# Site Restoration Programme

## Winfrith End State:

## Winfrith End State Environmental Monitoring Plan

Project report – ES(24)P389 Issue 1 December 2024

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## Abbreviations and Acronyms

| Term | Definition |
|---|---|
| AOD | Above Ordnance Datum |
| CEMP | Construction Environmental Management Plan |
| DfR | Deposit for Recovery |
| DQRA | Detailed Quantitative Risk Assessment |
| DWS | Drinking Water Standard |
| EAC | Emplacement Acceptance Criteria |
| EMP | Environmental Monitoring Plan |
| EQS | Environmental Quality Standard |
| ESSD | Environmental Site Setting Description |
| GRR | Guidance on Requirements for Release from Radioactive Substances Regulation |
| TPH-CWG | Total Petroleum Hydrocarbon Criteria Working Group |
| NDA | Nuclear Decommissioning Authority |
| NICoP | Nuclear Industry Code of Practice |
| PAH | Polycyclic Aromatic Hydrocarbon |
| RP | Representative Person |
| RTD | River Terrace Deposits |
| SRS | Site Reference State |
| SWESC | Site Wide Environmental Safety Case |
| SQEP | Suitably Qualified and Experienced Personnel |
| WAC | Waste Acceptance Criteria |
| WHO | World Health Organisation |

# 1 INTRODUCTION

## 1.1 Context

The End State strategy for the Winfrith site is to prepare the site for its next planned land use which is 'heathland with public access', as determined through community consultation. The optimised End State includes on-site disposals of wastes at SGHWR and Dragon.

The site already conducts extensive groundwater monitoring on the site for the purposes of land quality monitoring. At current, there are 135 operational boreholes.

The Winfrith End State Stewardship Plan (Ref. 1) sets out the overall management arrangements that cover the period from the completion of the SGHWR and Dragon disposals through to the Site Reference State (SRS). It is assumed within the Stewardship Plan that the disposals will still be under NRS management until the SRS is reached.

## 1.2 Purpose

The purpose of this report is for NRS to set out how the cap and groundwater will be monitored following the completion of the disposals/deposits at SGHWR and Dragon. The monitoring will continue until the SRS is achieved, a few decades after the site's Interim End Point that is currently planned for the late 2030s.

The monitoring of the groundwater is intended to assess and validate the performance of the disposals. The monitoring of the cap is intended to confirm that the cap is functioning as specified, with:

- Settlement within performance parameters;
- Effective drainage;
- Confirmation there has been no human or animal intrusion.

## 1.3 Scope

The scope of this Environmental Monitoring Plan (EMP) includes:

- Groundwater monitoring to assess disposal/deposit and cap performance following the completion of the disposals/deposits at SGHWR and Dragon until SRS;
- Cap monitoring to assess cap performance following the completion of the disposals/deposits at SGHWR and Dragon until SRS.

The scope of this document does not include:

- EPR compliance monitoring that is currently being undertaken at the Winfrith site;
- Monitoring during construction of the disposals/deposits. This is covered by the Construction Environmental Management Plan.

## 1.4 Structure

This report will include:

- A description of the conceptual site model and the geo-environmental setting of the site, including a description of the application design;
- A summary of the current quality of the groundwater;
- A summary of the current monitoring programme;
- The parameters, locations, methodology and frequency of sampling that forms the post-disposal monitoring programme;
- The quality control, data management and data validation arrangements;
- The identification of, and response to unexpected results that facilitates a responsive monitoring regime or consideration of remedial or contingency measures;
- Requirements to review the EMP.

## 1.5 Regulatory context

Suitable permissions will be required to implement the End State. These will include variation to the existing environmental permit under the RSR for on-site disposal of radioactive wastes, an Environmental Permit for Deposit for Recovery (DfR) activities and planning permission.

The EMP will fulfil the requirements of the Guidance on Requirements for Release from Radioactive Substances Regulation (GRR) and DfR permits to ensure the disposals/deposits perform as anticipated in the risk assessments (Refs. 2, 3) and Site Wide Environmental Safety Case (SWESC) (Ref. 4).

### 1.5.1 Guidance on Requirements for Release of Nuclear Sites from Radioactive Substances Regulation

Requirement R8 of the GRR outlines the requirements for site characterisation and monitoring to support the WMP and SWESC. R8 states the EMP must also *"include appropriate validation monitoring to provide technical confirmation that progress towards the site reference state is as expected or to validate that the site reference state has been achieved".* The approach to site and disposal monitoring should be "reasoned and proportionate" and data must be collected during the period of RSR to ensure that the behaviour of radioactive substances is consistent with the SWESC assessments.

Requirement R8 (Section A4.21) includes the requirement for levels of specific contaminants that will trigger action. Additionally, R8 requires a plan to deal with unexpected levels of contamination and confirm any apparently positive results to exclude the risk of a false positive observation.

Non-radiological monitoring is also an implicit requirement under Requirement R15 (protection against non-radiological hazards), which states that the "*level of protection should be consistent with that provided by the national standard applicable at the time when relevant actions are taken".* Section A4.105 states that the "*SWESC should demonstrate that adequate protection is achieved against non-radiological hazards ... using methods and approaches suited to … the non-radiological hazards*," and Section A4.19 (under Requirement R8) states that monitoring *"should include measurements of … chemical parameters relevant to the SWESC*."

This EMP will be updated with planning and permit conditions as needed. It is anticipated that this plan will be 'live' so that any updates to requirements can be incorporated without varying the permit.

### 1.5.2 Deposit for Recovery

Aftercare is '*the period between the time the Environment Agency issues an aftercare permit until they accept the surrender of your environmental permit*' (Ref. 5). During aftercare, the site must be managed, maintained and monitored to ensure that no pollution events occur. Aftercare monitoring is required to confirm the recovered waste is physically and chemically stable. Aftercare has been incorporated into stewardship arrangements to standardise the approach to the management of radioactive disposals, deposit activities and wider management of the site.

The DfR permit requires that it is possible to access the locations used for monitoring. Any monitoring borehole that becomes blocked, stops working, or that cannot be accessed at the surface must be restored or replaced.

The DfR permit also requires that the following records are kept in the management system:

- The methods used to carry out checks;
- The equipment used in the checks and how it's calibrated;
- Any maintenance required to enable checks;
- The frequency of the checks.

The key components that require monitoring as part of the DfR permit are gas, leachate, groundwater, weather and cap and ground settlement. These are described below.

#### 1.5.2.1 Gas monitoring

Gas monitoring is required under the DfR permits where the risk assessment suggests that:

- The waste is likely to produce gas;
- It is planned to deposit waste more than 2 metres below the surrounding ground surface.

If monitoring is not undertaken, a justification must be included in the permit application.

#### 1.5.2.2 Leachate and groundwater

Environment agency guidance (Ref. 5) states that site specific completion criteria must be developed if the site will produce contaminated leachate. Completion criteria must be set at concentrations that will not have an unacceptable impact on groundwater or surface water. Leachate completion criteria can be assessed using groundwater quality measurements. The leachate completion criteria are considered to have been met where it can be shown that the emissions are not causing a breach of a compliance limit. Where there is no compliance limit, it must be shown that there is no significant increase over the background quality for that pollutant in the groundwater.

Groundwater must be monitored using a minimum of one monitoring point in the groundwater in-flow region (up hydraulic gradient), and 2 monitoring points in the groundwater out-flow region (down hydraulic gradient). Prior to monitoring, enough time must be allowed for substantial degradation of the waste and for the waste to become physically and chemically stable.

#### 1.5.2.3 Weather

Guidance on the production of the Environmental Site Setting Description (ESSD) report (Ref. 6) requires that meteorological information be obtained. This includes total rainfall, effective rainfall and prevailing wind direction and strength.

#### 1.5.2.4 Cap and ground settlement

The DfR aftercare guidance (Ref. 5) states that, where topographic surveys are required, these must be carried out once a year and after part or all of the disposal is completed. Surveys must continue until all reprofiling work is completed and the change in ground level is not statistically significant[1] when compared to the previous 2 surveys.

### 1.5.3 Guidance used to develop the groundwater and cap monitoring regime

The following guidance has informed the groundwater sampling schedule:

- Environmental Radiological Monitoring (Ref. 7);
- LFTGN02- Guidance on Monitoring of Landfill Leachate Groundwater and Surface Water (Ref. 8);
- Nuclear Industry Code of Practice for Routine Water Quality Monitoring (‘NICoP’) (Ref. 9);
- Managing On-site Stockpiling and Use of High Volumes of Concrete-based Demolition Material (Ref. 10).

The following guidance has informed the cap monitoring regime:

[1] The Environment Agency considers statistically significant means that the variance in the data is less than 5% (Ref. 5).

- Landfill operators: environmental permits (Ref. 11);
- Landfill and deposit for recovery: aftercare and permit surrender (Ref. 5).

# 2 SUMMARY OF CONCEPTUAL SITE MODEL

This section provides a summary of the conceptual site model of Winfrith Site to inform the design of the environmental monitoring. For a more comprehensive conceptual site model, please refer to the 2023 Golder Conceptual Site Model (Ref. 12).

