into the Afon Prysor and a dam on the southern edge of the reservoir. **Figure 15** shows the surface water catchment for the site. The site is located within the Afon Tafarn-Helyg catchment which flows northwards approximately 150 m east of the site before joining the Afon Dwyryd, approximately 4.2 km north of the site. Two small tributaries of the Afon Tafarn-helyg flow across or near the site boundary: an unnamed stream flowing off Craig Gyfynys and Nant Gwylan. The unnamed stream originates from springs on the east face of Craig Gyfynys and flows to the north-east, initially over ground near the western site edge and then goes underground via a culvert north of the site until it resurfaces via a pipe near the sewage works and then joins the Afon Tafarn-helyg. The unnamed stream channel is approximately 0.5 m wide and 0.015 m deep[37]. The Nant Gwylan originates from a valved outlet through the Gyfynys Dam, required as compensatory flow. This watercourse flows to the north through a culvert under the eastern corner of the National Grid site before joining the Afon Tafarn-helyg. The typical flow rate is 2.5 litres/second. The watercourse channel is about 0.75 m wide and 0.3 m deep. The site is located in the catchment of WFD Dwyryd – lower Surface Water Body (GB110065053600) within the Western Wales River Basin District. In the 2016 WFD classification (Cycle 2) the water body achieved an overall classification of 'Poor'. The Afon Prysor upstream (GB110065053752) and downstream (GB110065053751) of Llyn Trawsfynydd Surface Water Body achieved an overall classification of 'Poor' and 'Moderate' respectively in the 2016 WFD classification (Cycle 2). Llyn Trawsfynydd Surface Water Body (GB31034870) is located approximately 100 m south of the site and in the 2016 WFD classification (Cycle 2) achieved an overall classification of 'Moderate'.[38]

Rainfall data is detailed in section 4.1.2. Golder (2019) reports effective rainfall to be 1200mm per year.

[37] Wood (July 2021). Ponds Flood Risk Assessment. 807058.
[38] Source: https://nrw.maps.arcgis.com/apps/webappviewer/index.html?id=2176397a06d64731af8b21fd69a143f6 (accessed 30/08/19). Status definitions from 2016 WFD classification (Cycle 2).

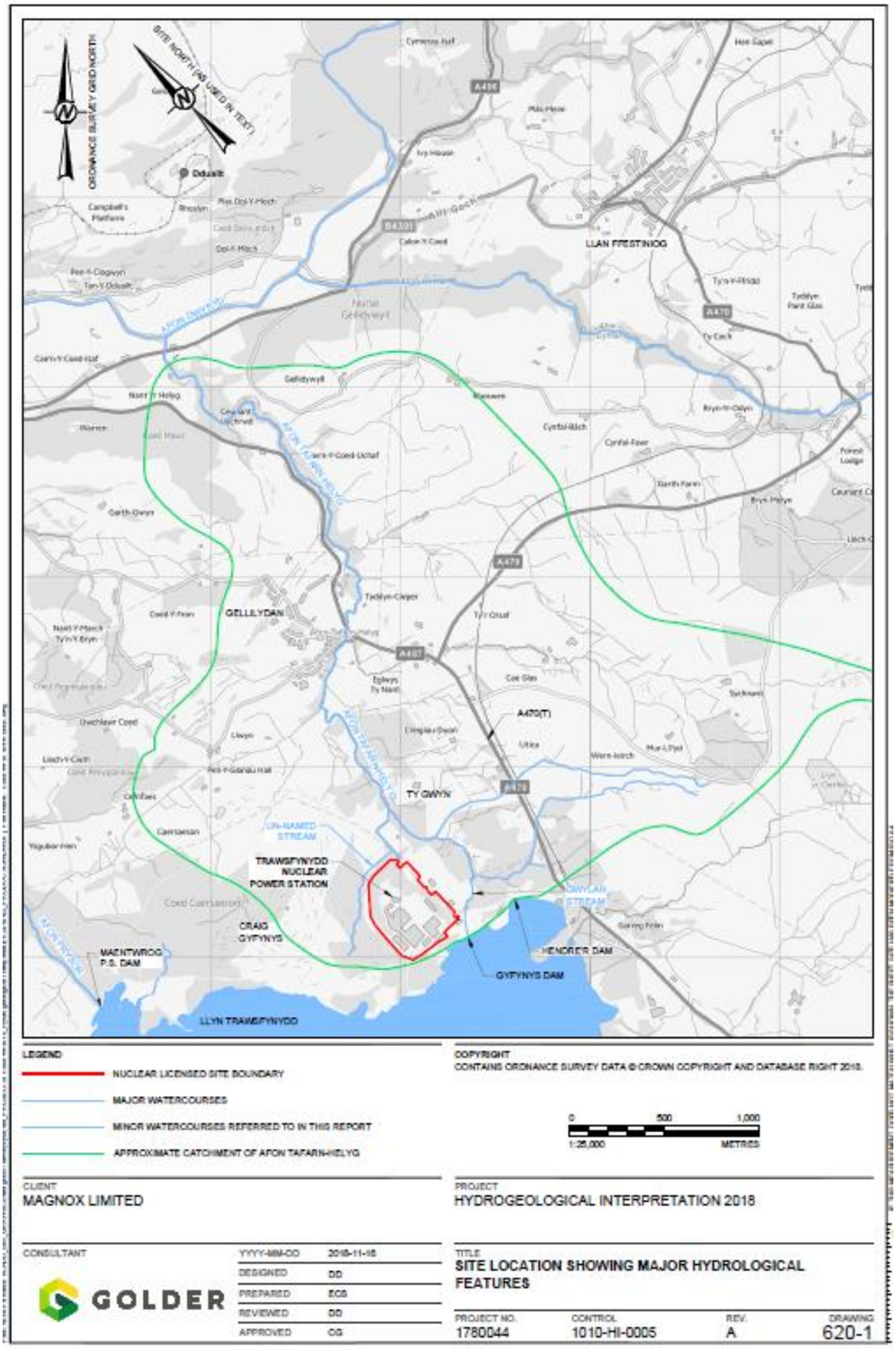



**Figure 15 Catchment**

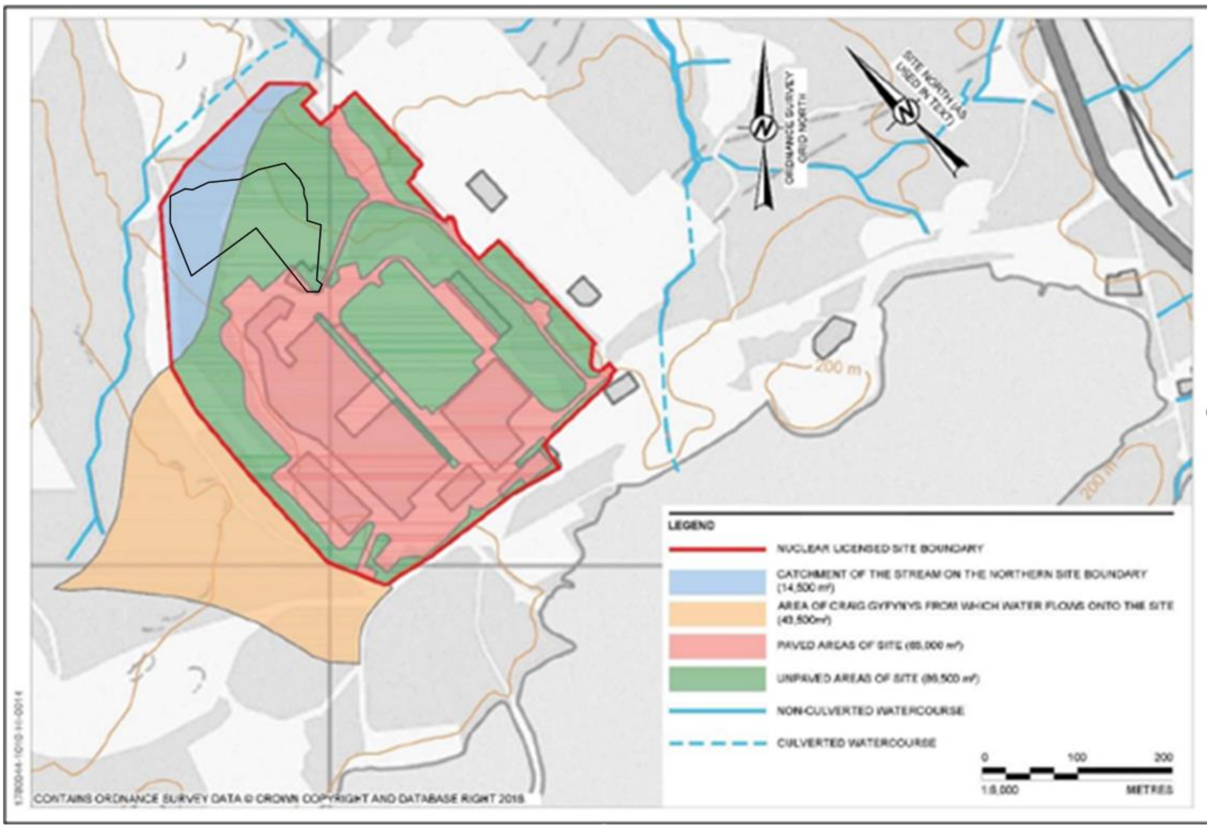



**Figure 16 – Catchment of different site areas (adapted from Golder, 2019) with DfR area overlain (black polygon) showing proximity stream from Craig Gryfynys (>20m).**

#### 2.2.2.2 Surface Water Receptors

Drainage networks at the site include surface water, foul, redundant oily water and groundwater drainage (see **Appendix A1**). The drainage networks have been modified during the decommissioning process and continue to be so. The surface water drainage system drains the Licenced site plateau falling west to east. The discharge is then via the diversion culvert. The drainage system runs through the site but does not serve the north end where the DfR activity will occur. The site surface water drainage system is generally >50m from the DfR area. Road gulleys feed to the system on the site roadways, however these are not present in the vicinity of the permit application boundary except the very southern tip of the DfR area which is within 10m, however at this point the depth of deposit is limited to capping of 125mm (See WRP) hence potential for contaminated runoff in this area is greatly reduced).

The unnamed stream flowing off Craig Gyfynys to the west and north of the DfR is 20m at its closest point, any runoff would soak into the soils thus the potential for contamination to this stream is considered low. **Figure 16** shows the DfR in relation to the stream, **Figure 17** shows the DfR area (green polygon) in relation to the site surface water drainage system. The potential for migration of pollutants from the RCA laydown area through the existing drainage network is low.

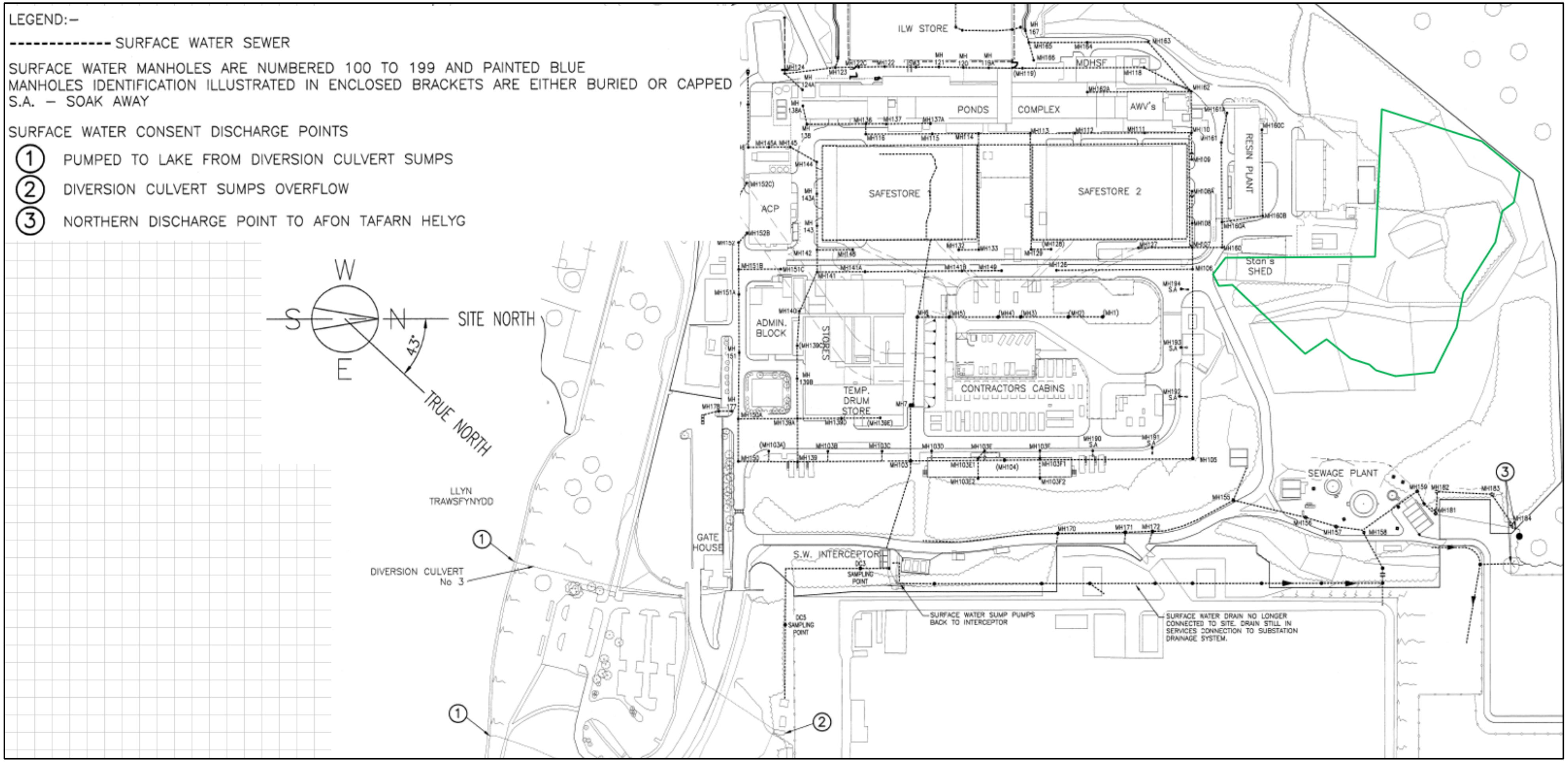



**Figure 17 – Site layout plan showing DfR area (green polygon) in relation to the site surface water drainage system**

As can be seen in the figures above the principle surface water receptor is the unnamed stream directly north of the application area, and the Afon Tafarn-Helyg stream, which Groundwater discharges to directly and indirectly via the Northern Outfall Pipe.

