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Roche Clarecastle:

Road Map for IE Licence Surrender

Prepared for

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Clarecastle
Co. Clare

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ABBREVIATIONS

AEC	-	Area of Environmental Concern
AECOM	-	AECOM Ireland Limited
CPT	-	Cone Penetration Testing
CSM	-	Conceptual Site Model
DCM	-	Dichloromethane
DQRA	-	Detailed Quantitative Risk Assessment
DSA	-	Detailed Site Assessment
EK	-	Epikarst
EPA	-	Environmental Protection Agency
HPT	-	Hydraulic Profiling Tool
IE	-	Industrial Emissions
ISTT	-	In-Situ Thermal Treatment
LB	-	Limestone Bedrock
MIP	-	Membrane Interface Probe
MPE	-	Muti-Phase Extraction
PSA	-	Preliminary Site Assessment
Roche	-	Roche Ireland Limited
THF	-	Tetrahydrofuran
TTZ	-	Target Treatment Zone
WWTP	-	Wastewater Treatment Plant

1 INTRODUCTION

This report presents an overview of the remedial strategy that has been developed to address Areas of Environmental Concern (AECs) at Roche Ireland's former manufacturing facility in Clarecastle, Co. Clare ("the site") following its closure in 2020. The report includes a summary of the detailed site assessments and environmental risk assessments that were completed over the period 2017 – 2023 to inform the remedial strategy for the site. The report also focuses on what can be expected following completion of remediation of the site in terms of groundwater quality, and it provides an outline of the groundwater monitoring programme currently envisaged to verify post-remediation groundwater quality.

An Industrial Emissions (IE) licence (Licence Register No. P0012-06) was granted to Roche by the Environmental Protection Agency (EPA) in February 2023, the purpose of which is to facilitate remediation of the site within a robust regulatory framework. The primary aim of this report is to facilitate discussion and agreement with the EPA on the process of surrendering the IE licence following successful completion of site remediation. It is hoped that any points of potential concern the EPA may have in relation to the remedial strategy, its implementation and post-remediation monitoring, can be discussed and, if considered necessary, plans adjusted at an early stage in the remediation works programme. This is with a view to the IE licence being surrendered and the site being redeveloped for productive use without delay following completion of the remediation works programme.

Four AECs have been identified at the site and a remedial strategy and an associated remediation works programme have been developed for each area.

The AECs are located in the following areas of the site:

- AEC1 - former main production building;
- AEC2 - former Equalisation Basin
- BH201 hotspot[1]
- Landfill area

The locations and approximate extent of the AECs are shown on the insert figure on the following page. All other areas of the site outside these AECs were assessed in accordance with the EPA's guidance on the assessment of contaminated land and groundwater, and were found not to require further assessment or remediation.

A two-phase licence surrender process has been agreed in principle with the EPA, with an initial focus on the northern and western areas of the site located above the River Fergus floodplain. This so-called "Phase 1" area is shown shaded red on the figure on the following page and includes areas of the site with the greatest potential for future redevelopment. Subject to EPA agreement, it is planned for the Phase 1 area to be removed from the licensed

[1] In some technical reports, this area is considered as part of AEC2

site boundary by Technical Amendment of the IE licence following completion of remediation of AEC1 and the BH201 hotspot. This is expected to take place during 2027.

Insert Figure A: Areas of Environmental Concern

Note: Phase 1 area shaded red; area prioritised for future redevelopment

The Phase 1 area covers c. 31 acres (approximately 35% of the total site area) and generally coincides with the former production, manufacturing support and administrative areas of the site. The Phase 1 area excludes the shipping container laydown area located in the central area of the site, because licensed activities are scheduled to take place in this area until close to project completion.

The planned remediation works programme for each of the AECs is described in the Operational Report submitted to the EPA during the licence review process[2] and is summarised below:

AEC1: Former Production Building:

- Excavation and off-site treatment of shallow odorous soil (completed 2023);
- Multi-phase extraction (MPE) - to be applied to deeper soil (glacial till) and the uppermost limestone bedrock.