The conceptual site model is used to understand the source-receptor-pathway linkages present on the Winfrith site at the End State, following the construction of the SGHWR/Dragon disposals/deposits. This will inform the contaminants of potential concern and guide the monitoring determinands and frequency.

## 2.1 Geo-environmental setting of the site

This section sets out how the environment on the site functions at current and at the time the disposals are implemented and managed. A more detailed summary is included in the Site Description Report (Ref. 13).

### 2.1.1 Topography

The ground at the site slopes downwards towards the Rivers Win and Frome from the high point of Blacknoll Hill at 62 m Above Ordnance Datum (AOD) at the south-west corner of the site. The ground elevations range from approximately 20 mAOD to 50mAOD. To the north of the railway and adjacent to the River Frome, the topography falls to about 17 mAOD.

### 2.1.2 Rainfall

The average annual rainfall over the period from 1961 to 2004 was 915mm, with average winter monthly rainfalls of approximately 100mm and average summer monthly rainfalls of approximately 58mm.

### 2.1.3 Surface Water

There are two natural surface water catchments on the site. The northern catchment is approximately 96.75 ha and drains the majority of the Winfrith site to the north-east and east towards Flume 1 and the Frome Ditch. The southern catchment of approximately 14.2 ha drains south and south-east towards the River Win.

### Geology

The regional and local geology around and under the site is comprehensively covered in *Winfrith Site: Interpretation of Present and Future Hydrogeological Conditions* (Ref. 14). A high-level summary of the features relevant to the EMP has been included below.

The superficial deposits at the site consist of River Terrace Deposits (RTD), head deposits and alluvium, sand and gravel deposits. These overlie the Poole Formation and London Clay Formation. These in turn overlie the Portsdown Chalk of the Upper Chalk of the Cretaceous period, summarised in Table 1.

**Table 1. Superficial and Bedrock Geology in the Vicinity of the Winfrith Site (from Ground Surface Downwards) (Ref. 14).**

| Geological Group | Formation | Description | Approximate Thickness |
|---|---|---|---|
| **Quaternary Deposits** | Head | Poorly stratified clay, silt, sand, gravel and Chalk | Up to 4m thick. Locally absent. |
| | River Terrace Deposits | Mainly angular flint gravel in a sandy, locally clayey, matrix | |
| | Alluvium | Soft, organic mud | |

| Geological Group | Formation | Description | Approximate Thickness |
|---|---|---|---|
| **Bracklesham Group (Palaeogene)** | Poole Formation | Sand and clay | 8m or thicker to the south of the Site, and ~30m to the north-east |
| **Thames Group (Palaeogene)** | London Clay Formation comprising the West Park Farm Member | Sandy clay and sand, locally pebbly | 10m or thicker to the south of the Site, thickness not proven to the north-east |
| **Upper Chalk (Cretaceous)** | Portsdown Chalk Formation | Chalk, soft, marly near base, flintier in upper part | Up to 130m thick regionally |

Made ground occurs in areas of the site with buildings and roads. This may include the remains of demolished buildings and reworked natural material. In areas that have been developed, there is typically 1m of Made Ground that comprises a thin (usually less than 150mm) layer or topsoil or Tarmac over a mixture of silt, sand and gravel. In areas where backfill has occurred there may be greater thicknesses of made ground.

The Quaternary deposits are made up of head deposits, RTDs and alluvial deposits. The Head and RTD are up to 4m thick and present across much of the site. Head deposits are associated with the higher ground and run northwards through the central part of the site. The RTD comprise sand and gravel and are associated with the trace of the Rivers Frome and Win, particularly in the east of the site. Alluvial deposits are present along the River Frome. Due to the similarity in lithological descriptions, the boundary between the Quaternary deposits and underlying Poole Formation cannot be defined with confidence across parts of the Site.

The Poole Formation is the bedrock formation under the Site and is exposed in the west of the Site. Each of the four depositional sequences comprises a lower sand unit and an upper clay unit, and the formation is highly variable laterally. There appears to be an increase in clay layer frequency and thickness with depth, especially in the north-east of the Site.

The London Clay Formation underlies the Poole Formation and comprises both sand-rich and clay-rich zones. According to the BGS, this is in turn underlain by the Portsdown Chalk, however other reports interpret boreholes to show the London Clay underlain locally by the ‘Reading Beds’. These are described as irregular-bedded sand and flint gravels. The thickness of the Portsdown Chalk Formation has not been proven beneath the Site. It has been suggested that the surface elevation is -30m to -40m AOD.

The presence of a thick clay layer beneath the SGHWR and immediate surrounds acts locally as an aquitard, preventing vertical migration down from the SGHWR, illustrated in Figure 1.

The base of Dragon reactor is within the Poole Formation.

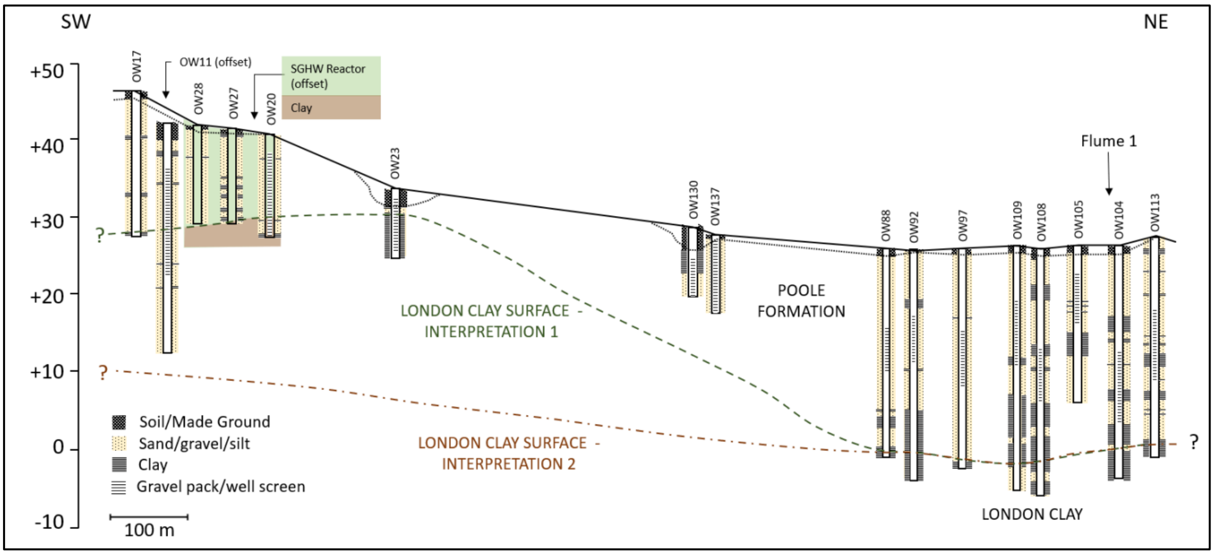


**Figure 1. Geological cross section south-west to north-east across the Winfrith Site illustrating both conceptual interpretations for the southern part of the Site (Ref. 14).**

## 2.2 Contaminants of potential concern

### 2.2.1 Non-radiological

Three tiers of risk assessment have concluded that the non-radiological hydrogeological risk from the envisaged SGHWR and Dragon reactor End States meets regulator compliance limits (Ref. 3).

A Tier 3 (complex, site specific) risk assessment/detailed quantitative risk assessment (DQRA) (Ref. 3) of the SGHWR and Dragon reactor End States was undertaken. The contaminants requiring DQRA are listed in Table 2. Components and contaminants relevant to the HRA and not listed in Table 2 were screened out in lower tiers. The reference scenario model used is a cautious estimate of the predicted evolution of the disposals.

**Table 2. Summary of the contaminants requiring DQRA (Ref. 3).**

| Component in the SGHWR and Dragon Reactor | Contaminants |
|---|---|
| **Concrete blocks** | Alkalinity (pH) |
| **Demolition arisings** | Alkalinity (pH)<br>Chromium (as Cr(III) and Cr(VI)), copper, lead and zinc<br>PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180 |
| **Oil-stained concrete (SGHWR Regions 1 and 2 only)** | Total Petroleum Hydrocarbon Criteria Working Group (TPH-CWG) >C10-C12, >C12-C16 and >C16-21 aromatic fractions |

Modelling of the reference scenario demonstrated the risk for all modelled contaminants is acceptable.

In some cases, groundwater flows from the SGHWR disposal to the Dragon reactor disposal. The assessment of cumulative impacts has shown that the risks to groundwater are below compliance limits.

The Nuclear Decommissioning Authority (NDA) (Ref. 10) highlights Cr, Hg, Mo and Se as becoming mobilised at high pH, and as such these contaminants may be of concern in the expected high pH environment of the proposed disposals.

Hydroxyl ions are expected to be leached from the concrete-based demolition arisings. There is no environmental quality standard or drinking water standard for hydroxyl ions. However, hydroxyl ions increase the pH of water and there is both an environmental quality standard and a drinking water standard for pH. pH will therefore be used as a proxy for hydroxyl ions dissolved in water.