#### 2.2.2.3 Flooding

There have been no incidences of flooding within the Application area, and only a few incidences of historical flooding within the power station complex and nearby village of Gellilydan which can be summarised as follows:

- Flooding in February 2004 of the lower area of the sewage works during a period of extreme wet weather. Major remedial work was undertaken to the power station complex's surface water drains (which also intercept shallow groundwater) which has successfully prevented further flooding.
- Flooding on several occasions following heavy rainfall slightly north-west of the ponds building within the power station complex. During flooding, water was observed to flow vigorously from the slope above the roadway. Flooding of this area has been less severe since Gwynedd Council improved drainage along the National Cycle Path Route 8, which is uphill from the nuclear licensed site.
- Flooding at property known as Tafarn-helyg, Gellilydan, in early 1998. The property lies upstream of the bridge crossing of the Afon Tafarn-helyg, approximately 1.4 km north (downstream) of the site. A tributary of the Afon Tafarn-helyg flows off Mynydd Maentwrog, crosses the property in a culvert and then discharges into Afon Tafarn-helyg. A study by Golder (2002) indicated that flooding at the property is unlikely to have been caused by flooding from the Afon Tafarn-helyg (the catchment within which the power station complex is located) but instead by flooding from its tributary flowing off Mynydd Maentwrog.

Flood Risk from Rivers mapped layer[39] shows that the site is not within an area with risk of flooding from the sea or rivers. A small part of the existing RCA laydown area is within an area described as having a high risk of flooding (each year this area has a chance of flooding of greater than 1 in 30 (3.3%)) from surface water and small watercourses (**see Figure 18**).

However, it should be noted that this mapping uses broad-scale topographic data that will not pick up on minor local topographic detail such as kerbs, gullies and minor falls as well as not accounting for the site drainage system.

For this reason, the mapping should be taken as a guide to broad patterns of flood risk rather than confirmation of specific extents and levels of risk. Relatively recent improvements have been made to the drainage system to reduce the likelihood of further flooding. In addition, raising the plateau level of the RCA laydown area will help to decrease the risk of flooding in the future and the increased porosity of the fill material being used to raise and extend the RCA laydown area, will enable it to be free draining.

[39] Flood and Coastal Erosion Risk Maps, accessed 27 January 2025.

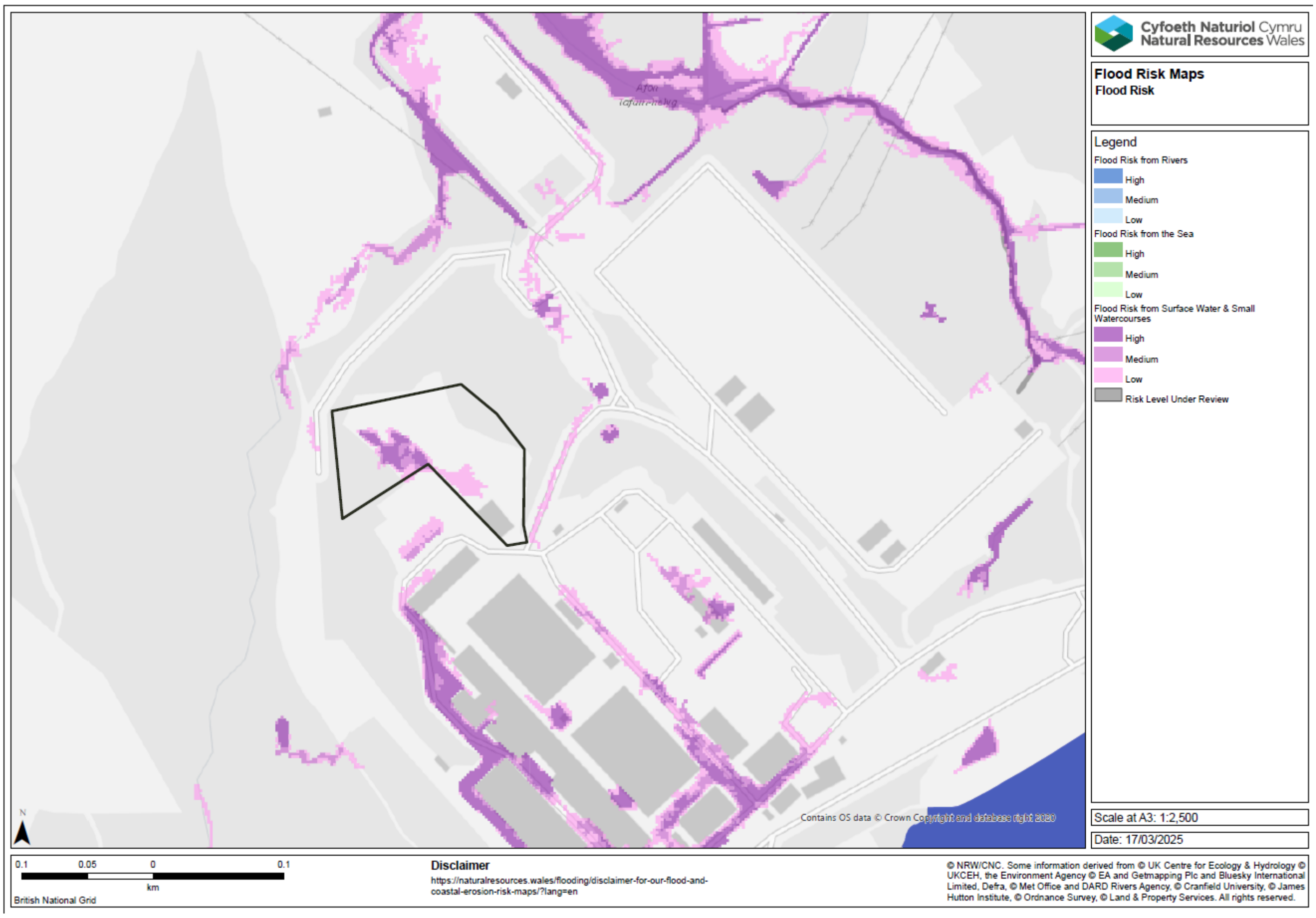



**Figure 18 Flood risk (DfR Area boundary in black)**

#### 2.2.2.4 Surface water quality

Surface water quality in the watercourses that flow adjacent to the site (unnamed watercourse and Nant Gwylan which flow into Afon Tafarn-helyg) has been impacted by historical contamination sources at the site, either directly by contaminant spills reaching the surface water drainage (e.g., oils) or indirectly by contaminated shallow groundwater baseflow. The main potential historical sources (known as Areas of Potential Concern, APC in Golder, 2015 and SKM Enviros, 2013) of radiological, hydrocarbon, chemical or solvent contamination of the ground across the site have been identified in previous assessments (Golder, 2015 and SKM Enviros, 2013). The site infrastructure (e.g., drains) is also a potential source and pathway of contamination. **Table 6** summarises the potential source areas from the whole Nuclear Licenced Site and the associated contaminants.

**Table 6. potential source areas and the associated contaminants** (Source: Based on Golder (2019), summarising Golder (2015) and SKM Enviros (2013)).

| Potential contaminant source areas | Contaminants | Historical contamination summary |
|---|---|---|
| Safestore building footprint | Radionuclides (cobalt-60 and tritium) | In the 1980s groundwater seeped into Safestore waste vault 1 and became contaminated with radionuclides (tritium and cobalt-60). Cobalt-60 was detected in BH08 and the Diversion Culvert discharge in the 1980s, but concentrations have now dropped below the laboratory detection limit after the radioactive waste was removed from the Safestore vaults. |
| Cooling Ponds Complex | Radionuclides (caesium-137, strontium-90 and tritium) | Several incidents have led to groundwater and soil contamination in this part of the site including the release of cooling ponds water through a fault in joint No. 7 into the underlying drains, soil and groundwater. |
| Radiologically Controlled Area (RCA) former active drainage system | Radionuclides and hydrocarbons | The RCA active drains, which led to an oil separator tank, were designed to convey aqueous radioactive wastes and any oil spills from facilities in the RCA. There were incidents where parts of the active drainage system became flooded and contaminated water overflowed at ground level and entered the surface water drainage system. The active drainage system has been decommissioned and remaining structures grouted. |
| Workshop complex | Hydrocarbons and chlorinated hydrocarbons | Spills from storage and use of fuel and solvents. |
| Construction disposal area and asbestos burial | Hydrocarbons, heavy metals and asbestos | The disposal area initially accepted construction waste and subsequently asbestos containing materials, neutralised waste acid and methylated spirits. Historical oily seepages have been reported at the base of the slope of the disposal area, and these are now intercepted by a drain which discharges into the sewage works. This area is not currently used for waste disposal. |
| Former Turbine Hall area and associated structures | Hydrocarbons (turbine oils and transformer oils) | Historically, substantial quantities of hydrocarbon-based lubricants were used in this area. Oily waters were collected by sumps and discharged to surface water via an oily drain system and the now disused main oil separator. A hydrocarbon seepage along Roadway 5 and subsequent groundwater and surface water contamination is attributed to materials formerly used in this area. A French drain was installed in 1999 to capture this seepage and discharges to the NOP via an oil interceptor. |
| Substations operated by National Grid and Scottish Power | Hydrocarbons | Not assessed in Golder (2019). Potential oil leaks at the substations could result in groundwater and surface water contamination. |

Radioactive contamination is not discussed. Historical hydrocarbon contamination of groundwater is mainly attributed to a leaking oily drain system that has since been decommissioned. Interception of shallow groundwater and use of an oil interceptor ensures there is minimal impact on the local watercourses (Magnox, 2014).

Site monitoring data has been previously screened[40] against water quality standards (WQS) defined as the freshwater annual average Environmental Quality Standards (AA-EQS) set out in The Water Framework Directive (Standards and Classification) Directions (England and Wales), 2015. This found that for hydrocarbon contamination (radioactive contamination is not discussed):

- Unnamed stream west of the site which flows off Craig Gyfynys: the heavier, less mobile, aliphatic and aromatic hydrocarbon carbon fractions (above C16) were found at detectable concentrations in some of the samples in the downstream (SW6) of the discharges from the NOP (SW5) and sub-station (SW7).

[40] Wood (July 2021). Ponds Flood Risk Assessment. 807058.

Concentrations upstream (SW1) were generally below detection limit (<0.01 mg/l) except for isolated measurements slightly above the detection limit (as aromatics and aliphatics C21-C35 and C8-C40). The small increase in concentrations downstream (SW6) is likely to reflect inputs from the NOP discharge (SW5) and, to a lesser extent, substation discharge (SW7; limited data available) which contain detectable concentrations above upstream water quality. The detectable concentrations in the discharge from the NOP are likely to be attributed to shallow groundwater inflows to the upstream drainage system which, as discussed above, is known to contain detectable hydrocarbon concentrations from historical contaminant sources (Golder, 2019a). However, all concentrations in the discharges and downstream of the discharges are below WQS (where available); and

- Nant Gwylan and Llyn Trawsfynydd: the heavier, less mobile, aliphatic and aromatic hydrocarbon fractions (above C16) were found at detectable concentrations at SW2 and SW3 (Nant Gwylan) and SW4b (Llyn Trawsfynydd) but below WQS where available. SW2 and SW4b provide an indication of water quality in Llyn Trawsfynydd.

The monitoring data is consistent with the historical contamination sources at the site discussed in **Table 6**. There is minimal impact of the historical hydrocarbon leakage on the local watercourses (concentrations below WQS), due to interception of shallow groundwater and use of an oil interceptor.

### 2.2.3 Hydrogeology

#### 2.2.3.1 Aquifer Characteristics

Golder (2019) advises there are two groundwater flow systems at the site: A deep groundwater flow system in fractures of the bedrock; and a shallow groundwater flow system in the highly permeable shallow drift and rockfill deposits. The shallow groundwater flows from the south-west and south-east towards the north and north-east and the flow through shallow deposits dominates the flow through the deeper bedrock;

- The shallow groundwater levels generally follow the rock-head topography. There is a trough in rock-head under the south-eastern half of the Cooling Pond Complex and the north-western half of Reactor 1, where groundwater ponds above the rockhead;
- Engineered structures on site influence shallow groundwater flow. These include the Cooling Pond Complex and Reactor foundations as well as the foundation walls of the Goliath Tracks, a cooling water culvert underlying the former Turbine Hall and the Gyfynys Dam; and
- The groundwater drains around the Reactor buildings leading to the Diversion Culvert (passing through Manhole 6) have only localised effects on shallow groundwater elevations. However, the drains do provide preferential pathways for groundwater flow.

It is reasonable to assume that the mass concrete structures have a strong influence on shallow groundwater movement across the site, although these are not expected to influence flow in the DfR area as the Eastern Goliath wall (the only below ground structure which slightly intercepts the area) is discontinuous at this end.

| Material | Hydraulic conductivity | | Effective porosity | |
|---|---|---|---|---|
| | (m/s) | Source | (-) | Source |
| Bedrock | <=$10^{-9}$ to $2x10^{-5}$ | a1 | ~0.01 | b, c, d |
| Drift | $2x10^{-8}$ to $3x10^{-4}$ | a2, b | 0.04 to 0.28 | b |
| Rock fill | $5x10^{-5}$ to >= $1x10^{-3}$ | a2, a3 | ~0.35 | c, d |

**Figure 19 – Measured hydraulic conductivities for different groundwater units within the site**

It should be noted that only the Bedrock is classed as Secondary A aquifer. The overlying units (drift and rock fill) are not classified.