AEC2: Former Equalisation Basin:

- In-situ Thermal Treatment (ISTT) of soil (estuarine deposits) and shallow groundwater.

[2] AECOM, 2022: "*Attachment 4.8.1, Operational Report, IE Licence P0012-05 Review, Application ID LA005493*" dated 25 September 2022

BH201 hotpot: Former WWTP Tanks:

- MPE - to be applied to soil (estuarine deposits) and epikarst.

Landfill:

- Removal and off-site treatment of waste from the landfill area.

A more detailed description of the remedial strategy and the planned remediation works programme for each AEC is provided in subsequent sections of this report.

In subsequent sections of this report we present the following:

- In Section 2 we present a summary of the tasks completed during Stage 1 and Stage 2 of the process outlined in EPA 2013[3], and we present a reference list of the technical reports generated from these tasks.
- In Section 3, we discuss details of the planned implementation and aftercare stage of the project (Stage 3), including an outline programme, the expected outcome of the planned remediation works programme in terms of improvement in groundwater quality, and how end outcomes will be verified.
- In Section 4, we outline a schedule of progress reports we propose to submit to the EPA during the remediation works programme, and the closure reports we propose to submit following completion of remediation in each area.

2 DEVELOPMENT OF REMEDIAL STRATEGY

2.1 Introduction

The remedial strategy for the site has been developed with reference to the EPA's 2013 publication "*Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites*" (EPA 2013). The guidance document recommends that a risk-based approach is taken when assessing the need for remediation, and when developing a remedial strategy when remediation is found to be necessary. The risk assessment methodology outlined in EPA 2013 follows a staged approach:

- STAGE 1: Site Characterisation & Assessment
- STAGE 2: Corrective Action Feasibility & Design
- STAGE 3: Corrective Action Implementation & Aftercare

The remedial strategy for the Clarecastle site was also developed with consideration of the conditions required for the EPA to accept surrender of the site's IE licence. The EPA is required to assess each application for licence surrender on a case-by-case basis with reference to Section 95(7) of EPA Act 1992 (as amended), which states the following:

"If the Agency is satisfied that the condition of the relevant installation is not causing or likely to cause environmental pollution and the site of the activity is in a satisfactory state, it shall accept the surrender of the licence or revised licence…"

[3] EPA, 2013: "*Guidance on the Management of Contaminated Land & Groundwater at EPA Licensed Sites*"

The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (as amended) is an important consideration when the EPA considers IE licence surrender applications; the so-called Groundwater Regulations promote improvement in groundwater quality in Ireland over time with an ultimate aim of achieving "good" status for all groundwater bodies.

As the EPA is aware, Roche submitted an updated Closure Restoration and Aftercare Management Plan (CRAMP) on 27 February 2024 (LR082230). The CRAMP was developed in compliance with Condition 10 of the facility's IE licence and adheres to the EPA's *Guidance on Assessing and Costing Environmental Liabilities* (2014).

The primary goal of the CRAMP is to prevent environmental harm following site closure and to ensure the site is left in an environmentally safe condition (i.e. make safe). However, the site remediation project aims to go further in its objectives, which are to remove waste for appropriate recovery and disposal, and remediate residual contamination which ultimately enables the efficient and timely surrender of the IE licence.

2.2 Stage 1: Site Characterisation & Assessment

2.2.1 Preliminary CSM Development & Risk Assessment (2017)

A preliminary Conceptual Site Model (CSM) was developed for the site in 2017, following on from Roche's decision to close the site. This initial task was completed by AECOM and included the following steps:

Stage 1.1: Preliminary Site Assessment: Detailed review of available information regarding the site's history as a pharmaceutical manufacturing site, including past site assessment reports and past groundwater monitoring data;

Stage 1.2: Detailed Site Assessment: Site-wide investigations were completed focusing on Areas of Potential Environmental Concern identified during the Preliminary Site Assessment;

Stage 1.3: Detailed Quantitative Risk Assessment (DQRA): A quantitative assessment of risks to potential receptors from Areas of Environmental Concern (AECs) identified from the Detailed Site Assessment was undertaken, including risks to potential human health receptors, the River Fergus, and off-site groundwater.