#### 2.2.2 Radiological

A radiological performance assessment (Ref. 2) has assessed the potential radiological doses and risk arising from radioactive sources on the Winfrith site once the Interim End State has been reached. The assessment considered impacts arising from:

- Natural evolution of the disposals through aqueous release of radionuclides to areas where members of the public might become exposed in the future;
- Direct external irradiation of site occupants;
- Inadvertent human intrusion and the subsequent exposure of members of the public to radioactivity;
- Radiological impacts to non-human biota.

The role of this EMP is to provide reassurance that the disposals are performing as expected in terms of the natural evolution and direct external radiation scenarios.

The highest peak dose rate calculated from the Natural Evolution model, which occurs over 50,000 years in the future, is associated with the smallholder representative person (RP), and is more than two orders of magnitude lower than the GRR risk guidance level (0.017 mSv $y^{-1}$). The key radionuclides contributing to this dose rate are $^{210}$Pb, $^{227}$Ac, $^{229}$Th, $^{230}$Th and $^{238}$U.

The peak dose rate for $^{90}$Sr for all RPs occurs within the first hundred years after the construction of the disposals. This is due to the size of its inventory, relatively short half-life and weak sorption potential to undegraded concrete. This is also true for some RPs for some actinides ($^{234}$U, $^{238}$U). The peak dose rate for tritium for all RPs is within the 10 years following construction.

The risk to site occupants from direct external irradiation was also assessed. An upper bounding case of a caravan dweller with an occupancy time of 4,500 hours above the disposal caps was considered. For both Dragon and SGHWR, the calculated annual effective dose at 2027 was many orders of magnitude below the dose equivalent of the risk guidance level.

### 2.3 Hydrogeological conceptual flow model

Groundwater is present in the Quaternary deposits, Poole Formation and Chalk, however there is no hydraulic continuity between the Poole Formation and Chalk. The Poole Formation is classified as Secondary A aquifers, and the Head deposits are classified as a Secondary (undifferentiated) aquifer. The London Clay is an Unproductive aquifer with little or no resource potential. The Quaternary deposits and Poole Formation can be treated as a single hydrogeological unit. Low hydraulic conductivity clay lenses within the Poole Formation may cause a localised effect upon the groundwater level and flow and result in ‘perched’ water tables.

Groundwater levels are several metres below the surface beneath much of the site. Levels recorded during monitoring rounds between January and March are typically higher than those between July and September, likely a response to variation in recharge from rainfall.

Flume 1 receives most of the water from the on-site surface water drainage network. ‘Rubble’ drains were installed in the 1950s to lower the water table, and where they intersect groundwater (in the north-eastern, eastern and central parts of the Site) groundwater elevations are controlled. West of the Monterey roundabout, the ‘rubble’ drains are interpreted to intersect much of the site-wide flow that would otherwise discharge to the surface. As the site progresses to the Interim End Point, the existing surface water drainage network will be decommissioned, removing the drainage capacity and allowing water to be naturally managed on the surface.

At SGHWR, groundwater elevations are currently below the top of the base slabs of the Annexes but above the base of the Primary Containment, Delay Tank Room and Turbine Hall. Groundwater is at least 1m lower than the top of Dragon reactor base slab and 3m beneath the Dragon mortuary tube structures.

It is not expected that implementation of the end state will change groundwater levels. Modelling predicts that the average groundwater level will rise by approximately 0.4 m at SGHWR and 0.3 m at Dragon due to the implementation of the end state. The 'decommissioning' of rubble drains may lengthen groundwater flow pathways but the general groundwater flow direction and locations of groundwater discharge are expected to be unchanged.

Modelling indicates that groundwater levels could rise above the top of the base of the South Annexe for short periods totalling 4% of the time and above the top of the base of Dragon for short periods totalling 2% of the time in climate change conditions (Ref. 14).

Figure 2 shows the summary of the Hydrogeological Interpretation in an illustrated model.

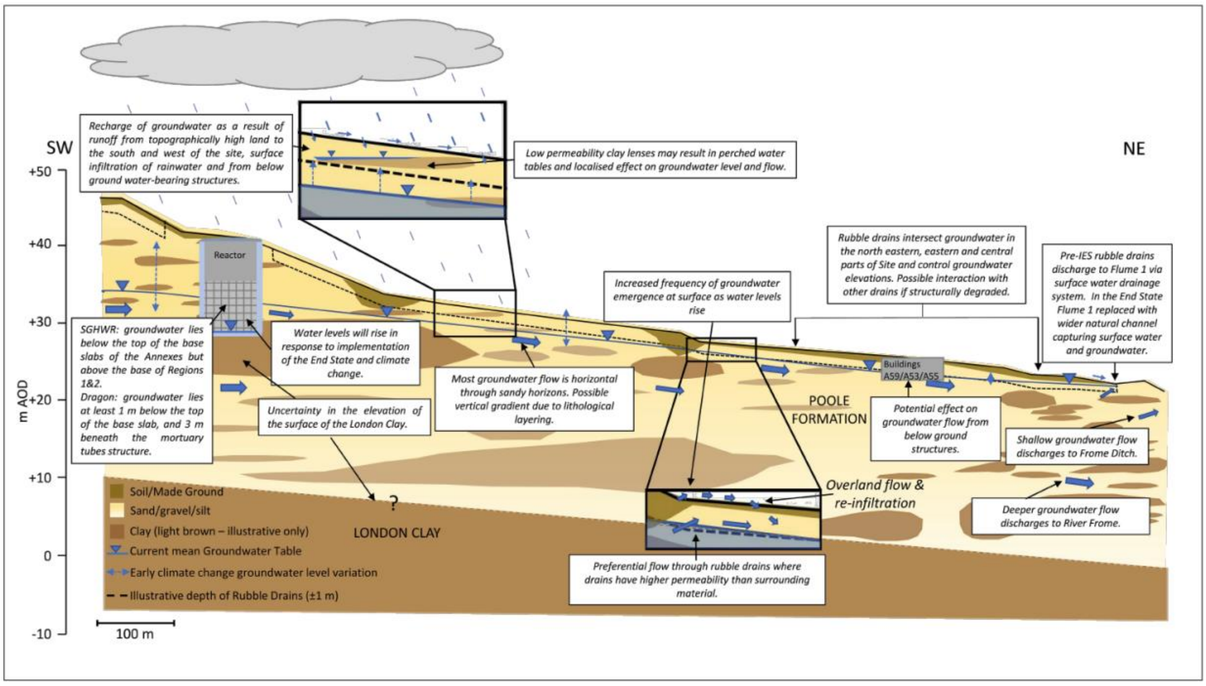


**Figure 2. Summary of the Hydrogeological Interpretation (Ref. 14).**

# 3 SUMMARY OF THE CURRENT AND BACKGROUND QUALITY OF GROUNDWATER

To define the potential impacts from the disposals/deposits it is necessary to define the baseline conditions. The baseline dataset is comprised of the boreholes that are currently in use as part of the Winfrith land quality work. The baseline dataset will continue to be collected until the disposals are implemented.

The site background levels are set out in the backgrounds report (Ref. 15). This covers the background levels at the site that are unaffected by historic operations.

## 3.1 Summary of current monitoring arrangements

A network of 135 boreholes exists at the site for groundwater monitoring in support of the land quality work. Groundwater and surface water monitoring is undertaken quarterly. The borehole locations for 2023/2024 are illustrated in Figure 3. The quantity and locations of the boreholes sampled do not vary significantly from year to year, which allows for trend analysis of the groundwater quality data.

The determinands that are analysed vary across the network, but include metals, VOCs, major ions, TPH-CWG, pH, gross alpha, gross beta and tritium.

Quarterly reports are also issued which summarise the groundwater quality at the site and identify any deviations in trend or exceedances of Limits of Detection and/or Drinking Water Standards (Refs. 16, 17, 18).