#### 2.2.3.2 Groundwater Flow

The flow of groundwater beneath the wider site is overwhelmingly through the shallow flow system developed in the drift, rock fill and the shallowest parts of the bedrock. **Figure 20** shows the main flow of groundwater across the site, with the DfR area shown bounded green.

The main routes by which groundwater leave the wider Site are inferred to be as follows:

- Via the Diversion Culvert system storm drain, including groundwater that issues on the western edge of the Site and is then captured by the surface water drains, and groundwater captured by the groundwater drain leading into Manhole 6 from Reactor 1 (and then pumped to Llyn Trawsfynydd via Diversion Culverts No. 3 and No. 4);
- Via the road drains associated with Roadway No. 5 that flow to the Northern Outlet Pipe, which capture the groundwater seeping from springs along the west side of this road. When operable, the French drain described in Golder (2017e) can be expected to have collected much of this groundwater;
- Flow in Rock Fill, and in bedrock (although there is a strong upward component in bedrock flow)
- Issues at springs on the eastern Site boundary (some of which is captured by the Pwmp Dail and pumped back to the Main Drains Oil Interceptor), and surface flow across the site boundary; and
- Via pathways in Rock Fill leading north-eastward towards the stream that runs off Craig Gyfynys and thence around the west side of the Scottish Power site.

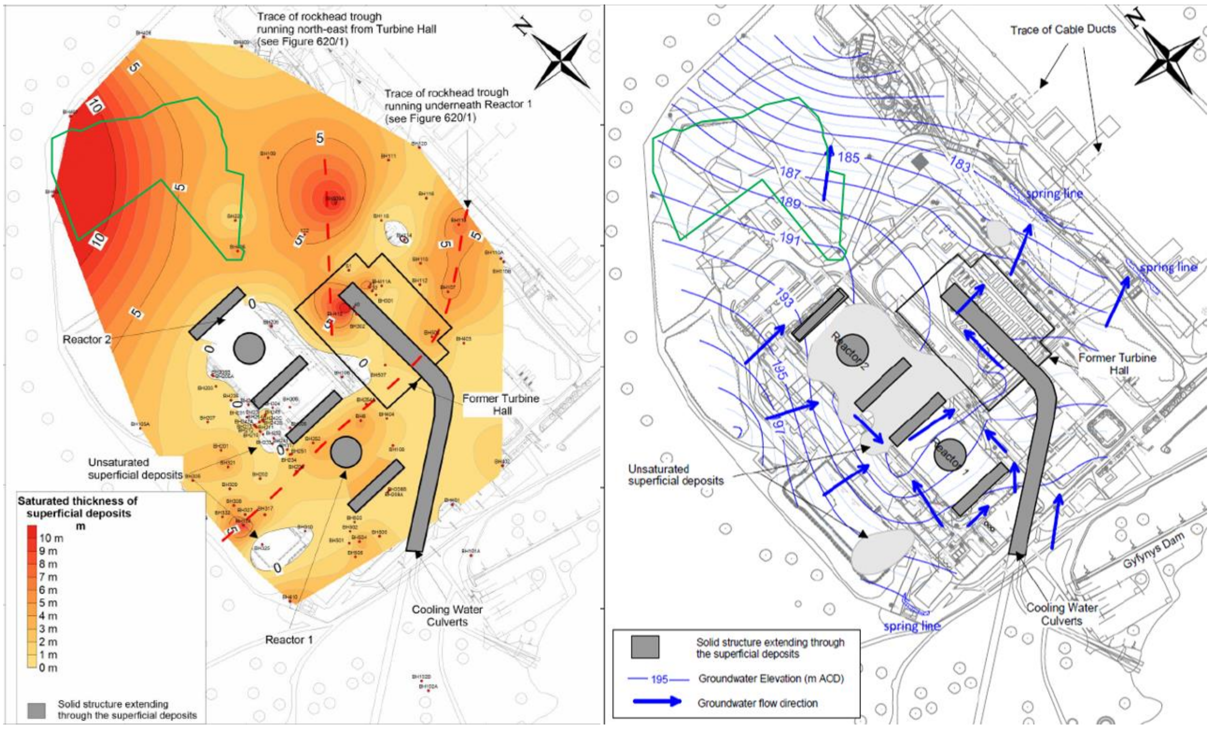
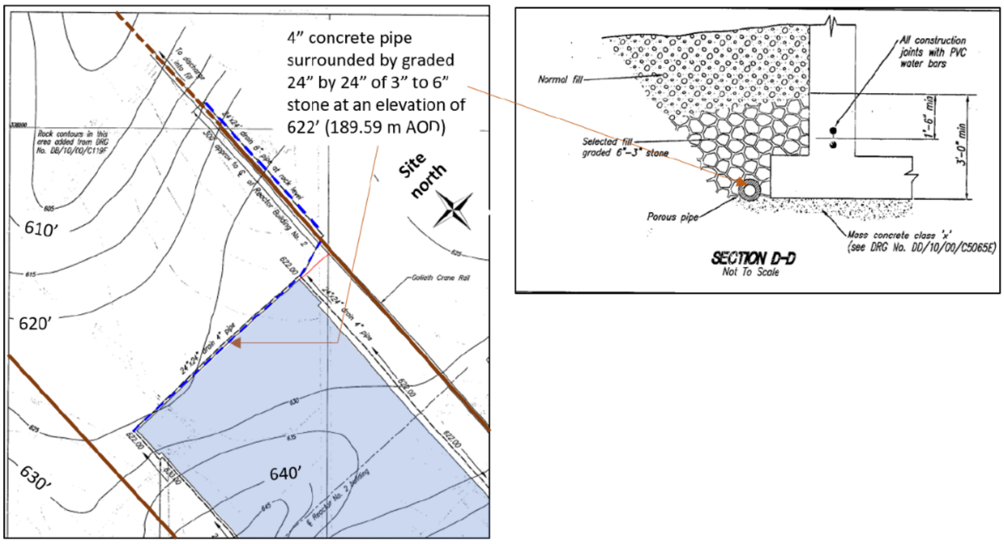



**Figure 20 Groundwater elevation, flow direction and saturated thickness (adapted from Golder (2019). DfR area overlaid (Green polygon).**

The groundwater beneath the Application Area (bounded green) is flowing NE. **Figure 20** indicates the majority of the groundwater will discharge to the un-named stream directly North/northeast, whilst some will be picked up in the spring to the north east and discharge via the northern outlet. A very small portion may be picked up by a groundwater drain in the Southeast of the area which runs adjacent to the east Goliath Wall and flow to the Diversion Culvert and discharge to Lake Trawsfynydd (**Figure 21)**. Note that status of this drain is not known.

**Figure 20 - Extracts from Golder (2000a) Showing Designed Groundwater Drainage Adjacent to the Footings of the North Wall of Reactor 2**



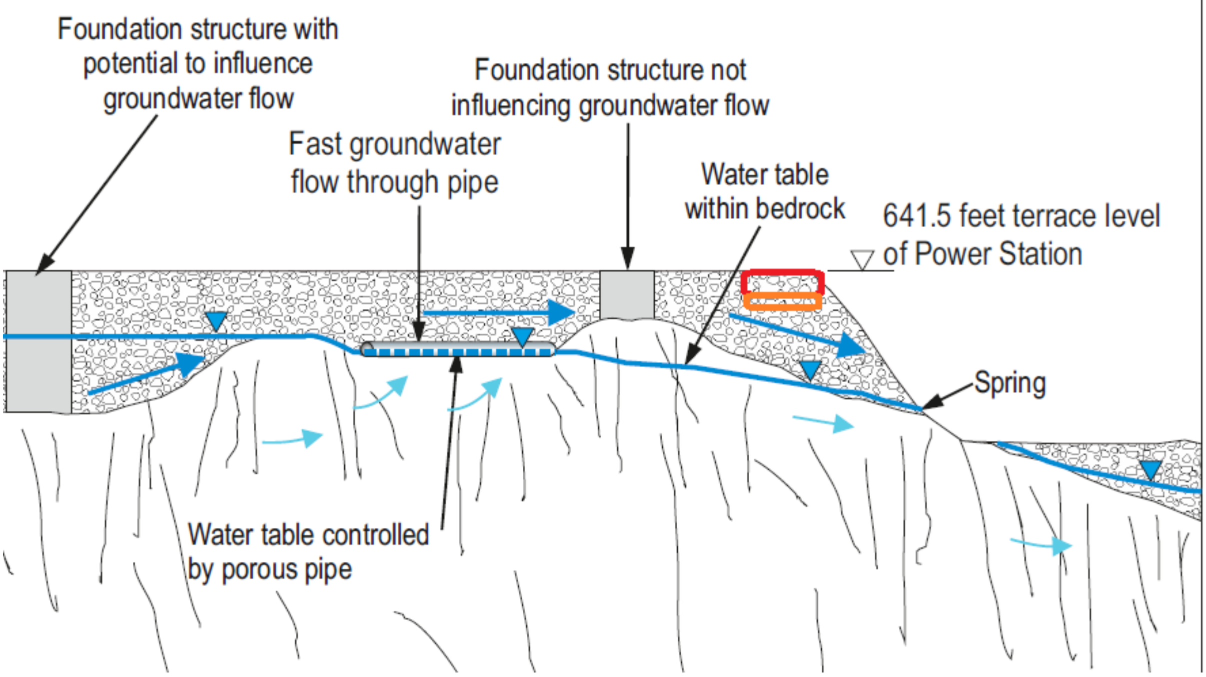



**Figure 22 Simplified cross-section, RCA laydown area shown in red, historic deposits in orange (adapted from Golder, 2019). Note majority of discharge from rock fill groundwater expected to be to the stream to north of site, not the spring which discharges to the NOP.**

A review of groundwater monitoring data was carried out, covering the period following the Golder (2019) review to present day (2025). This confirms the water contours presented above in **Figure 20** remain valid (borehole time-series data presented in **Figure 23**). Locations of boreholes used for baseline monitoring can be found in **Figure 24.** The elevation of the base of the laydown area (see **Figure 24**) was compared with the groundwater contours presented in **Figure 20 (Table 7).** There is generally >4.5m unsaturated zone between the base of the laydown area (the current site topography) and the groundwater elevation. The exception is the western edge of the proposed RCA laydown area where it drops to 1.5m (worst case).

**Figure 23 Time series showing variability in groundwater level from 2019 to present day (2025).**

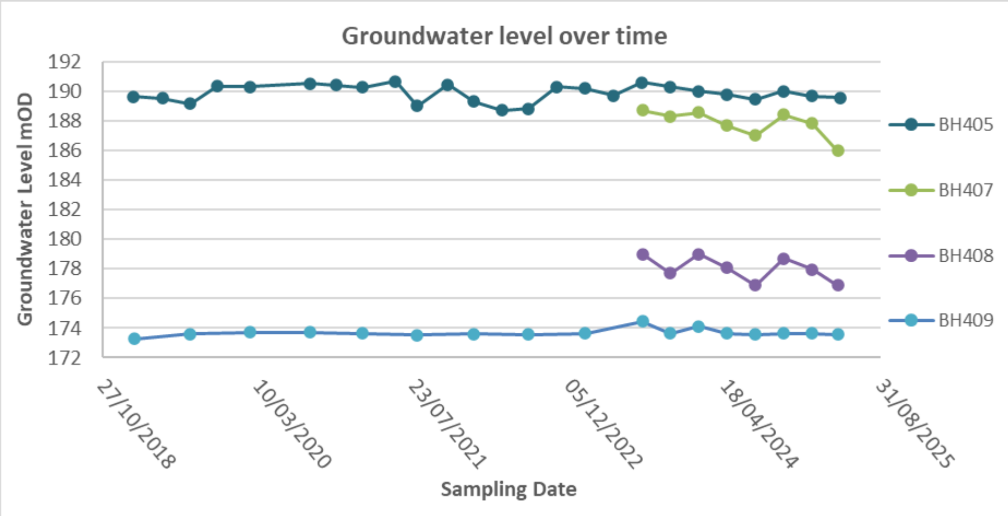



**Table 7 Groundwater level (mAOD) relative to relevant nearest lowest point of laydown area**

| **Location** | **Laydown Base Elevation (mAOD)[1]** | **Groundwater Level (mAOD)[2]** | **Delta (m)** |
|---|---|---|---|
| North East Boundary | 186.25 | 181 | 5.25 |
| South Boundary | 195.75 | 191 | 4.75 |
| West Boundary | 192.75 | 191 | 1.75 |
| [1] **See Figure 24**. | | | |
| [2] Interpreted from groundwater contours presented in Figure 20 | | | |