No unacceptable risks to the above-mentioned potential receptors were identified from any of the AECs. However, it was recognised that remediation works were required within each of the AECs to facilitate IE licence surrender and to facilitate redevelopment of the site for productive future use.

To reiterate, Stage 1.1 of the process – Preliminary Site Assessment (PSA) – considered the entire site in accordance with the guidance outlined in EPA 2013. Stage 1.2 – Detailed Site Assessment (DSA) then focused on areas of potential environmental concern highlighted in the PSA. However, the DSA also provided soil and groundwater quality data from areas of the site outside areas of potential environmental concern. There is a considerable body of data showing that remediation is not required in areas of the site outside the AECs.

2.2.2 Refinement of Risk Assessments (2020-2023)

In 2020, Geosyntec was retained by Roche to refine the preliminary CSM and risk assessments developed for the site. The following tasks were completed in stages over the period 2020 – 2023 with this aim in mind:

Site-wide

A root-and-branch review of the existing groundwater monitoring well network at the site was completed. A series of 44 new groundwater monitoring wells were installed during 2020 in two stages, including several well pairs designed to assess groundwater quality separately in the Epikarst (EK) and the underlying Limestone Bedrock (LB).

AEC1

- An initial investigation of the AEC1 source area was conducted in 2021 following decommissioning and removal of equipment from, and prior to demolition of, the main production buildings. This included a programme of soil probing using a MIP-HPT-CPT rig (41 locations), follow-on soil boring (20 locations), deeper borehole drilling at 10 locations and installation of eight additional groundwater monitoring wells;
- An additional seven groundwater monitoring wells were installed in the area down-gradient of AEC1 in 2022;
- An updated DQRA for AEC1 was completed in 2021, taking into account the data collected during the 2021 investigations and follow-on groundwater monitoring. This was further updated following completion of the 2022 investigations.

The updated DQRAs confirmed the findings of the preliminary DQRA for AEC1 insofar as no unacceptable risks to the River Fergus were identified. In addition, investigations and subsequent monitoring confirmed that the dissolved-phase plume associated with AEC1 extends no further than 70m from the source area.

AEC2 & BH201 hotspot

- Additional monitoring wells were installed in the vicinity of AEC2 and the BH201 hotspot during the site-wide investigations conducted in 2020. An updated DQRA for these two areas was completed in 2021, which found there were no unacceptable risks to potential receptors from these source areas.

Landfill Area

- Additional monitoring wells were installed in the landfill area and within the riverbank area during the site-wide investigations conducted in 2020;
- An additional 12 groundwater monitoring wells were installed in the so-called "Marshy Area" situated generally down-gradient of the H2 cell area in 2022;
- An updated DQRA for the landfill area was completed in 2021, based on the data collected from the 2020 site investigation, which found there were no unacceptable risks to potential receptors from the landfill. The DQRA included a flux assessment for ammoniacal nitrogen migrating to the River Fergus via groundwater baseflow; this was completed because the EPA has voiced concern in the past about ammoniacal nitrogen in

groundwater at the site in the context of the Water Framework Directive and its objectives. The DQRA and ammoniacal nitrogen flux assessment were further updated following completion of the 2022 investigations.

2.2.3 *Stage 1 Reports*

The following table presents a summary of the Stage 1 reports prepared for the site over the period 2017 through 2023. The most recent Stage 1.3 (DQRA) reports are highlighted in red text.