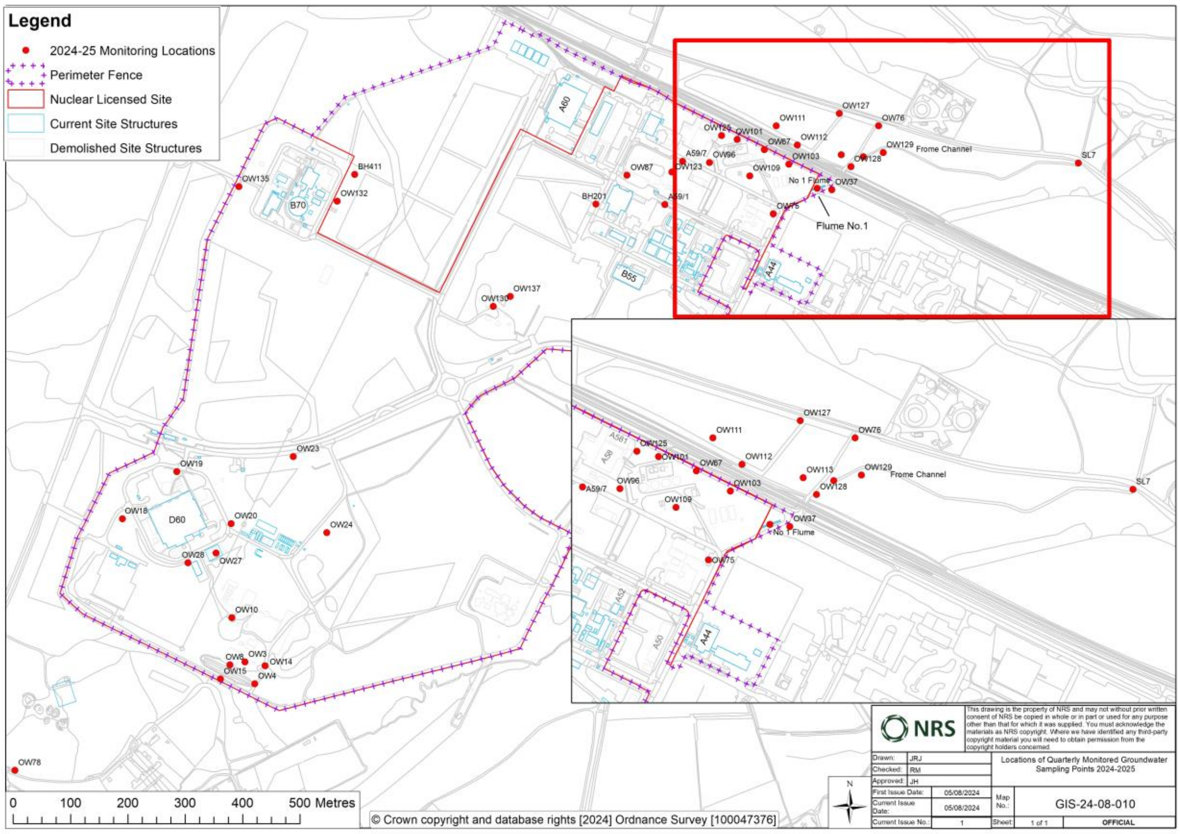


**Figure 3. 2024/2025 Routine Groundwater Monitoring Locations**

The quarterly monitoring has not found exceedances of screening levels for non-radiological contaminants downstream of the SGHWR and Dragon reactors in 2023.

In the groundwater sampling undertaken in 2023 (Refs. 16, 17, 18) gross alpha activity concentrations were above the World Health Organisation (WHO) guideline level of 0.5Bq/l in groundwater samples collected from monitoring well OW132 (0.62Bq/l). OW132 is downgradient of the Dragon reactor. This is comparable with historical ranges and there is no discernible increasing trend in gross alpha concentrations.

Tritium results for all samples in the period 2020-2023 were below the site trigger level of 100Bq/l.

# 4 END STATE ENVIRONMENTAL MONITORING REGIME

This section covers the End State environmental monitoring regime, including groundwater and cap monitoring. The timeframe considered begins upon the completion of the Dragon disposal and continues until the Site Reference State is reached. The objective of the monitoring is to verify that the disposals/deposits are performing as expected.

The role of this EMP is to demonstrate the requirements of the GRR and DfR will be met once disposals / deposits are implemented.

## 4.1 Water environment monitoring

### 4.1.1 Basis of parameters to be monitored

The selection of parameters to be monitored has been informed by the contaminants of potential concern identified in the DQRA (Ref. 3) and radiological Performance Assessment (Ref. 2) as outlined in Section 2.2.

Historic groundwater monitoring has identified gross alpha activity concentrations and gross beta concentrations above the WHO guideline levels. Therefore, gross alpha and gross beta measurements will continue to be taken. The radiological performance assessment predicted that peak doses of tritium from the disposals will occur within 10 years of the disposals being constructed. As such, tritium monitoring will also be undertaken.

Measurement of field parameters (dissolved oxygen, temperature, redox conditions, pH and electrical conductivity) will be made at the time of sample collection. pH will also be included in the schedule for laboratory analysis.

Characterisation will be used as part of the verification of the emplacement acceptance criteria (EAC) for the backfill. Due to the potential for leaching of metals, monitoring of groundwater for metals will be continued post-implementation of the disposals. EPR 2016 identifies As, Ba, Cd, Cr (total) Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, Cl, F and $SO_4$ as leachable substances in waste landfill sites. Samples will be analysed against this suite, which includes:

- Cr, Hg, Mo and Se, which NDA guidance (Ref. 10) highlights as becoming more mobile at high pH.
- Cu, Pb and Zn, identified in the HRA as contaminants of potential concern arising from demolition arisings (Ref. 3).

All metals and major ions outlined above have been included in the schedule for groundwater monitoring points. Metals will be monitored in the dissolved phase. Dissolved metals are generally considered more mobile and biologically available than those bound to solids and Environmental Quality Standard (EQS) concentration limits for the majority of metals are for the dissolved phase only on this basis. Total alkalinity will be measured to determine the effect of cement leachates. Additionally, Na, K and Mg will be analysed so that major ion chemistry is characterised.

The EAC will require that disposed / deposited waste does not contain organic substances. Furthermore, hydrocarbons are modelled to be several orders of magnitude below compliance limits, and therefore are excluded from the monitoring schedule (Ref. 3). However, abnormal operations could give rise to organic contamination during the works. In the case that contamination occurs during the construction of the disposals that requires ongoing monitoring this will be recorded in the Construction Environmental Management Plan (CEMP). This will also trigger a review of this EMP to determine if TPH-CWG and polycyclic aromatic hydrocarbon (PAH) compound monitoring is required.

As is the case for hydrocarbons, PCBs are modelled to be at least one order of magnitude below compliance limits, with the conservative assumption that the entire inventory is instantly water available despite being bound in solid material (Ref. 3). Furthermore, the peak concentration is calculated to take at least 1,200 years to be observed immediately downgradient of the disposals/deposits. As such, they are excluded from the monitoring schedule.

In summary, the selected determinands for analysis of groundwater samples are:

- Gross alpha;
- Gross beta;
- Tritium;
- Metals (dissolved): As, Ba, Cd, Cr (total and Cr(VI), Cu, Hg, Mo, Ni, Pb, Sb, Se and Zn;
- Major ions: Ca, Na, K, Mg, Cl, F, $SO_4$, nitrate, total alkalinity

#### 4.1.2 Monitoring location and type

The locations for boreholes as part of the EMP are as follows:

- Up and down hydraulic gradient of the disposals / deposits at SGHWR and Dragon, to verify the performance of the disposals;
- Upgradient of the mire to understand any potential impact on receptors.

Baseline monitoring has been undertaken for groundwater to provide a baseline of environmental concentrations and the historical impact of the operation of the reactors and their decommissioning. The monitoring outlined in this EMP will take place at locations where a baseline has been developed. This will allow for an analysis of trends in groundwater quality.

The boreholes that will be monitored are listed below:

- OW17 and OW18 upgradient of SGHWR;
- OW19, OW20, OW27 and OW28 immediately downgradient of SGHWR;
- OW22 and OW23 further downgradient of SGHWR and upgradient of Dragon and the mire receptor;
- OW131 and OW135 upgradient of Dragon;
- OW132, OW133, OW134 and BH411 downgradient of Dragon.

The locations of the groundwater monitoring points are shown in Figure 4.