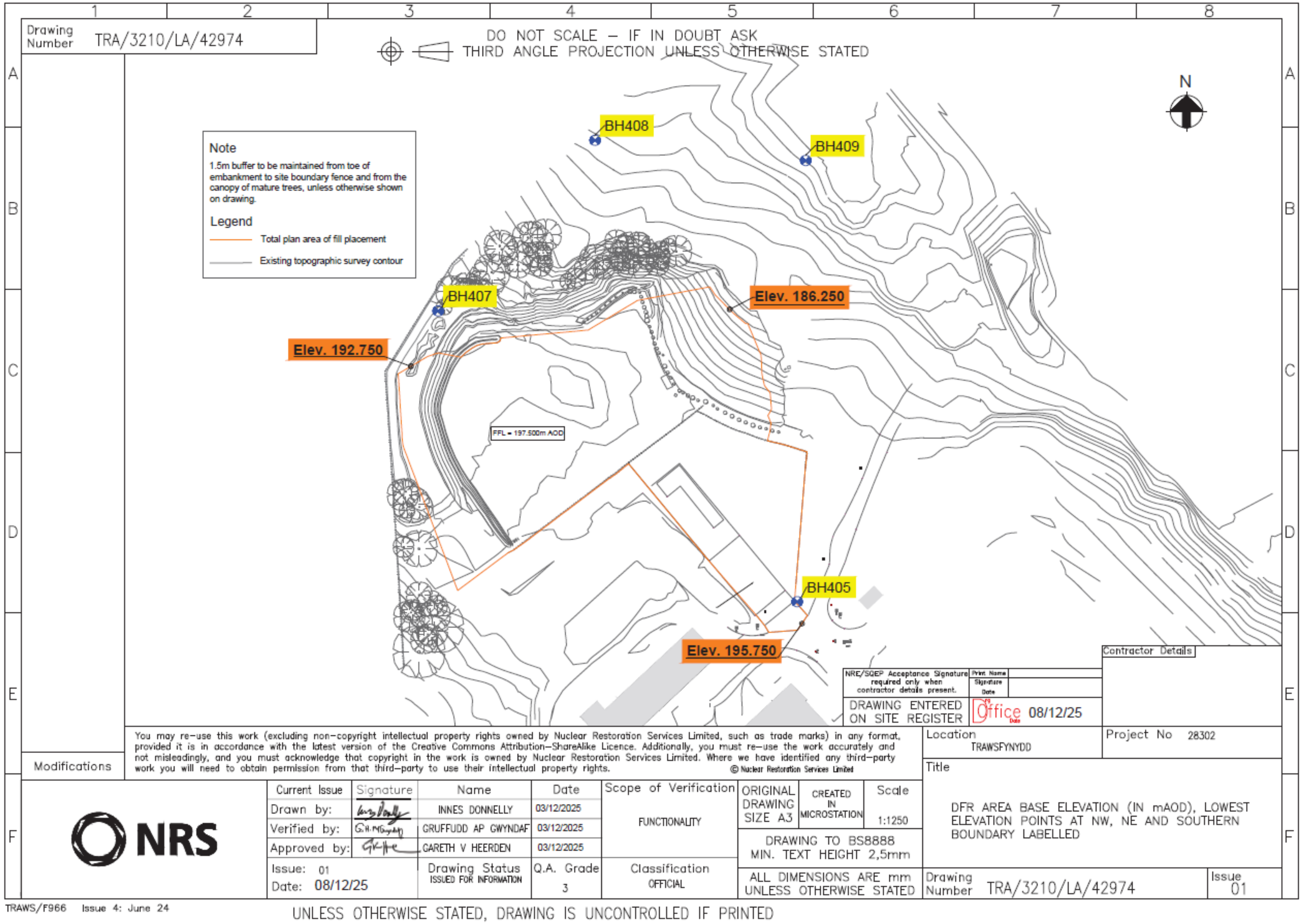



**Figure 24: DFR Area base elevation (in mAOD), lowest elevation point relative to borehole locations. For full topography see Drawing TRA-3210-LA-42971 (Appendix A5 of Waste Recovery Plan).**

The groundwater within the rock fill does not support a terrestrial ecosystem[41]. There are a significant number of obstructions to groundwater flow within the rock fill (although these are not expected to influence flow in the DfR area) as well as groundwater drains which are directed to the main storm water drain. Whilst there are other pathways for the migration of groundwater from the rock fill this is one of the main ones and none are considered to support a groundwater dependent ecosystem.

Secondary migration pathways are then capable of facilitating the distribution of contaminants across and off site.  These comprise:

- Migration of shallow groundwater through the rock fill and superficial deposits (advective flow) and subsequent baseflow to the tributaries of the Afon Tafarn-helyg – the Gwylan Stream and the unnamed stream from Craig Gyfynys, the latter judged to be the dominant migration pathway for the DfR area.
- Rapid transportation across the site via the site drainage systems associated with the Reactor buildings and the surface water main drain from the area around the RCA and former Turbine Hall, both leading to the Diversion Culvert sump, which is discharged to Llyn Trawsfynydd via the Diversion Culvert Overflowing of the Diversion Culvert pump sump into the Gwylan Stream in extreme high flow conditions.
- Migration of shallow groundwater to the underlying bedrock (either advective transport of contaminants or as free non-aqueous phase contaminants).

**Impacts of climate change on groundwater levels**

WSP (2023)[42] considers the effects of climate change on groundwater occurrence at the Nuclear Licenced Site up to 2080. It was found in relation to groundwater in bedrock, it is unlikely that climate change induced variation to annual average recharge will have a marked effect on the typical groundwater levels and pressures. It also concluded that climate change effects are unlikely to lead to widespread continuous saturation of made ground within the Trawsfynydd NLS boundary at a higher level than now.

#### 2.2.3.3 Water Resources and Abstractions

NRW online mapping[43] indicates that the site is not within or close to a Source Protection Zone (SPZ).

There are several water abstraction licences held by NRS Ltd associated with activities within the power station, none of which are used for drinking water.

There is a licensed abstraction held by Trawsfynydd Lake Management Committee using up to 113 m$^3$ water for a fish farm throughflow which is approx. 920m to the south of the site. The Pysgotfa Prysor Fishery at Nant Tyddyn-Yr-Yn has a licensed abstraction and is approx. 950m to the southeast of the site. Except for the power station, there are no abstractions within 500m of the site.

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[41] WSP (2025) Trawsfynydd Site: Review of Groundwater and Surface water monitoring. December 2025, Ref UK0038631.1487.648.

[42] WSP (2023) Trawsfynydd Ponds Complex: Hydrogeological Conceptual Model to Support the Demolition and Disposal Project. June 2023, Ref. 21480599.601/A.2.

[43] Source Protection Zones (SPZ) Merged | DataMapWales

#### 2.2.3.4 Groundwater Quality

The major ion chemistry is typically dominated by calcium and bicarbonate. Calcium bicarbonate type water is typical of groundwater freshy recharged by rainfall and is formed by carbon dioxide saturated water acquiring calcium from dissolved minerals in the soil zone. In aquifer systems groundwater chemistry typically evolves to sodium chloride type water because of processes including ion exchange and mineral dissolution within the aquifer. Here such evolution is not judged to be occurring and instead the trend from calcium bicarbonate type water to sodium chloride type water is inferred to be a result of surface run off from dissolved de-icing salt.

The pH of groundwater flowing from Craig Gyfynys and from Llyn Trawsfynydd is typically a little below 7. Where groundwater does not pass beneath the Site (e.g. north of the Site), the pH does not discernibly change downgradient. There are three areas of groundwater that have elevated pH: Towards the north of the east side of the Cooling Ponds (around BH235). This may be a consequence of interaction with concrete foundations, including those of the Cooling Ponds Complex and/or ILW Store; At the south end of the Cooling Ponds Complex. This may be associated with interaction with concrete foundations and/or leakage from surface water drains; and Beneath the Turbine Hall. This may be associated with leaching of crushed concrete used to fill the basement void. As can be seen in **Figure 25** the pH downgradient of the RCA laydown area (relevant BHs BH407, BH408, BH409) is not elevated (with 2023 included in **Figure 27**). BHs 405, 407, 408 and 409 have been monitored quarterly since 2023 (see **table 8** below) with no elevated pH detected. It is therefore reasonable to assume that previous deposits of 6F2 in the application area have had no discernible impact on the pH. Chromium has only been detected above the EQS (max value Cr(VI) 1.2ug/l) in BH412, BH507 and BH509A, which are within or on the periphery of the Turbine Hall footprint, where crushed concrete was historically used as infill and saturated causing elevated pH, there have been no detections in boreholes downgradient of the DfR area[44]. **Figure 26** is also included to demonstrate historical contamination from the area (downgradient boreholes BH407, 408, 409) is not detected.

**Table 8 pH results 2023-2025 for monitoring points near RCA laydown area**

| pH | TRN/BH405 | TRN/BH407 | TRN/BH408 | TRN/BH409 |
|---|---|---|---|---|
| Jan 2023 | 6.55 | | | 6.65 |
| Apr 2023 | 6.82 | | | |
| Jul 2023 | 6.44 | 6.18 | 5.56 | 7.02 |
| Oct 2023 | 6.82 | 6.38 | 6.53 | 6.36 |
| Jan 2024 | 6.42 | 6.72 | 6.71 | 6.85 |
| Jul 2024 | 6.36 | 6.51 | 6.60 | 6.34 |
| Oct 2024 | 6.33 | 6.15 | 6.10 | 6.63 |
| Jan 2025 | 6.46 | 6.37 | 6.33 | 7.00 |
| Apr 2025 | 6.75 | 7.44 | 7.28 | 7.22 |
| Jul 2025 | 6.33 | 6.31 | 6.07 | 6.42 |

[44] WSP (2023) Current Quality of Groundwater, Surface Waters and Sediments

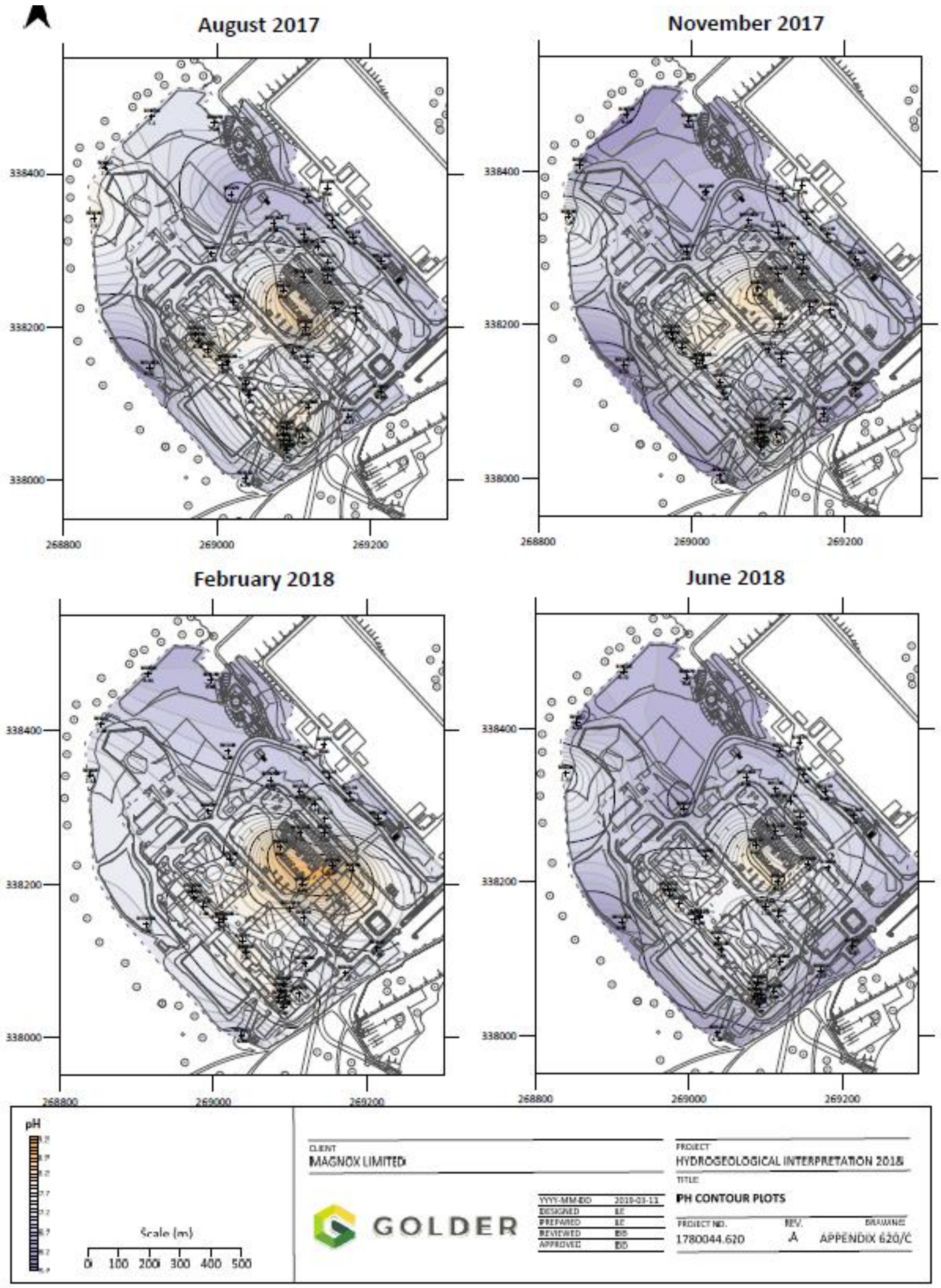



**Figure 25 pH Contour plots (from Golder, 2019)**

**Table ● Comparison of the Recently Collected Groundwater Quality Data with the Design Expectations for the Additional Groundwater Monitoring Boreholes**

| Borehole | Design Expectations | Potential Contaminants of Concern[4] | Contaminants of Concern above Screening Values in Groundwater |
|---|---|---|---|
| BH401 | Characterisation of potential contaminants in area of Workshop Complex consolidated APC. | Hydrocarbons: lubricating oil, gas circulator oils, shield cooling oil, chlorinated hydrocarbons – degreasers. | None |
| BH402 | | | None |
| BH403 | | | Bis (2-ethylhexyl) phthalate: 12 µg/l. Gross alpha: 0.61 Bq/l. |
| BH404 | | | Di-n-butyl phthalate: 134.7 µg/l. Gross beta: 1.2 Bq/L |
| BH405 | Up-gradient monitoring of the construction disposal area. | | Di-n-butyl phthalate: 202.9 µg/l. Total dissolved iron: 2088 µg/l. |
| BH406 | Down hydraulic gradient of the construction disposal area. | Hydrocarbons: ethanol, petroleum distillates, organic acids, heavy metals. | None |
| BH407 | Down hydraulic gradient of construction area. | | None |
| BH408 | Down hydraulic gradient of construction area. | | None |
| BH409 | Down hydraulic gradient of construction area. | | None |
| BH410 | Up-gradient monitoring of the Site. | | n/a |
| BH411A | Monitor potential residual source beneath former turbine hall/ down gradient of RCA. BH301, BH302 and BH303 were formerly in this location, but were destroyed. This area is between the RCA and the 'perimeter' boreholes and was not able to be subject to monitoring. | Hydrocarbons: Turbine oils, transformer oils (PCBs). | None |
| BH412 | | | Total dissolved chromium:6.3 µg/l. Gross beta: 2.8 Bq/l. |
| BH501 | To provide further information regarding MH138, MH138A and the FDTs as potential sources of radiological and/or non-radiological contamination. | Radionuclides: Cs-137, Sr-90, tritium, & others. Hydrocarbons: Acetone and Trichloroethene (and solvent breakdown products). | None |
| BH502 | | | 1,1,1-trichloroethane: 152 µg/l. |
| BH503 | | | None |
| BH504 | | | None |
| BH505 | | | Chloroform: 5 µg/l. |
| BH506 | | | None |
| BH507 | There is a requirement to monitor contaminated groundwater originating from the Ponds that is not intercepted by the groundwater drains associated with Reactor Safestores 1 and 2. The opportunity should also be taken to monitor for hydrocarbon contamination potentially originating from surrounding APCs. | Radionuclides: Cs-137, Sr-90, tritium, & others. Solvents (from the vicinity of MH138A) and hydrocarbons from other Site APCs. | Gross beta: 5.1 Bq/l. |
| BH508 | | | Gross alpha: 0.13 Bq/l. Gross beta: 1.4 Bq/l. |
| BH509A | | | None |

**Figure 26 Golder (2017) Groundwater Interpretative Report – BH407 – BH409. No evidence of contaminants of concern.**

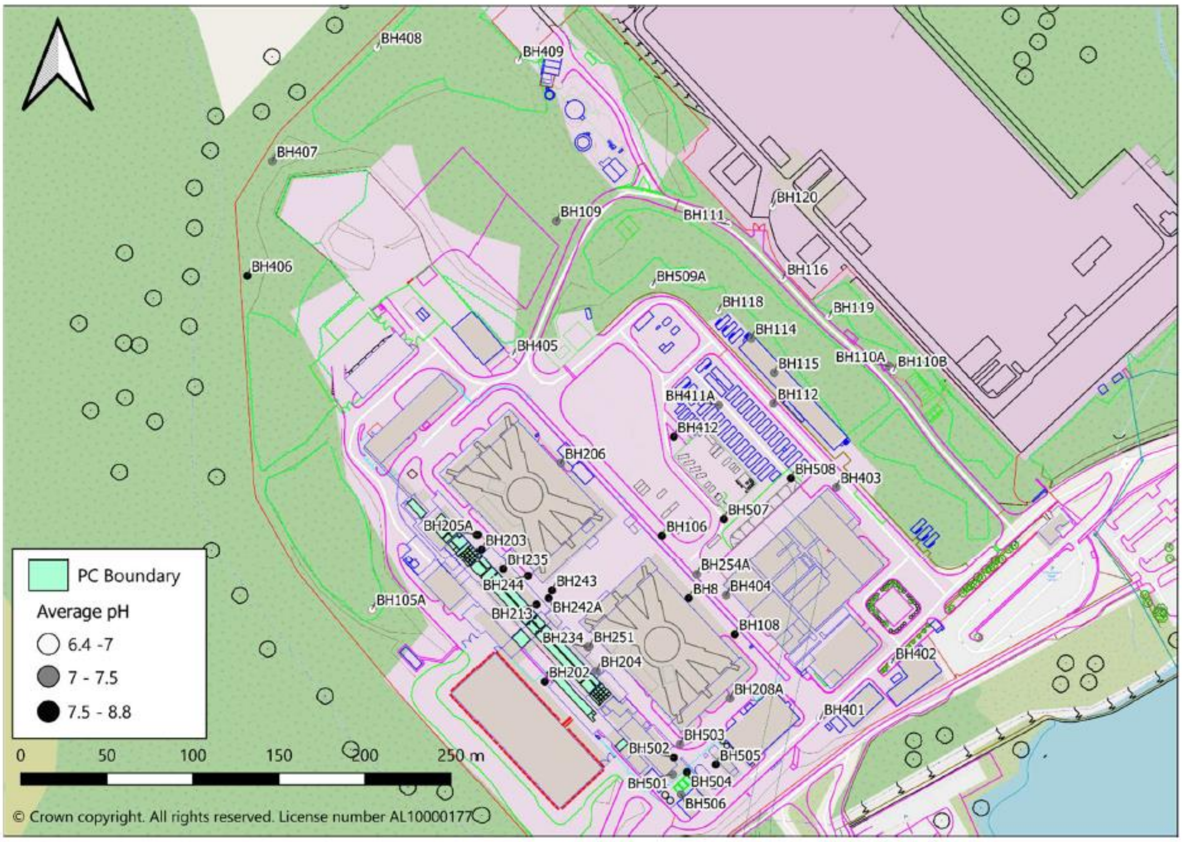



**Figure 27 Locations of Average pH Measurements and Value (WSP, 2023)[45]**

### 2.2.4 Man-made subsurface pathways

These are presented in **Table 9**.

**Table 9 Potential man-made subsurface pathways**

| Feature | Comment |
|---|---|
| BH220 & BH405 | Borehole located near southern edge of DfR area. Boreholes adequately sealed to ensure direct runoff via headworks is not a credible pathway. Future site works will be controlled in order to protect boreholes. |
| Possible groundwater drain | Located at depth in the Southeast of the area which runs adjacent to the east Goliath Wall (at the base) and flow to the Diversion Culvert and discharge to Lake Trawsfynydd (**Figure 21**). Note that status of this drain is not known. |

### 2.2.5 Receptors summary

The key water environment receptors include:

[45] WSP (2023) Current Quality of Groundwater, Surface Waters and Sediments

- Groundwater in the bedrock (Rhinog Grits), classified as a Secondary A aquifer. The groundwater is not abstracted in the immediate vicinity down hydraulic gradient of the site for potable uses. The RCA laydown area will not intercept the water table (generally >5m unsaturated zone), and will not increase infiltration to the historic landfill.
- Afon Tafarn-helyg (receiving surface water from Gwylan Stream and the unnamed stream from Craig Gyfynys).
- Any runoff reaching the surface water drainage system could discharge via the Diversion Culvert to Llyn Trawsfynydd[46] (a recreational fishery, SSSIs are located on the shores of the lake, the chemical quality of the lake has been classified as good and it has a moderate ecological status under the WFD). The RCA laydown area is >10m from the nearest stream.

The key human/public receptors include a number of footpaths located around the site which are used by members of the public and the nearest residential property is Ty Gwyn which is over 500m to the north east of the site (**Figure 28**).More distant receptors include the small village of Gellilydan is located 1.5 km northeast of the site and Trawsfynydd village is located about 3 km to the southeast across the lake. Full details of human receptors are contained in the **Dust Management Plan**.

Although several nationally designated sites lie within 2 km of the site (see **Table 2**), the key receptors of ecological significance are the Ancient Woodland 20m west of the DfR area, and BAP habitats.

[46] This is an artificial lake created to supply the hydroelectric power station at Maentwrog

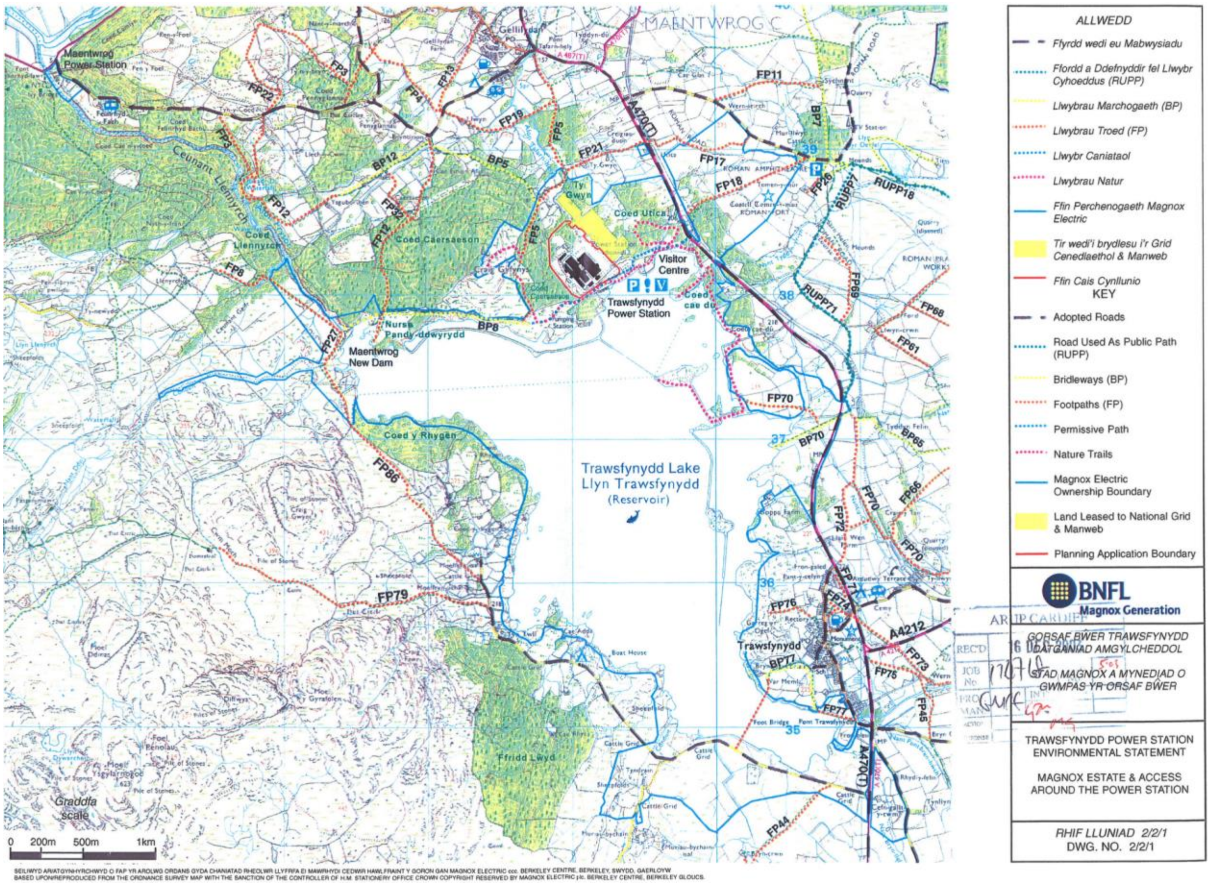



**Figure 28 – Public footpaths around the NLS and the location of Ty Gwyn (nearest residential property).**

### 2.2.6 Receptors and Compliance Points

Further discussion of the impacts to receptors is included in section 2.4 and the ERA.

**Groundwater and Surface water**

The CSM has not identified a requirement for groundwater and surface water compliance points.

**Amenity**

Migration pathways for noise and dust are through the air and directly towards sensitive receptors. The prevailing wind direction across the site is south westerly. **Figure 28** shows the location of public footpaths around the site and the location of the nearest residential property, Ty Gwyn which is over 500m to the northeast of the site. Noise and dust monitoring will be carried out during the RBHR project to ensure that the mitigation measures put in place are fit for purpose. A **Dust Management plan** also accompanies this application.