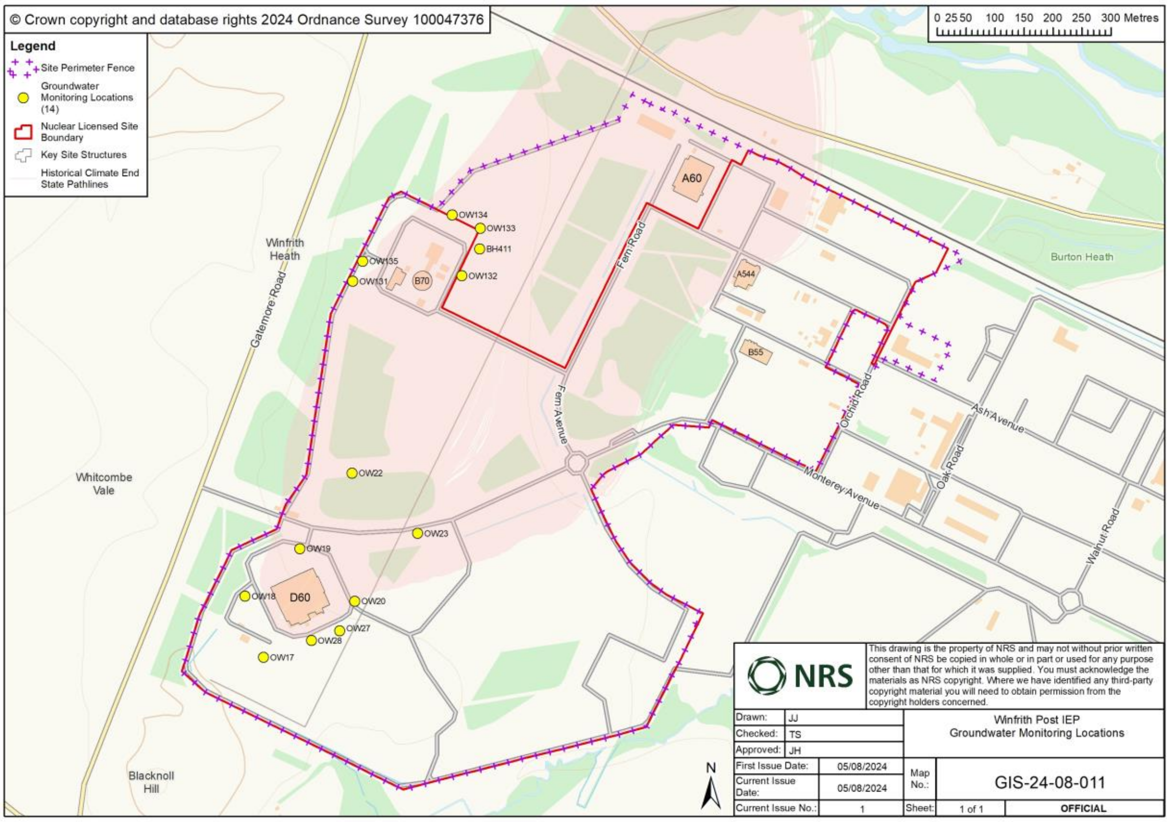


**Figure 4. Proposed groundwater monitoring locations.**

Current land quality monitoring has resulted in an extensive network of boreholes available at Winfrith site. Figure 5 and Figure 6 show the location of the planned boreholes as part of the EMP monitoring regime, but also the remainder of the installed boreholes surrounding SGHWR and Dragon respectively. In the event that the disposals/deposits do not perform as expected, these could be reactivated for additional monitoring.

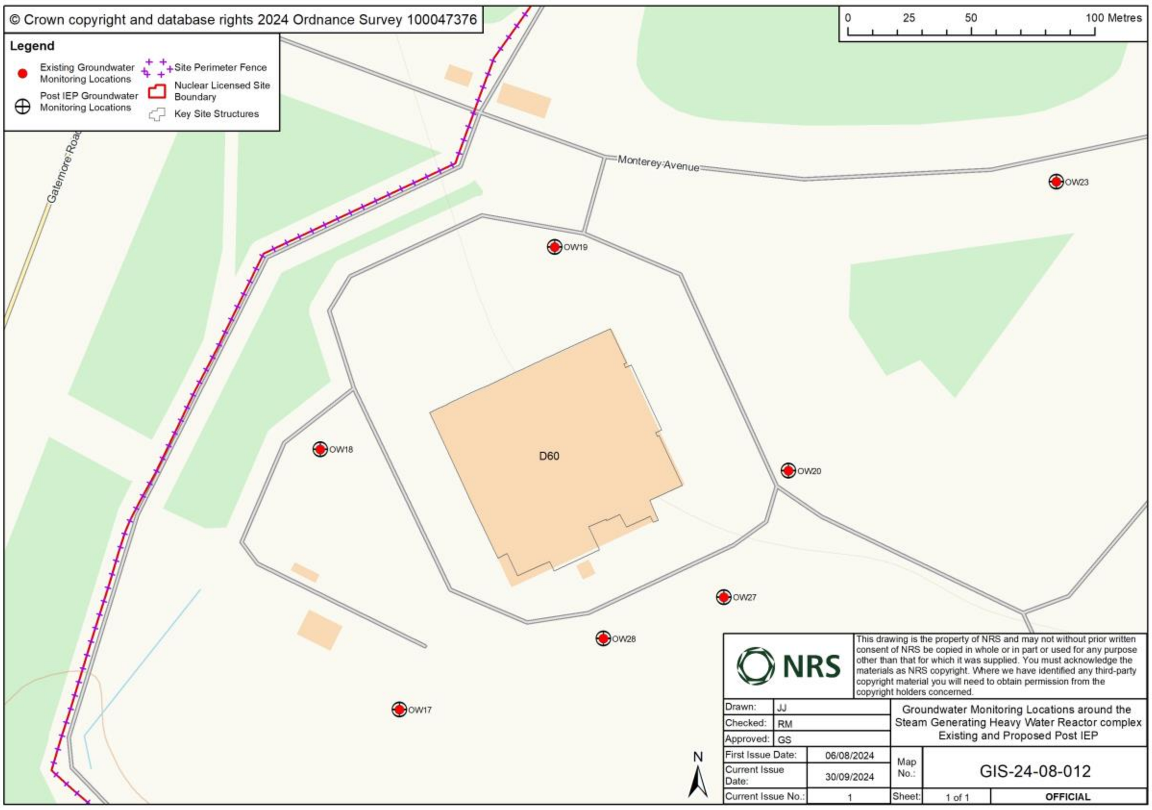


**Figure 5. Planned and current groundwater monitoring locations surrounding SGHWR.**

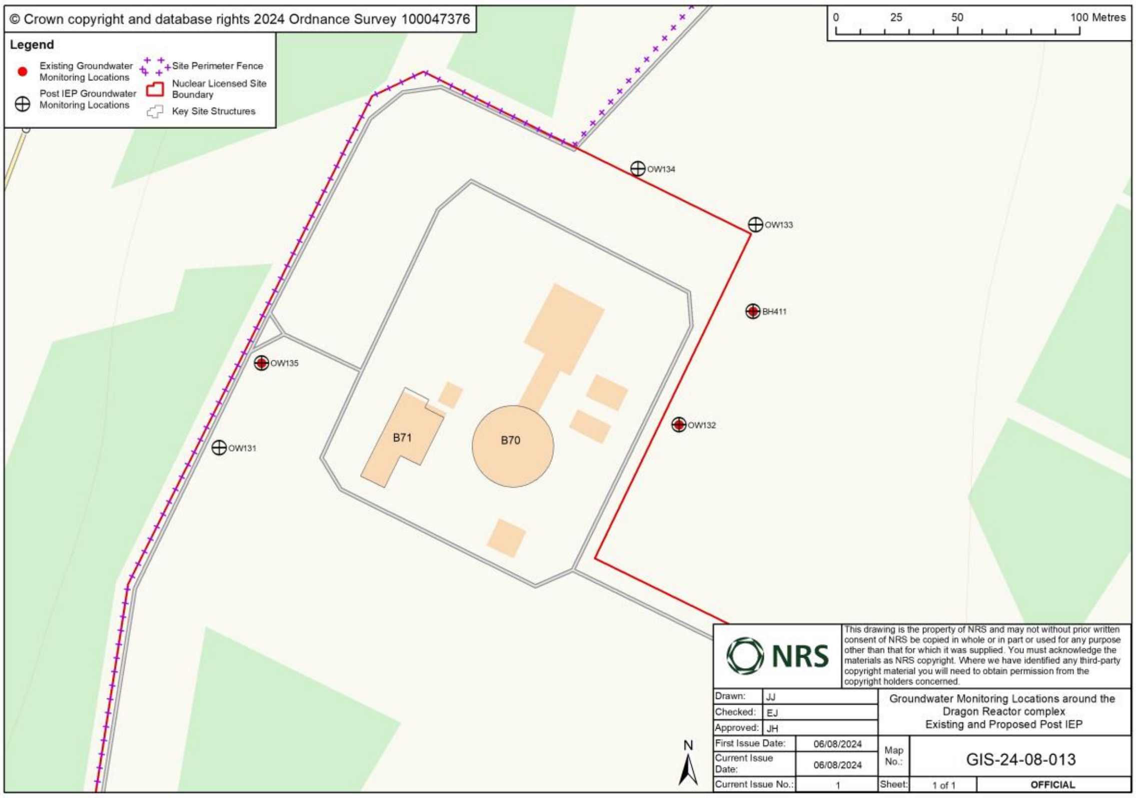


**Figure 6. Planned and current groundwater monitoring locations surrounding Dragon.**

#### 4.1.3 Sampling methodology

Groundwater sampling will be conducted as described in the relevant standards and as detailed in the NICoP for Routine Groundwater Quality Monitoring (Ref. 9) for the collection of groundwater samples by use of a submersible pump or bailer.

#### 4.1.4 Frequency of monitoring

Rainfall varies with the seasons, with average winter monthly rainfall at the Site approximately 40mm more than average summer monthly rainfall. Groundwater levels are therefore higher at the site between January and March than between July and September. To ensure seasonal changes in groundwater quality, should they occur, are monitored, the frequency of monitoring will be quarterly at all locations.

Continuous measurements of flow at OW133, downgradient of Dragon, and at OW19, downgradient of SGHWR will be taken one year prior to the construction of the disposals until one year post works. This is to demonstrate the (expected negligible) effect of the demolition and disposal works on groundwater flow.

### 4.2 Cap structural monitoring

#### 4.2.1 Basis of parameters to be monitored

Cap structural monitoring will take the form of annual topographic surveys and visual inspections. Annual topographic surveys will be undertaken using specialist topographic surveying equipment.

The following activities will be undertaken during the annual topographic surveys:

- Calculate the rate of settlement of the waste by comparing the levels with the levels in previous surveys;
- Record and monitor any dips and hollows on the cap surface;
- Inspect cap integrity following completion of settlement;
- Identify potentially unstable slopes.