| Table 10: Conceptual Site Model and Risk Screening | | | | | |
|---|---|---|---|---|---|
| Receptor | Source | Harm | Pathway | Risk Screening | |
| What needs protecting? | What is the contaminant? | What are the impacts if the contaminant reaches the receptor? | What route could the contaminant reach the receptor? | Covered by Standard Rules GRA? (Note - bespoke ERA completed anyway. Question included to indicate appropriate level of risk assessment required.) | Completed risk assessments |
| Local human population. Users of footpath 150m NW of site. | Releases of particulate matter (dusts) from deposits and disturbance of historic asbestos landfill. | Harm to human health - respiratory irritation and illness. | Air transport then inhalation. | N - presence of historic landfill | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ Dust Management Plan |
| Local human population. Users of footpath 150m NW of site. | As above | Nuisance - dust on cars, clothing etc. | Air transport then deposition | N - presence of historic landfill | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ Dust Management Plan |
| Local human population, livestock and wildlife. | Litter | Nuisance, loss of amenity and harm to animal health | Air transport then deposition | Y | ERA (qualitative assessment) |
| Local human population. Site access road and A470. | Waste, litter and mud on local roads | Nuisance, loss of amenity, road traffic accidents. | Vehicles entering and leaving site. | Y | ERA (qualitative assessment) |
| Local human population. Nearest receptor Ty Gwyn 500m NE. | Odour | Nuisance, loss of amenity | Air transport then inhalation. | Y | ERA (qualitative assessment) |
| Local human population. Users of footpath 150m NW of site. Ty Gwyn residential receptor 500m NE. | Noise and vibration | Nuisance, loss of amenity, loss of sleep. | Noise through the air and vibration through the ground. | Y | ERA (qualitative assessment) |
| Local human population. Users of footpath 150m NW of site. Ty Gwyn residential receptor 500m NE. | Scavenging animals and scavenging birds | Harm to human health - from waste carried off site and faeces. Nuisance and loss of amenity. | Air transport and over land | Y | ERA (qualitative assessment) |
| Local human population. Users of footpath 150m NW of site. Ty Gwyn residential receptor 500m NE. | Pests (e.g. flies) | Harm to human health, nuisance, loss of amenity | Air transport and over land | Y | ERA (qualitative assessment) |
| Local human population and local environment, associated with Afon Tafarn-Helyg catchment. | Flooding of site | If waste is washed off site it may contaminate buildings / gardens / natural habitats downstream. | Flood waters and other extreme weather events | Y | ERA (qualitative assessment) |
| Local human population and / or livestock after gaining unauthorised access to the waste operation | All on-site hazards: wastes; machinery and vehicles. | Bodily injury | Direct physical contact | Y | ERA (qualitative assessment) |
| Local human population and local environment. | Arson and / or vandalism causing the release of polluting materials to air (smoke or fumes), water or land. | Respiratory irritation, illness and nuisance to local population. Injury to staff, fire fighters or arsonists/vandals. Pollution of water or land. | Air transport of smoke. Spillages and contaminated firewater by direct run-off from site and via surface water drains and ditches. | Y | ERA (qualitative assessment) |
| Local human population and local environment | Accidental fire causing the release of polluting materials to air (smoke or fumes), water or land. | Respiratory irritation, illness and nuisance to local population. Injury to staff or fire fighters. Pollution of water or land. | As above. | Y | ERA (qualitative assessment) |
| All surface waters close to and downstream of site. The unnamed stream flowing off Craig Gyfynys, Afon Tafarn-helyg and to a lesser extent Llyn Trawsfynydd. | Spillage of liquids, leachate from waste, contaminated rainwater run-off from waste e.g. containing suspended solids. | Acute effects: oxygen depletion, fish kill and algal blooms | Direct run-off from site across ground surface, via surface water drains, ditches etc. | Y | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |
| All surface waters close to and downstream of site. The unnamed stream flowing off Craig Gyfynys, Afon Tafarn-helyg and to a lesser extent Llyn Trawsfynydd. | Spillage of liquids, leachate from waste, contaminated rainwater run-off from waste e.g. containing suspended solids. | Chronic effects: deterioration of water quality | As above. Indirect run-off via the soil layer | N - Complies with key control measure (>10m from watercourse) however presence of historic landfill requires additional consideration. | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |
| Abstraction from watercourse downstream of facility (for agricultural or potable use). Except for the power station, there are no abstractions within 500m of the site. | Spillage of liquids, leachate from waste, contaminated rainwater run-off from waste e.g. containing suspended solids. | Acute effects, closure of abstraction intakes. | Direct run-off from site across ground surface, via surface water drains, ditches etc. then abstraction. | Y | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |
| Groundwater. - Rhinog Grits Secondary A aquifer. It is accepted there is upward flow from the aquifer into the shallow groundwater in made ground (which in turn flows laterally to the unnamed stream flowing off Craig Gyfynys, Afon Tafarn-helyg via NOP and Lake Trawsfynydd via groundwater drains to diversion culvert. | Spillage of liquids, leachate from waste, contaminated rainwater run-off from waste e.g. containing suspended solids. | Chronic effects: contamination of groundwater, requiring treatment of water or closure of borehole. | Transport through soil/groundwater then extraction at borehole. | N - Complies with key control measure (above water table and outside SPZ) however presence of historic landfill requires additional consideration. | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |
| Groundwater. - Rhinog Grits Secondary A aquifer. It is accepted there is upward flow from the aquifer into the shallow groundwater in made ground (which in turn flows laterally to the unnamed stream flowing off Craig Gyfynys, Afon Tafarn-helyg via NOP and Lake Trawsfynydd via groundwater drains to diversion culvert. | Spillage of liquids, leachate from waste, contaminated rainwater run-off from waste e.g. containing suspended solids. | Chronic effects: contamination of groundwater, breaching relevant EQS. | Transport through unsaturated zone to groundwater beneath the site. | N - Complies with key control measure (above water table and outside SPZ) however presence of historic landfill requires additional consideration. | ERA (qualitative assessment)<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |
| Local human population using Llyn Trawsfynydd. | Contaminated waters used for recreational purposes | Harm to human health - skin damage or gastro-intestinal illness. | Direct contact or ingestion | Y | ERA (qualitative assessment) |
| Protected sites - Ancient Woodland and BAP protected habitat (semi-broadleaved woodland) adjacent to site. | Any | Harm to protected site through toxic contamination, nutrient enrichment, smothering, disturbance, predation etc. | Any | N - Ancient woodland and BAP habitat within 50m. | ERA (qualitative assessment)<br>+ Dust Management Plan<br>+ ESSD CSM<br>+ ESSD 2.4 supplement |

## 2.3 CSM Summary

The S-P-R pollutant linkages are assessed in the Environmental Risk Assessment (separate document). The guidance on risk assessment for installations, waste and mining waste operations and landfill sites indicates that the Environmental Site Setting & Design (ESSD) report should be used to consider the additional risks for deposit for recovery activities. Therefore the remainder of this section considers solely the discharge of contaminants from the waste to ground and surface waters, taking into consideration the historic waste disposal activities, which took place beneath the RCA laydown area.

## 2.4 Tier one supplementary risk assessment

### 2.4.1 Qualitative risk assessment

Qualitative risk assessment is the first tier of assessment required in NRW's Groundwater risk assessment guidance[47]. Further stages of risk assessment are only required where qualitative assessment suggests there's an unacceptable risk. Reviewing section 2.1.2, the risks to ground and surface waters are from contaminants in the waste, and risks of mobilising contaminants from historical deposits beneath the area.

Previous studies have confirmed that the crushed concrete is expected to comply with inert WAC requirements[48]. In regards assessment of the risks leachable inorganic (i.e. chromium and pH), the standard rules criteria are relevant. The standard rules permit is *SR2017No1 – Use of Waste in a Deposit for Recovery Activity* which permits the use of up to 60,000m$^3$ inert wastes in a recovery activity. Condition 2.4.2 states:

The activities shall not be carried out:

(a) within 500 metres of a European Site or a Site of Special Scientific Interest (SSSI);

(b) within 250 metres within the presence of Great Crested Newts where it is linked by good habitat to the breeding ponds of the newts;

(c) within 50 metres of a site that has species or habitats protected under the Biodiversity Action Plan that Natural Resources Wales considers at risk to this activity;

(d) within 50 metres of a National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Site (LWS), Ancient woodland or Scheduled Ancient Monument;

(e) within groundwater Source Protection Zones 1 and 2 or if a source protection zone has not been defined then not within 250 meters of any well, spring or borehole used for the supply of water for human consumption. This includes private water supplies;

(f) on any landfill whether historical, closed, or operational;

(g) within 10 metres of a watercourse; or

(h) within a specified Air Quality Management Area for particulate matter less than 10 microns (PM10).

Condition 2.1.1 of the standard rules permit states that *No waste shall be deposited into a water body or sub-water table.*

Reviewing the criteria above, the standard rules permit criteria are met apart from:

- The presence of BAP habitats within 50m (sub-clause 'c').

[47] Groundwater risk assessment for your environmental permit - GOV.UK
[48] DD/REP/0021/23 TRAWSFYNYDD PONDS COMPLEX DEMOLITION AND DISPOSAL PROJECT: TIERED ASSESSMENT OF RISKS TO GROUNDWATER FROM NON-RADIOLOGICAL POLLUTANTS

- the proximity of an Ancient Woodland Site (sub clause 'd') and
- the presence of the former waste disposal area (sub clause 'f').

In all other respects the criteria are met. NRW/EA guidance[49] states:

*If you are applying for a bespoke permit but most of your activities are covered by standard rules, you only need to do a risk assessment for the activities or risks that are not covered by the generic risk assessment for those standard rules*.

When considering the standard rules generic risk assessment[50], impacts from leachate and contaminated rainwater run-off from waste:

- To surface waters are qualitatively judged to be '**medium**' on the basis of potential contamination to watercourses and natural habitats leading to chronic effects and deterioration of water quality. The residual risk is judged to be **'low**' on the basis the activity is not permitted within 10m of a watercourse and there are no point source discharges. Risk is limited by waste acceptance rules and limits to permitted waste types. Good onsite management practices must be detailed in the management system for controlling and containing water and leachate on the site.
- To groundwater are judged to be '**medium**' on the basis of potential contamination of groundwater requiring treatment of water or closure of a borehole. The residual risk is judged to be '**low**' on the basis its outside a Source Protection Zone 1 or 2, not within 250m of any drinking water source, and that waste is not deposited sub water table. Importantly, the importance of good waste acceptance procedures are emphasised in reducing the risk.

In the case of the proposed RCA laydown area, it should be noted there will be no direct discharge into groundwater. There is a significant attenuation zone (generally about 5m, see 2.2.3.2) directly beneath the RCA laydown area. The attenuation zone will offer attenuation due to the permeability and composition of the underlying RCA laydown area, made ground, and dilution within the groundwater within the units overlying the bedrock. As discussed in section 2.1.2, as is typical with crushed concrete handling, there will be potential for elevated pH in the short term (12 months) which is associated with freshly crushed concrete, however this will undergo a degree carbonation as coarse grade material will be stockpiled and then subsequently placed in lifts not exceeding 125mm depth, both aspects will permit the carbonation of the 6F2 aggregate. The carbonation process is diffusion controlled and therefore slower in saturated conditions, but in unsaturated conditions (which is the case here) it is quicker because the rate of diffusion of dissolved carbon dioxide is lower than the rate of diffusion of carbon dioxide gas[51]. Alkalinity in porewater that migrates to the water table will be attenuated by processes including neutralisation, carbon dioxide in-gassing, reaction with aluminosilicate minerals and surface adsorption.

Previous stockpiling of 1,943m$^3$ of 6F2 in the area during 2017 (this was derived from site won concrete of similar provenance to the RBHR arising, and was spread over the area in 2023[52]), have also been subject to previous risk assessment[53], which assessed the risks to surface and groundwaters as mild severity, unlikely likelihood, with a trivial significance. The

[49] Risk assessments for your environmental permit - GOV.UK
[50] https://nrwcmsv13-a3hwekacajb3frbw.a02.azurefd.net/696607/copy-of-sr2017-no01-v1-generic-risk-assessment.xlsx
[51] Magnox (December 2021): Trawsfynydd PCDD: Assessment of Risk to Groundwater from Alkalinity for a base case for the interim and end states of the disposal area.
[52] Magnox (August 2023): North Laydown Area Improvement – Drainage assessment. TRAWS-EAN-23-027
[53] Magnox (June 2017): QLRA, Proposed Stockpiling of Residual Product for Site Re-use

downgradient monitoring (see 2.2.3.4) has confirmed that there have been no impacts on pH or chromium (VI) associated with these[54], hence confidence is high that there is sufficient attenuation of relevant pollutants (such as pH and any metals) in the unsaturated zone.

The relevant standard rules criteria above are met hence the residual risk can be readily determined to be low as the relevant standard rules safeguards (no deposit sub-water table, >10m from a watercourse, not within an SPZ or 250m of a borehole used from drinking water, waste acceptance rules) provide assurance for attenuation and dilution processes. The risks posed from the activity exacerbating impacts from historic waste deposits and risks to protected species/habitats are not covered by the standard rules generic risk assessment, hence these are further discussed below.

### 2.4.2 Consideration of historic disposal activities and other previous works

NRS maintains a site-wide (NLS) qualitative risk assessment for all APCs (see section 2.1.1). The risks were previously assessed in SKM Enviros (2013)[55] which considered historical contaminants which could be mobile (asbestos is not mobile and is not considered a contaminant of concern with respect to groundwater) being metals, hydrocarbons, solvents and acids, with medium risk to via baseflow in the shallow groundwater to the un-named stream to the north of the application area, on the basis that at the time there was limited characterisation and monitoring. Since that time, additional monitoring and further characterisation work has taken place (as detailed in section 2.1.1). The site wide risk assessment was updated in 2020[56], a summary of the risks to controlled waters from the relevant APC's in the application area is presented in **Table 4** (see section 2.1.1). Risks from historic contaminants are well understood, and risks classed as either low or very low.

The proposed works will not increase the amount of water infiltrating to ground[57], therefore will be no change to the rate of any leaching of contaminants from the historical deposits. There is at least 2m of soils covering the asbestos deposits beneath the RCA laydown area, the buffering capacity of this material, combined with the fact that the 6F2 is not saturated hence will carbonate relatively quickly, means that the risk of any new leachate adversely interacting with historic contaminants is low, and what little risk there is in the short term will reduce in the long term as the material fully carbonates. Confidence is high due to the fact that previous use of similarly derived 6F2 in the past has not resulted in any contamination being detected in downgradient boreholes.

Although not part of the formal mitigation as previous works to place more material above asbestos have already been completed[58], the proposed works, will further act to protect the asbestos from disturbance, hence the works will improve the risk to human health from historic asbestos fibres as there will be greater protection which will only act to avoid further disturbance.

Considering the evidence above the qualitative assessment presented in **Table 4** remains valid, the proposed DfR activity will not increase the risks associated with the historical deposits, and existing arrangements in managing the risks from the historic deposits exclusively via the site Land Quality programme are considered adequate in controlling the risks associated with these deposits.

[54] WSP (2023) Current Quality of Groundwater, Surface Waters and Sediments

[55] SKM Enviros (March 2013): QLRA Risks to controlled waters from non-radioactive land contamination
[56] Golder (September 2020): 2020 Update of the Land Quality Qualitative Risk Assessment.
[57] TRAWS-EAN-23-027 North Laydown Area Improvements – Drainage Assessment. Magnox (2023)
[58] Magnox (January 2022) Land Quality Management Summary, advised all physical work for the identified APCs is complete.

### 2.4.3 Consideration of impacts to Habitats and Protected Species

As part of the planning application a Preliminary Ecological Appraisal (PEA) was undertaken, which can be found in **Appendix A6** of the **ERA**. This identified habitats which can support proximity within the site and the Ancient Woodland c.20m west of the DfR area. The PEA found that qualifying habitats would not be adversely affected through changes in air and or **water quality**), however disturbance impacts could not be ruled out within woodland on site and the adjacent woodland (semi-natural broadleaved woodland, a Section 7(also known as BAP) habitat), therefore required further assessment was subsequently undertaken carried on 7th August 2024 and the following conclusions reached:

- No mature trees are to be removed as a result of the proposals.
- There are no PRFs in any of the trees within the 30 meters radius survey area and as a result
- there is no potential for disturbance of bats or bat roosts as a result of noise/dust/vibrations during the course of the works.
- Due to the fact that no mature trees are to be removed, there will be no physical habitat fragmentation.
- Due to the fact that there will be no nighttime working, there will be no requirement for illumination of the working area and therefore no habitat fragmentation due to temporary lighting.
- There will be no permanent illumination installed which could result in habitat fragmentation.

The report concluded the proposed works were as having ‘No’ potential to have any negative impact on bat roosts or habitat connectivity and that no further bat survey work or mitigation measures will therefore be required. The full report is available in **Appendix A7** of the **ERA**.

The PEA also recommended the following mitigation measures in respect of Protected Species/Habitats:

- Breeding birds: Pre-works checks for any works disturbing breeding bird habitat; any vegetation clearance to be supervised by a suitably qualified ecologist.
- Riparian mammals: Pre-works checks; otter survey up to 10 weeks prior to works.
- Badger: Pre-works checks; badger survey up to 10 weeks prior to works.
- Dormouse: Pre-works checks immediately prior to works and during vegetation clearance. Any vegetation clearance to be supervised by a SQE.
- Reptiles: Pre-works checks immediately prior to works and during vegetation clearance. Any vegetation/hibernacula clearance to be supervised by a suitably qualified ecologist (SQE).
- Invasive non-native species (INNS): Removal or avoidance of INNS present in site has been recommended. Any vegetation clearance to be supervised by a SQE.

Appropriate measures have been incorporated in the Construction Environment Management Plan (CEMP) which can be found in **Appendix 4** of the **EMS Summary**.

In addition to the measures listed above (which were identified in support of the planning application), a **Dust Management Plan** accompanies this application which will also ensure risks to sensitive receptors from dust are minimised.

Infiltration from the site will not harm the adjacent ancient woodland or protected species as the natural geology and soil composition provide sufficient attenuation to prevent direct runoff or significant changes to groundwater flow that could impact the woodland ecosystem. Additionally, the woodland is not reliant on surface water from the site, and no identified groundwater-dependent habitats are present[59]. Standard mitigation measures, such as perimeter bunding, will be employed to further reduce any residual risk of sediment transport or contamination. Given these factors, the potential for infiltration to negatively affect the ancient woodland and protected species is considered negligible. The risks to sensitive ecological receptors with mitigation measures has therefore been determined to be low and further assessment is not considered necessary.

[59] WSP (2025) Trawsfynydd Site: Review of Groundwater and Surface water monitoring. December 2025, Ref UK0038631.1487.648.

# 3. Pollution and Control Measures

## 3.1 Site Engineering

Various measures will be put in place to prevent pollution and environmental impacts from low volumes of high pH rainwater run-off which has been in contact with freshly crushed concrete, these include:

- placing recycled aggregate above ground, so that it does not become waterlogged
- Producing the coarsest recycled aggregate which can be used for hardstanding in order to minimise the surface area of freshly exposed concrete
- Minimise the volume of rainfall entering the RCA laydown area through profiling
- Placing a geotextile layer (T1000 or similar) across the area prior to depositing cementitious and non-cementitious 6F2, and placing a geotextile layer above the final 6F2 layer containing any concrete containing bagwash.
- Capping the RCA laydown area with 150mm non-cementitious or concrete which has been assessed as free from bagwash aggregate as a final surface layer.
- Carefully manage fines from crushing and screening process (which will be carried out under a Part B permit) and minimise uncontrolled contact with rainwater, and to ensure the RCA laydown area remains free-draining.
- Utilise the organic component of soils within the made ground (underneath the RCA laydown area to neutralise/buffer any alkaline run-off generated prior to carbonation[60]
- Ensuring controls put in place in order to protect boreholes from accidental damage which could cause these to act as pathways to groundwater.

The physical characteristic of the source which is of potential concern is dust generated from crushing and screening the RCA, and to a lesser extent dust from stockpiling and placement of materials. Dust will be managed during processing and stockpiling using recognised mitigation measures as described in PGN 3/16 (12) Process Guidance Note for Mobile Crushing and Screening[61], see **Dust & Emissions Management Plan**. The crushing and screening process will be managed under an EPR mobile plant licence (outside the scope of the DfR permit).

The DfR area will be fully contained inside the secure perimeter of the nuclear licenced site, hence security arrangements are assured.

## 3.2 Aftercare

Once the lay-down area has been completed, a topographical survey will be carried out in accordance with permit requirements, to confirm the lay-down area has been constructed in accordance with the designs presented here and in the Waste Recovery Plan.

Regular inspection and maintenance of the condition of the capping layer, as required, to address any damage caused by rutting etc. will continue post completion of the DfR activity, in accordance with NRS duty in respect of the historic asbestos landfill.

[60] Recycled Concrete Aggregate Leachate: A Literature Review (wa.gov)
[61] 1 (publishing.service.gov.uk)

# 4. Environmental Monitoring

## 4.1 Weather

### 4.1.1 Local wind speed and direction

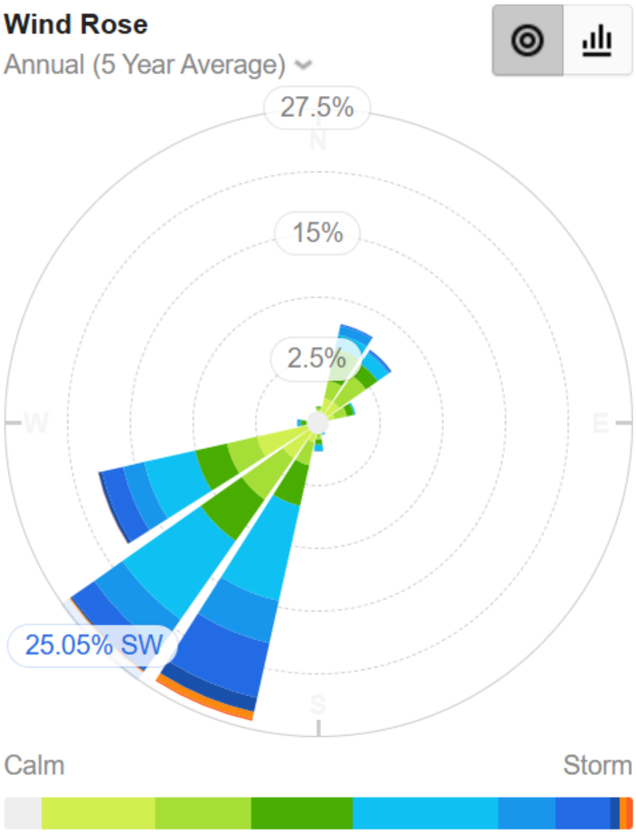



**Figure 29 – Windrose from Capel Curig Weather Station (2020-2024) WillyWeather[62]**
**Wind speed and direction data from the meteorological observation station at Capel Curig, which is located approx. 15 miles to the north of the site is broadly representative of the local site conditions.**

[62] Trawsfynydd Wind Forecast, Gwynedd LL41 4 - WillyWeather

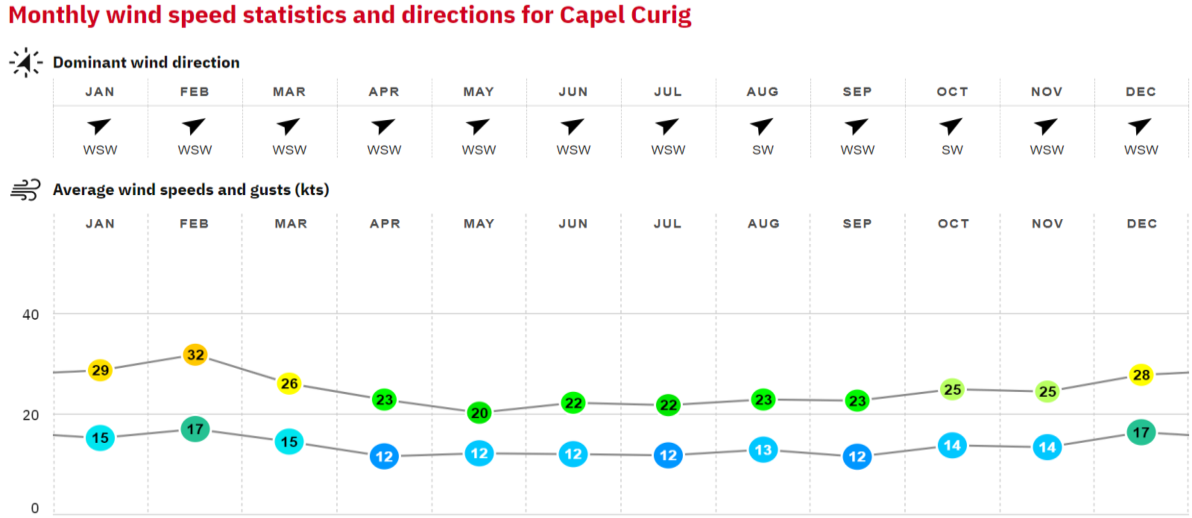



**Figure 30 – Monthly wind speed and direction observations from Capel Curig (2024) WindFinder**

**Figure 29** indicates that the prevailing wind direction is from the west-south-west, followed by winds from the south-west and west. Winds from the north-north-east, north-east and south-south-east are relatively infrequent.

**Figure 30** provides the monthly average wind speed and direction; this confirms the prevailing wind direction is west-south-west.

### 4.1.2 Local monthly and annual average rainfall data

Climate period: 1991-2020

**Station: Capel Curig No 3**

| Month | Maximum temperature (°C) | Minimum temperature (°C) | Days of air frost (days) | Sunshine (hours) | Rainfall (mm) | Days of rainfall ≥1 mm (days) | Monthly mean wind speed at 10 m (knots) |
|---|---|---|---|---|---|---|---|
| January | 7.03 | 1.91 | 8.49 | – | 309.62 | 19.53 | 15.52 |
| February | 7.11 | 1.74 | 7.72 | – | 258.17 | 17.64 | 15.06 |
| March | 8.82 | 2.69 | 5.09 | – | 213.40 | 16.80 | 13.61 |
| April | 11.37 | 4.19 | 2.64 | – | 155.79 | 15.48 | 11.41 |
| May | 14.43 | 6.65 | 0.70 | – | 141.97 | 14.34 | 11.43 |
| June | 16.61 | 9.37 | 0.03 | – | 144.16 | 13.97 | 10.97 |
| July | 18.16 | 11.29 | 0.00 | – | 157.63 | 15.57 | 10.89 |
| August | 17.84 | 11.32 | 0.00 | – | 189.67 | 16.94 | 10.77 |
| September | 15.99 | 9.35 | 0.10 | – | 206.34 | 15.97 | 11.08 |
| October | 12.77 | 7.09 | 1.03 | – | 274.01 | 19.00 | 12.92 |
| November | 9.75 | 4.50 | 3.31 | – | 300.38 | 20.87 | 13.42 |
| December | 7.58 | 2.40 | 7.19 | – | 345.99 | 20.38 | 14.90 |
| Annual | 12.31 | 6.07 | 36.30 | – | 2697.13 | 206.49 | 12.66 |

**Figure 31 Monthly and annual average rainfall data for Capel Curig 1992-2020 Met Office**

**Figure 32** shows relevant rainfall data applicable to the site. The average annual rainfall ≥ 1mm/day for the area of the Site is 206.5 days per year, comprising approximately 57% of the year.

### 4.1.3 Monitoring

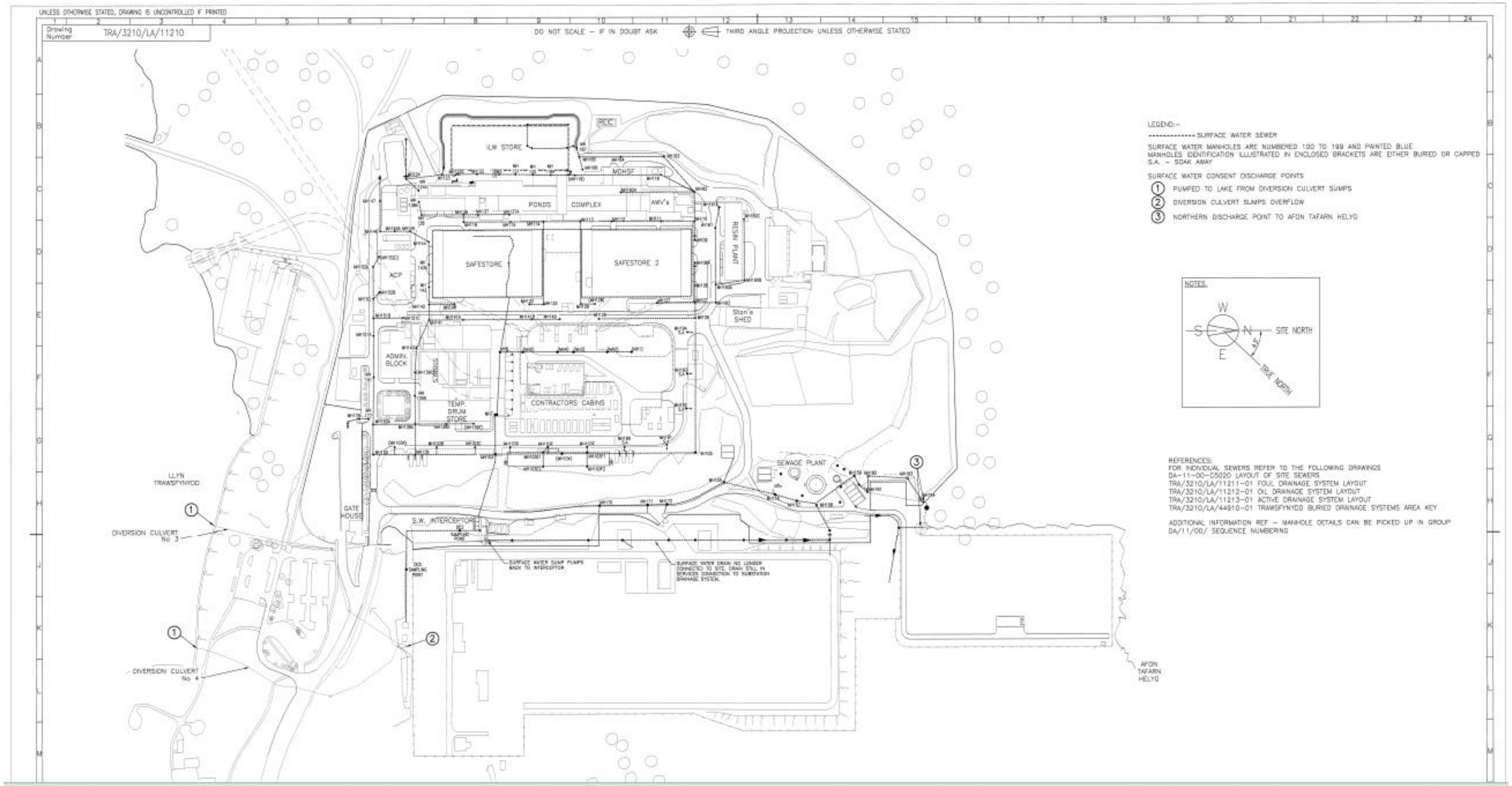
Dust monitoring will be carried out as identified in the **Dust Management Plan.** As the risks to controlled waters are screened out in the ESSD, groundwater and surface water compliance monitoring is not required.