During the routine inspections, the following will also be monitored:

- Evidence of intrusions into the cap, and the type of intrusion;
- Evidence that the drainage for the cap is becoming less effective;
- Evidence of burrowing animals and deep-rooted plant growth disturbing the surface;
- Impacts on the cap and cap vegetation arising from cap visitor behaviour that may not have been considered in the disposal performance assessments and restoration design.

#### 4.2.2 Monitoring methodology

The method of cap monitoring is not yet specified; it is likely that it will be walkovers by trained personnel with photographic/video evidence alongside either stable permanent survey stations or remotely piloted drones with high-resolution cameras and remote sensing tools. A decision on the technologies to be used can be made prior to implementation, with the most appropriate equipment available at the time being used.

#### 4.2.3 Frequency of monitoring

Topographic surveys of the caps will be carried out after disposal of waste is completed and once a year thereafter.

A topographic survey will not be conducted prior to the disposal of waste due to the presence of the SGHWR and Dragon reactor structures.

Visual inspection of the caps will be undertaken quarterly for the first 5 years following the completion of each disposal. This is due to the high-profile nature of the site, and the consequences of an inadequate cap. This will then be reduced to annually until the SRS is reached, if results indicate that this is appropriate. It may be the case that the frequency of monitoring of the Dragon cap has reduced to annually before the SGHWR cap has been completed. In this instance, the cap at the Dragon disposal will continue to be monitored annually whilst the cap at the SGHWR disposal is monitored quarterly.

## 4.3 Cap surface radiological monitoring

### 4.3.1 Basis of parameters to be monitored, location and type

The purpose of cap external radiation monitoring is to verify the results of the radiological risk assessment (Ref. 2).

Cap external radiation monitoring will take the form of an initial large area gamma survey and subsequent spot dose rate measurements.

The large area gamma survey will be of the entire cap surface for both SGHWR and Dragon disposals.

The spot measurements will be at the location of max dose, with 1 spot measurement taken each for the SGHWR and Dragon disposals. Based on the modelling, this is likely to be above the reactor bioshield in each instance however the large area gamma survey will provide confirmation. The location of the measurement will be at the same coordinates for every survey.

### 4.3.2 Monitoring methodology

The method of cap surface radiological monitoring is not yet specified. It is likely that the large area gamma survey will be conducted using equipment such as Groundhog®. The most appropriate equipment at the time of monitoring will be used to obtain spot dose rate measurements.

The location of the measurements will be recorded using GPS equipment.

### 4.3.3 Frequency of monitoring

The initial large area gamma survey will occur once over each cap for the SGHWR and Dragon disposals. This will take place following the completion of the disposals.

The spot measurements above the cap at the location of max dose will take place annually.

## 4.4 Basis for parameters to be excluded

### 4.4.1 Gas

As the waste will not contain any organic material it is not expected to produce methane and carbon dioxide gas. The exclusion of putrescible materials will be ensured through the EAC and accompanying acceptance and quality assurance procedures.

The Environment Agency guidance on Aftercare and Permit Surrender for landfills and deposit for recovery operation states that permanent gas monitoring points must be installed where certain criteria are met, as outlined in Section 1.5.2.1. As the waste is unlikely to produce gas, it does not meet the conditions for requiring gas monitoring.

Additionally, gas monitoring boreholes may create preferential pathways for water ingress and compromise the integrity of the disposal. As such, no gas monitoring will be undertaken.

Further justification for the exclusion of gas as a parameter to be monitored can be found in the ESSD (Ref. 6).

### 4.4.2 Leachate

Environment Agency guidance (Ref. 5) states that leachate should be monitored to determine if completion criteria for the surrender of the DfR permit are met.

In the case of the SGHWR and Dragon disposals, it will not be possible to collect leachate. This is because the in disposal boreholes will compromise the integrity of the disposals and potentially create groundwater pathways. Furthermore, the cap will prevent sampling from perched levels within the disposals. Instead, the impact of the disposals and the leachate completion criteria will be assessed based on groundwater quality monitoring.

The backfill materials are derived from a single site of origin, with characterisation undertaken of demolition arisings to date and robust EAC will be in place at the time of disposal. This appropriately characterises the source inventory for the deposits. The Tier 3 DQRA conducted as part of the HRA found that the risks to groundwater from cumulative impacts are below compliance limits.

Further justification for the exclusion of leachate as a parameter to be monitored can be found in the ESSD (Ref. 6).

# 5 SAMPLE QUALITY CONTROL, DATA VALIDATION AND DATA MANAGEMENT

## 5.1 Sample quality control

Quality control samples will be taken in line with industry best practice at the time, and as described in NICoP for Routine Water Quality Monitoring. This will include duplicate samples, field blanks, trip blanks and tap water blanks (Ref. 9).

Requirements for sample representativeness, comparability, precision and accuracy will be aligned to the current objectives and acceptance limits set out as part of the routine groundwater and surface water monitoring regime on the Winfrith site and in accordance with the NICoP for Routine Water Quality Monitoring (Ref. 9).

## 5.2 Assessment of monitoring results - data validation

Field and laboratory data will be assessed by suitably qualified and experienced personnel (SQEP) individuals for appropriate quality checks (‘data validation’) prior to being used, to identify errors and inconsistencies The checking will, where possible, be undertaken in sufficient time to afford an opportunity to re-run laboratory analysis within sample holding times.

After each monitoring event the following assessment will be undertaken by SQEP individuals:

- The analytical methods have achieved the required limits of detection;
- Checks against the lower and upper 95$^{th}$ percentile of existing data to identify potentially anomalous data;
- Checks for physically impossible or unlikely results;
- Checks for transcription errors (e.g. from field notes) and typographical errors (e.g. wrong units);
- Assessment of field notes for unusual occurrences (e.g. visual, olfactory observations);
- Checks on the ionic balance;
- Checks for events on site that could lead to potentially misleading data (e.g. severe weather);
- Checks of the results of analysis of quality assurance samples (Section 5.1).

Validation rules will be documented and formulated to avoid the rejection of data that, though extreme, represent real values. Where the data validation process exposes anomalous or erroneous data, additional checks will be undertaken, including cross checking the data with original field records and/or laboratory certificated, confirmation and checking with field and laboratory personnel and (if necessary) undertaking repeat measurement or analysis.

Where appropriate, erroneous data will be amended, otherwise the data point will be kept but flagged as potentially erroneous. The quality assurance procedure will incorporate a written record of erroneous data and subsequent actions taken to rectify it.

## 5.3 Data management

Field and laboratory results will be recorded within IMAGES data capture templates and uploaded to the IMAGES database as is current practice for the routine monitoring of groundwater and surface water at the site.

# 6 IDENTIFICATION OF AND RESPONSE TO UNEXPECTED RESULTS

This section explains how validated data will be reviewed to identify if groundwater or cap conditions have deviated, or could be deviating, from that expected.

## 6.1 Results assessment

The following assessment of samples will be undertaken:

- Review of water level data against established groundwater levels and flow direction including assessment of hydrographs and contour plans. If an unexplained change in water level or flow direction is identified, the SQEP reviewer will be consulted, the cause of the change evaluated, and an appropriate way forward agreed.
- SQEP review of concentrations of contaminants in water against baseline concentrations including time-series trend analysis. Further action (e.g. trending, further sampling, monitoring plan review) may be taken if:
    - A sustained upward or downward trend in concentration is identified; or
    - A large change in concentration is identified; or
    - A concentration higher than action levels (Table 3) is identified.

### 6.1.1 Action levels

Table 3,Table 4 and Table 5 include a list of 'action levels', i.e. contaminant concentrations that, if breached during groundwater quality monitoring, will trigger review and investigation according to Section 6.1. If the exceedance indicates that pollution is likely to occur or has occurred, this will be dealt with in accordance with Section 6.3.

The selection of contaminants is informed by the Hydrogeological Risk Assessment (Ref. 3). A detailed table outlining the relevant Freshwater EQS, Drinking Water Standard (DWS) and background groundwater quality concentrations is included in Appendix A. Table 5 includes a list of dose rates that, if breached during spot monitoring, will trigger review according to Section 6.1.

**Table 3. Action Levels for chemical determinands outlining concentrations triggering SQEP review.**

| Contaminant | Action level (µg/l except for pH) | Justification |
|---|---|---|
| pH | 8[2] | Atkins recommends that pH of groundwater where it interacts with the root zone is <8. |
| As | 6 | Mean concentration in background groundwater quality |
| Ba | 325 | One quarter of WHO health based standard |
| Cd | 1.25 | One quarter of DWS |
| Cr (VI) | 1 | Limit of quantification |
| Cu | 12 | Mean concentration in background groundwater quality |
| Hg | 0.4 | Mean concentration in background groundwater quality |
| Mo | 17.5 | One quarter of WHO health based standard |

[2] This value is based on a hydro-ecological study conducted by Atkins (Ref. 20).

| Contaminant | Action level (µg/l except for pH) | Justification |
|---|---|---|
| Ni | 15 | Mean concentration in background groundwater quality |
| Pb | 3 | Mean concentration in background groundwater quality |
| Sb | 1.25 | One quarter of DWS |
| Se | 2.5 | One quarter of DWS |
| Zn | 27 | Mean concentration in background groundwater quality |

**Table 4. Action Levels for radiological determinands outlining concentrations triggering SQEP review.**

| Radiological Determinand | Action level (Bq/l) | Justification |
|---|---|---|
| Tritium | 100 | Site trigger level |
| Gross Alpha | 0.5 | WHO guidance level |
| Gross Beta | 1 | WHO guidance level |

**Table 5. Action Levels for dose rates triggering SQEP review.**

| Location of spot dose rate measurement | Action level (mSv/hr) | Justification |
|---|---|---|
| SGHWR cap | 0.0003 | Site background level |
| Dragon cap | 0.0003 | Site background level |

### 6.2 Periodic review of monitoring data

A periodic review by SQEP individuals of all available monitoring data will determine whether the disposals are performing as expected. It will include assessment of hydrographs, groundwater elevation contour plans, trend analysis and an assessment of water quality data against expected concentrations, and statistical assessment against the pre-works baseline. Statistical assessment methods will be selected that allow identification of significant differences between the post-works data and baseline despite natural and monitoring method induced variation (‘noise’) in the two datasets.

Cap monitoring data will also be reviewed for evidence of intrusion, ineffective drainage, animal or plant disturbance. The rate of settlement will be reviewed for statistical significance as defined by the Environment Agency (Ref. 5).

All reporting requirements specified by the Environment Agency will be met.

### 6.3 Response if pollution has occurred, or is likely to occur

In the unexpected circumstance that pollution of groundwater is identified, or that monitoring results indicate that pollution is likely to occur, the most appropriate remedial action will be determined. Similarly, remedial actions can be taken if topographic data indicates that some slumping is present in the cap. This is outlined in the Stewardship Plan (Ref. 1) and will be preceded by an optimisation exercise to ensure that the action undertaken is proportionate, cost effective, and in line with regulatory requirements. This process is illustrated in Figure 7. Remedial measures may include, but are not limited to, additional sampling or monitoring, cap maintenance or additional capping or more active intervention measures.

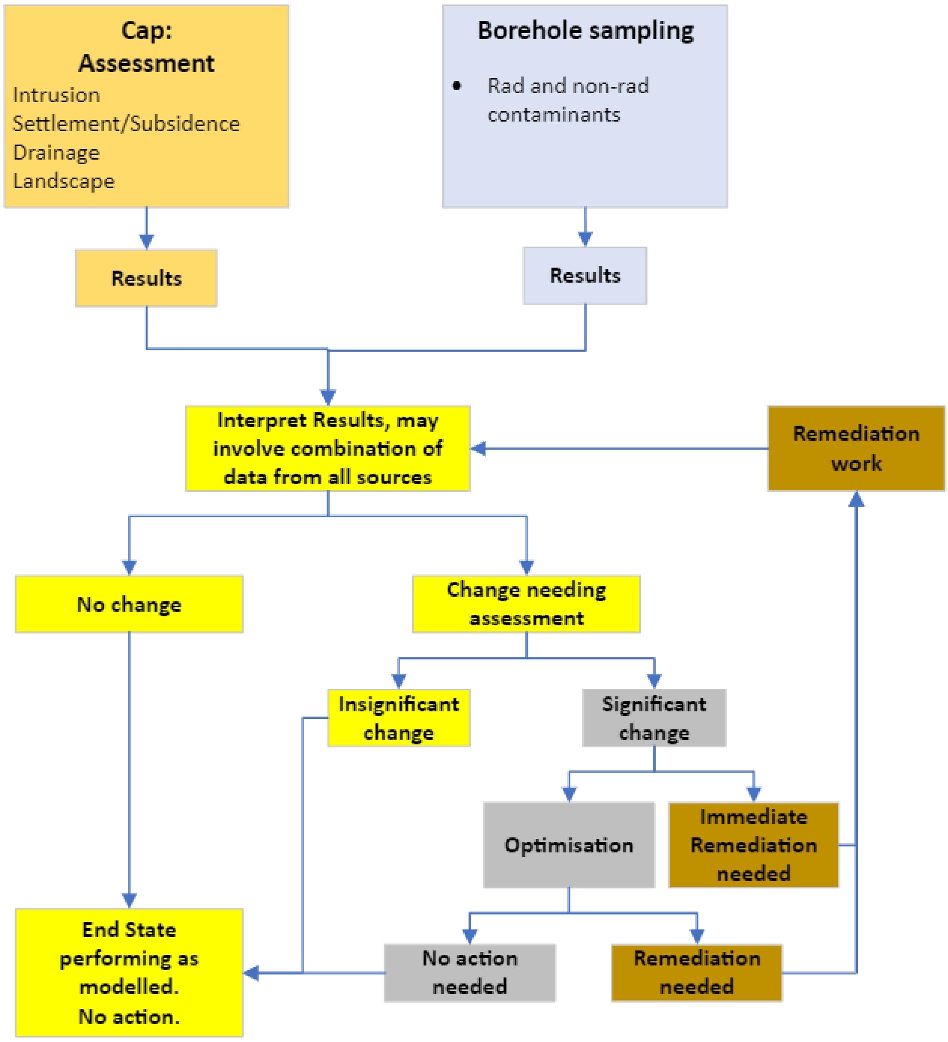


**Figure 7. Decision-making associated with the EMP results (Ref. 1).**

# 7 MONITORING PLAN REVIEW

This section explains how the EMP will be maintained so the scope of monitoring remains responsive to monitoring results and to changes in the hydrogeological and hydrological regime.

The events set out in Table 6 will trigger a review of this monitoring plan.

**Table 6. Events triggering a review of the Environmental Monitoring Plan**

| Event | Description |
|---|---|
| Detailed design of the disposals which results in changes in the concept | This EMP is based on the SGHWR and Dragon disposal concepts reflected in the GRR and DfR permit and planning applications. The EMP may be updated to reflect the detailed design of the disposals. |
| Granting of GRR or DfR permissions | The EMP will be updated to reflect any conditions that may be required as part of the GRR or DfR permissions. |
| Commencement of demolition and disposal works | Monitoring will continue to be undertaken quarterly until the construction of the disposals commences. This dataset will form the baseline for the site, and will be used to determine the quality of the groundwater at the site. It will also be used to revise the concentrations that could trigger action. |
| Organic contamination arises during construction works | In the case that contamination occurs during the construction of the disposals that requires ongoing monitoring this will be recorded in the CEMP. This will also trigger a review of this EMP to determine if TPH-CWG and PAH compound monitoring is required. |
| Design and construction of the mire | The EMP is based on the design of the mire as described in the Restoration Management Plan (RMP) (Ref. 19). The EMP should be reviewed if the location and/or size of the mire is different to that described. |
| Changes to drainage systems | The decommissioning of rubble drains will allow water to be more naturally managed at the surface. The impact of drain decommissioning on groundwater has been assessed in the hydrogeological interpretation. The EMP should be reviewed if the decommissioning of the drains causes any unexpected changes to groundwater characteristics. |
| Changes to monitoring infrastructure | If monitoring infrastructure is changed, for instance if a borehole becomes inaccessible, the plan will be reviewed to determine an appropriate alternative existing location for monitoring or the need to construct additional monitoring infrastructure. |
| Sustained period of no cap settlement | Should the change in cap level not be statistically significant when compared to the previous two annual surveys, annual topographic surveys can cease. |
| Sustained period of expected | If, as expected, there is insignificant effect of the SGHWR and Dragon demolition and disposals, the initial comprehensive monitoring regime set out in this plan may be scaled relative to the |

| Event | Description |
|---|---|
| performance of the disposals | risks by reducing the number of monitoring locations and/or the suite of determinands and/or the frequency of monitoring.<br><br>The first review will not be carried out until at least ten years of post-implementation monitoring has been completed. The first review will determine the appropriate timing of subsequent reviews. |

# 8 SUMMARY

Table 7 is a summary of the currently envisaged water environment monitoring regime. Monitoring locations are shown in Figure 4.

**Table 7. Water Environment Monitoring Regime**

| Locations | Area of interest | Hydrometric monitoring | Water quality sampling |
|---|---|---|---|
| **OW17** | Groundwater quality upgradient of both disposals | Quarterly monitoring of groundwater level | Quarterly monitoring:<br>• Field parameters: dissolved oxygen, temperature, redox conditions, pH and electrical conductivity<br>• Gross alpha/beta, tritium<br>• Major ions: Ca, Na, K, Mg, Cl, F, $SO_4$, total alkalinity<br>• Metals (dissolved): As, Ba, Cd, Cr (total and Cr(VI)), Cu, Hg, Mo, Ni, Pb, Sb, Se, and Zn<br>• pH |
| **OW18** | | | |
| **OW19** | Groundwater quality immediately downgradient of SGHWR disposal to assess performance of disposal | | |
| **OW20** | | | |
| **OW27** | | | |
| **OW28** | | | |
| **OW22** | Groundwater quality downgradient of SGHWR and upgradient of Dragon disposal and mire receptor | | |
| **OW23** | | | |
| **OW131** | Groundwater quality immediately upgradient of Dragon disposal | | |
| **OW135** | | | |
| **OW132** | Groundwater quality downgradient of Dragon | | |
| **OW133** | | | |
| **OW134** | | | |
| **BH411** | | | |

The type and frequency of cap monitoring is outlined in Figure 8.