## 5. Site Condition Report

A Site Condition Report (SCR) is only necessary for a site/area of a site where waste is not being permanently deposited. As all areas covered by the proposed permit boundary at are subject to a permanent deposit of waste, an SCR is not needed for this application.

# Appendices

## A.1 NLS Drainage Plan



## A.2 Details of Magnox concrete specifications from 1950s

Supporting Report No. MAT 11

# CONCRETE

This report covers the chemical and physical properties of the constituent materials of the various classes of concrete it is proposed to use, together with a detailed analysis of the proportions of materials which will give concretes of the correct strength and density.

APC

## CONTENTS

## CEMENT

The cement will be normal or rapid hardening Portland Cement conforming to the requirements of B.S. 12, obtained from the works of the Tunnel Cement Co. Ltd., at Mold, or the equivalent.

A typical maker's analysis of their normal portland cement is as follows:-

| | |
|---|---|
| Loss on ignition | 1.26% |
| $Si\ O_2$ | 21.29 |
| $Al_2\ O_3$ | 6.39 |
| $Fe_2\ O_3$ | 2.75 |
| Ca O | 64.08 |
| Mg O | 0.87 |
| $SO_3$ | 2.54 |

It is not considered that any advantage would be gained by the use of sulphate resisting cement in the foundations.

## ADMIXTURES

It is envisaged that fly-ash will be used as a replacement for cement for works such as:

(a) Blinding, filling casing and backing in class X concrete.

(b) Temporary foundations and structures.

(c) Permanent foundations below ground level where early strength is not important.

The fly-ash which will be supplied by the C.E.G.B. must comply with the following specification:

(a) Physical Requirements:
Fineness:- The specific surface shall not be less than 3,000 sq.cm per gm. and not more than 4,500 sq.cm. per gm. The value of the specific surface shall be determined in a manner similar to the method used for cement detailed in Appendix A of British Standard Specification No.12.

(b) Chemical Requirements:

| | Limits by weight |
|---|---|
| Minimum Silica content ($Si\ O_2$) | 40% |
| Minimum Alumina content ($Al_2\ O_3$) | 15% |





| | |
|---|---|
| Maximum Magnesia content (Mg O) | 3% |
| Maximum Sulphur content (as Anhydride) | 3% |
| Maximum loss on ignition | 10% |

Before a final decision is taken regarding the use of fly-ash, tests will be carried out to ascertain if an adequate supply to the correct specification is likely to be available. Sampling twice daily, at the source of supply for a period of a week or so is envisaged.

While the contractor will take all reasonable precautions in the use of fly-ash, due to the variations inherent in this material he cannot be held responsible for the quality of the concrete containing fly-ash, or for the consequences of any reduced rate of hardening, where they are due to circumstances beyond his control.

Wetting agents may be used in any part of the work, to increase the workability of the concrete, where this is deemed to be necessary.

The use of trass for the gunite concrete lining of the circulating water ducts was investigated, but was found to be unnecessary.

## WATER FOR CONCRETE

Water for concrete making will be taken from the Lake or from Town supplies. It will be clean and free from any substance that would be deleterious to the formation of satisfactory concrete.

A typical analysis of lake water is as follows:-

In parts per million of water:

| | |
|---|---|
| Total solid matter in solution | 20 |
| Chlorine in chlorides | 8.0 |
| Nitrates as $NO_3$ | 1.0 |
| Sulphate as $SO_4$ | 4.0 |
| Carbonates as $CO_3$ | 7.8 |
| Silica | 1.5 |
| Iron as Fe | 0.36 |
| Calcium Salts as Ca | 3.6 |
| Magnesium Salts as Mg | 1.0 |
| Total mineral matter | 27.26 |
| Ammoniacal nitrogen | 0.02 |
| Albuminoid nitrogen | 0.20 |
| Oxygen absorbed from permanganate in 4 hrs. at 80°F. | 2.32 |

| | |
|---|---|
| pH value | 6.5 |
| Temporary hardness | 13.0 |
| Permanent hardness | N.I. |
| Lead, copper, zinc | N.I. |
| Colour | 30 Hazen Units |
| Free Carbon dioxide as $CO_2$ | 3.3 |
| Suspended matter | Trace |

From this analysis it is clear that a satisfactory concrete can be made using the Lake water, but to prove the point cubes were made for comparative purposes, using (1) Lake water from near Gyfynys Dam. (2) Water from midway between Gyfynys Dam and Maentwrog Dam and (3) Mains water from Tunnel Portland Cement Works, and the following cube test results were obtained:-

**Cube Test Result**

| Water used | 7 days | 3 months | 6 months |
|---|---|---|---|
| (1) | 5147 | 7540 | 8192 |
| (2) | 4857 | 7395 | 8917 |
| (3) | 5220 | 6960 | 9425 p.s.i. |

## AGGREGATES

It is proposed to use coarse and fine aggregates from Enstons Gravel Pits at Upper Clynnog or the equivalent.

The aggregates are broadly a mixture of schist, quartzite, granite, porphyry, greywacke and basalt, all components being adequately strong. The shape of the particles is reasonably cubical, and tests have shown that the aggregates will give a satisfactory concrete as regards strength, weight and workability.

Tests on the coarse aggregate which will be mixed in its component sizes show that the grading requirements to comply with B.S. 882 can be met.

Tests on the fine aggregate, satisfied the grading requirements of B.S. 882 in zone 2.

R A typical analysis carried out on fine ground representative portions of the samples gave the following results:-





| | |
|---|---|
| Silicon | 32.6 |
| Aluminium | 8.01 |
| Iron | 3.95 |
| Calcium | 1.27 |
| Magnesium | 2.95 |
| Sodium + Potassium | 0.45 |
| Sulphur | .01 |
| Carbon (from Carbohydrate) | 0.38 |
| Oxygen | 50.63 |
| Hydrogen | 0.2 |

The coarse aggregate for exposed aggregate cladding panels is a grey Welsh granite.

## CONCRETE MIXES

Eight classes of concrete are laid down in the Enquiry Specification, and are required to reach the following minimum values in p.s.i. of the mean crushing strength at 28 days.

| | | | |
|---|---|---|---|
| Cubes | AA | - | 8,500 |
| | BB | - | 7,000 |
| | A | - | 5,750 |
| | B | - | 5,000 |
| | W | - | 4,500 |
| | C | - | 4,250 |
| | D | - | 3,500 |
| | E | - | 2,750 |

A mix 'X' is also specified for filling and blinding, but a 28 day strength is not laid down.

Preliminary tests will be carried out in accordance with the specification, to determine the actual mix to be used in each case.

From the work already done, the following mixes should more than meet the specification, and some reduction should be possible in the cement contents.

**Class AA Concrete**

| | |
|---|---|
| Rapid hardening Cement | 690 lb/cu. yd. |
| ¾" - ⅜" | 1612 lb/cu. yd. |
| ⅜" - 3/16" | 470 lb/cu. yd. |
| Sand | 1142 lb/cu. yd. |

**Class BB Concrete**

| | |
|---|---|
| Rapid hardening Cement | 590 lb/cu. yd. |
| ¾" - ⅜" | 1653 lb/cu. yd. |
| ⅜" - 3/16" | 496 lb/cu. yd. |
| Sand | 1157 lb/cu. yd. |

**Class A Concrete**

| | |
|---|---|
| Cement | 635 lb/cu. yd. |
| ¾" - ⅜" | 1622 lb/cu. yd. |
| ⅜" - 3/16" | 485 lb/cu. yd. |
| Sand | 1138 lb/cu. yd. |

**Class B Concrete**

| | |
|---|---|
| Cement | 600 lb/cu. yd. |
| ¾" - ⅜" | 1620 lb/cu. yd. |
| ⅜" - 3/16" | 486 lb/cu. yd. |
| Sand | 1134 lb/cu. yd. |

**Class C Concrete**

| | |
|---|---|
| Cement | 535 lb/cu. yd. |
| ¾" - ⅜" | 1698 lb/cu. yd. |
| ⅜" - 3/16" | 509 lb/cu. yd. |
| Sand | 1188 lb/cu. yd. |

**Class D Concrete**

Using ¾" Aggregate

| | |
|---|---|
| Cement | 492 lb/cu. yd. |





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| | |
|---|---|
| ¾" - ⅜" | 1672 lb/cu. yd. |
| ⅜" - 3/16" | 502 lb/cu. yd. |
| Sand | 1172 lb/cu. yd. |

Using 1½" Aggregate

| | |
|---|---|
| Normal Cement | 470 lb/cu. yd. |
| 1½" - ¾" | 1135 lb/cu. yd. |
| ¾" - ⅜" | 801 lb/cu. yd. |
| ⅜" - 3/16" | 289 lb/cu. yd. |
| Sand | 1145 lb/cu. yd. |

**Class E Concrete**

Using ¾" Aggregate

| | |
|---|---|
| Cement | 465 lb/cu. yd. |
| ¾" - ⅜" | 1674 lb/cu. yd. |
| ⅜" - 3/16" | 502 lb/cu. yd. |
| Sand | 1172 lb/cu. yd. |

Using 1½" Aggregate

| | |
|---|---|
| Normal Cement | 440 lb/cu. yd. |
| 1½" - ¾" | 1236 lb/cu. yd. |
| ¾" - ⅜" | 802 lb/cu. yd. |
| ⅜" - 3/16" | 289 lb/cu. yd. |
| Sand | 1148 lb/cu. yd. |

**Class W Concrete**

| | |
|---|---|
| Cement | 550 lb/cu. yd. |
| ¾" - ⅜" | 1650 lb/cu. yd.. |
| ⅜" - 3/15" | 495 lb/cu. yd. |
| Sand | 1155 lb/cu. yd. |



APC COMMERCIAL

Class X Concrete

Using 1½" Aggregate

| | |
|---|---|
| Normal Cement | 380 lb/cu. yd. |
| 1½" - ¾" | 1151 lb/cu. yd. |
| ¾" - ⅜" | 813 lb/cu. yd. |
| ⅜" - 3/16" | 293 lb/cu. yd. |
| Sand | 1163 lb/cu. yd. |

CONCRETE IN THE BIOLOGICAL SHIELD

The Biological Shield has been designed for a dry density of the concrete of 142 $lb/ft.^3$ To ensure that this is possible tests have been carried out, using the aggregates proposed, on 6" concrete cubes dried to a constant weight.

Cubes for a 1 - 7.3 mix showed an average density of 145.9 lb/cu.ft. and for a 1 - 5.3 mix 143.4 lb/cu.ft.

In order to reduce long term shrinkage in the large mass of concrete in the shield it is desirable to use the leaner mix wherever possible, but especially in the upper portion of the sides and in the top, owing to the congestion of reinforcement and service sleeves, greater workability will be required in order to obtain adequate compaction, and an increase in cement content may be essential.

Chemical tests have been carried out on the cubes previously used for density tests, for shielding calculation purposes, with the following results.

| Mix | 1 - 7.3 | 1 - 5.3 |
|---|---|---|
| Silicon | 32.346 | 30.00 |
| Aluminium | 4.79 | 4.66 |
| Iron | 1.83 | 2.00 |
| Calcium | 5.86 | 8.43 |
| Magnesium | 2.18 | 2.40 |
| Sulphur | 0.14 | 0.21 |
| Alkalies (Na+K) | 0.49 | 0.52 |
| Oxygen | 51.44 | 50.68 |
| Hydrogen | 0.42 | 0.47 |
| Carbon | 0.51 | 0.60 |

(Present as Carbonates)





OTHER PROPERTIES

The following properties have been taken for calculation of the temperatures in the Biological Shield. They are based on average values for this type of concrete.

| | |
|---|---|
| Specific Heat | 0.24 B.Th.U. per lb. |
| Thermal Conductivity | 0.833 B.Th.U. per ft. per hour per degree F. |
| Coefficient of Expansion | $5.5 \times 10^{-6}$ per degree F. |