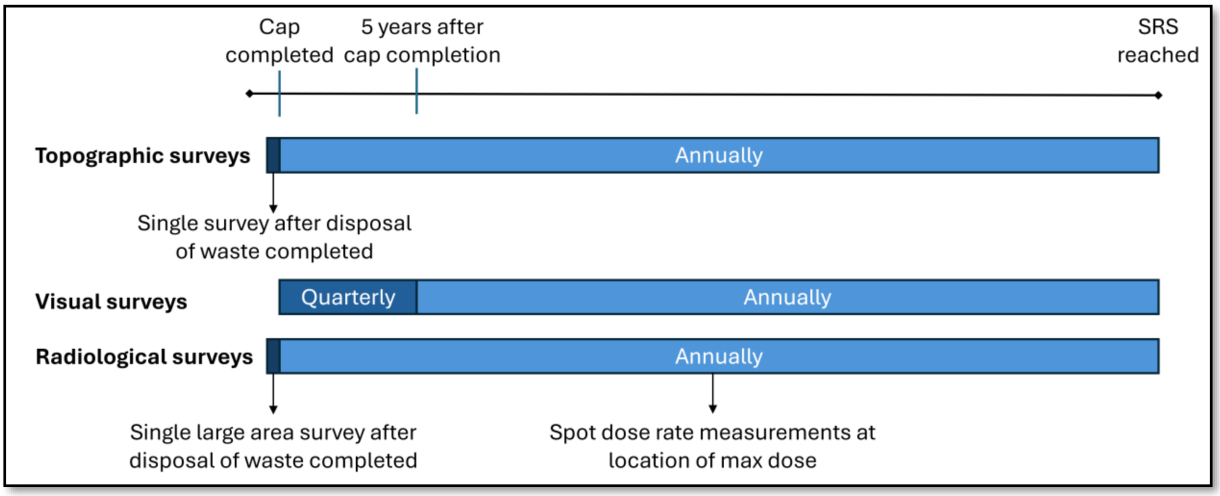


**Figure 8. Type and frequency of cap monitoring.**

Topographic surveys will continue to be carried out annually until NRS can make the case to reduce this. Visual surveys will take place quarterly until the cap has been completed for 5 years, after which they will reduce to annually. Radiological dose rate measurements will continue annually until NRS can make the case to reduce this. Surveys will cease at the SRS at the latest.

The monitoring plan will be reviewed following the occurrence of any of the events listed in Table 6 and to ensure that Best Available Techniques are being applied, with the monitoring outlined proportionate to the risks.

# 9 REFERENCES

[1] Stewardship Plan, ES(24)P386, Issue 1, December 2024

[2] Galson Sciences, Winfrith Site End State Radiological Performance Assessment, ES(23)P388, Issue 1, December 2024

[3] WSP, Non-radiological Hydrogeological Risk Assessment for Disposals at the SGHWR and Dragon Reactors at the Winfrith Site, ES(22)P361 Issue 1, December 2024

[4] Winfrith End State Project: Site-Wide Environmental Safety Case, ES(24)P390, Issue 1, July 2024

[5] Environment Agency, Landfill and deposit for recovery: aftercare and permit surrender, March 2022

[6] Winfrith End State: Environmental Site Setting Description Report, ES(24)P406, Issue 1, December 2024.

[7] SEPA, FSA, EA, Radiological Monitoring Technical Gudiance Note 2; Environmental Radiological Monitoring, Version 1, December 2010.

[8] Environment Agency, Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water, LFTGN02, Issue 1, February 2003.

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[17] WSP, Winfrith Site: Groundwater and Surface Water Monitoring and Sampling - May 2023, 70106973.606/B.0, Issue 1, August 2023

[18] WSP, Winfrith Site; Groundwater and Surface Water Monitoring and Sampling - November 2023, 70106973.621/A.0, Issue 1, March 2024

[19] WSP, Restoration Management Plan, ES(24)P399, Issue 1, December 2024.

[20] Atkins, Elevated Alkalinity Effects on Ecological Receptors, 5169252.308.001, Issue 1, February 2019

[21] UK Technical Advisory Group on the Water Framework Directive, Technical Report on Groundwater Hazardous Substances, 2016.

[22] World Health Organisation, Barium in Drinking-water, WHO/FWC/WSH/16.48, 2017.

[23] World Health Organisation, Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda, 2022.

[24] Drinking Water Inspectorate, Information Note on Regulation 11, December 2022.

## Appendix A – Action Levels

| Contaminant | Contaminant Classification | Freshwater Annual Average EQS (µg/l) or Minimum Reporting Value (µg/l except for pH)[3] | Drinking Water Standard (µg/l) | Mean Concentration in Background Groundwater Quality (µg/l except for pH) | Action level (µg/l except for pH) | Justification |
|---|---|---|---|---|---|---|
| pH | Non-hazardous | 6-9 (95th percentile) | | 5.75 | 8[4] | Atkins recommends that pH of groundwater where it interacts with the root zone is <8. |
| As | Hazardous | 5 | | 6 | 6 | Mean concentration in background groundwater quality |
| Ba | Non-hazardous | | 1300[5] | n/a | 325 | One quarter of WHO health based standard |
| Cd | Non-hazardous | 0.08[6] | 5 | n/a | 1.25 | One quarter of DWS |
| Cr (VI) | Hazardous | 1 | | n/a | 1 | Limit of quantification |
| Cu | Non-hazardous | 1 (bioavailable) | | 12 | 12 | Mean concentration in background groundwater quality |
| Hg | Hazardous | 0.01 | | 0.4 | 0.4 | Mean concentration in background groundwater quality |
| Mo | Non-hazardous | | 70[7] | n/a | 17.5 | One quarter of WHO health based standard |
| Ni | Non-hazardous | 4 (bioavailable) | | 15 | 15 | Mean concentration in background groundwater quality |
| Pb | Hazardous | 0.2 | | 3 | 3 | Mean concentration in background groundwater quality |
| Sb | Non-hazardous | | 5 | n/a | 1.25 | One quarter of DWS |

3 This column represents the limit of quantification (Ref. 21) for hazardous substances and the freshwater environmental quality standard for non-hazardous pollutants.

4 This value is based on a hydro-ecological study conducted by Atkins (Ref. 20)

5 There is no drinking water standard for barium. This is a health-based standard by WHO (Ref. 22).

6 Value appropriate where there is less than 40mg/l calcium carbonate

7 There is no drinking water standard for molybdenum. This is a health-based standard by WHO (Ref. 23).

| Contaminant | Contaminant Classification | Freshwater Annual Average EQS (µg/l) or Minimum Reporting Value (µg/l except for pH)[3] | Drinking Water Standard (µg/l) | Mean Concentration in Background Groundwater Quality (µg/l except for pH) | Action level (µg/l except for pH) | Justification |
|---|---|---|---|---|---|---|
| Se | Non-hazardous | | 10 | n/a | 2.5 | One quarter of DWS |
| Zn | Non-hazardous | 10.9 (bioavailable) | | 27 | 27 | Mean concentration in background groundwater quality |

| Radiological Determinand | Action level (Bq/l) | Justification |
|---|---|---|
| Tritium | 100 | Site trigger level[8] |
| Gross Alpha | 0.5 | WHO guidance level |
| Gross Beta | 1 | WHO guidance level |

| Location of spot dose rate measurement | Action level (mSv/h) | Justification |
|---|---|---|
| SGHWR cap | 0.0003 | Site background level |
| Dragon cap | 0.0003 | Site background level |

[8] Concentrations of tritium of 100Bq/l is the site trigger level in current land quality groundwater monitoring. Concentrations of tritium above 100Bq/l also requires the local authority to investigate the source and undertake a risk assessment as required by the Drinking Water Inspectorate (Ref. 24).

## Appendix B – Groundwater Monitoring Summary

| Locations | Area of interest | Hydrometric monitoring | Water quality sampling |
|---|---|---|---|
| **OW17** | Groundwater quality upgradient of both disposals | Quarterly monitoring of groundwater level | Quarterly monitoring:<br>• Field parameters: dissolved oxygen, temperature, redox conditions, pH and electrical conductivity<br>• Gross alpha/beta, tritium<br>• Major ions: Ca, Na, K, Mg, Cl, F, $SO_4$, total alkalinity<br>• Metals (dissolved): As, Ba, Cd, Cr (total and Cr(VI)), Cu, Hg, Mo, Ni, Pb, Sb, Se, and Zn<br>• pH |
| **OW18** | | | |
| **OW19** | Groundwater quality immediately downgradient of SGHWR disposal to assess performance of disposal | | |
| **OW20** | | | |
| **OW27** | | | |
| **OW28** | | | |
| **OW22** | Groundwater quality downgradient of SGHWR and upgradient of Dragon disposal and mire receptor | | |
| **OW23** | | | |
| **OW131** | Groundwater quality immediately upgradient of Dragon disposal | | |
| **OW135** | | | |
| **OW132** | Groundwater quality downgradient of Dragon | | |
| **OW133** | | | |
| **OW134** | | | |
| **BH411** | | | |