Area of Site	Report title (reference)	EPA Guidance Stage	Prepared by:	Date
Former Production Areas & Effluent Treatment Area (AEC1 & AEC2): Initial CSM Development & Risk Assessment	Preliminary Site Assessment – Production Areas (60509749-002)	Stage 1.1	AECOM	Mar-17
	Detailed Site Assessment – Production Areas (60509749-022)	Stage 1.2	AECOM	Aug-17
	Delineation Investigations and Detailed Quantitative Risk Assessment - Production Areas (60509749-052)	Stage 1.3	AECOM	Oct-17
Former Production Buildings (AEC1)	AEC1 Specific Investigation comprising MIP-HPT-CPT and follow-on Window Sampling, Deeper Borehole Drilling and Groundwater Monitoring Well Installation & Sampling (ref: GCU0240010)	Stage 1.2 (update)	Geosyntec	May-20
	AEC1 Conceptual Hydrogeological Model and Risk Assessment - June 2023 update (ref: GCU0240011)	**Stage 1.3 (update)**	**Geosyntec**	**Jun-23**
Former Effluent Treatment Area (AEC2)	**Roche Clarecastle: AEC2 Conceptual Hydrogeological Model and Risk Assessment (ref: GCU0240011)**	**Stage 1.3 (update)**	**Geosyntec**	**Sep-21**
Landfill Area	Preliminary Site Assessment - Landfill Area (60509749-001)	Stage 1.1	AECOM	Feb-17
	Detailed Site Assessment – Landfill Area (60509749-041)	Stage 1.2	AECOM	Jul-18
	Detailed Quantitative Risk Assessment – Landfill Area (60509749-053)	Stage 1.3	AECOM	Jul-18
	Landfill/H2 Area Conceptual Hydrogeological Model & Updated DQRA (ref: GCU0240011)	**Stage 1.3 (update)**	**Geosyntec**	**May-23**

2.3 Stage 2: Corrective Action Feasibility & Design

2.3.1 *Introduction*

In this section we outline the Stage 2 corrective action (remediation) feasibility and design tasks completed in relation to the four AECs at the Clarecastle site. The remedial strategy was developed with the following objectives in mind:

- Enable sustainable future use of the site;
- Return the site to a condition that satisfies the EPA and enables the EPA to accept surrender of the site's IE licence.

The above two objectives are to be achieved via:

- Reduction/removal of sources of contamination and odorous material
- "Betterment" of groundwater quality in source areas, given that the DQRAs completed for each of the source areas have found there is no risk to the River Fergus or off-site groundwater.

The concept of "betterment" of groundwater quality was adopted for the remedial strategy for the Clarecastle site because the DQRAs completed for the identified AECs concluded that there were no unacceptable risks to sensitive receptors from any of the source areas[4]. As a result, it was not necessary to calculate risk-based remedial target values for the identified contaminants of concern. The betterment approach is commonly adopted in remediation projects where no unacceptable risks are present.

"Betterment" with regard to remediation of groundwater at Clarecastle, will represent a comprehensive remedial solution for the site. It will comprise (i) selecting the best available remediation technology for each source area by completing a robust remedial options appraisal, (ii) designing and installing a conservatively designed groundwater remediation system using the selected technology, and (iii) operating that system and optimising contaminant mass recovery until mass recovery rates reduce to a low level - i.e. they approach a zero asymptote. In essence, the aim is to remove as much contaminant mass as is reasonably practicable from the target treatment zone in each area using the selected remediation technology.

In the following sections we outlined the remedial strategy for each of the AECs. A Gaant chart showing key remediation activities over time in each of these areas is appended as **Figure 1**.

2.3.2 AEC1 & BH201 Hotspot

Development of Remedial Strategy

During 2017, a remedial (corrective action) strategy and preliminary remediation design was developed by AECOM for AEC1, and also for the BH201 hotspot[5].

The following remedial strategy was outlined in the 2022 Operational Report (submitted to the EPA as part of the IE licence review documentation) for AEC1 and the BH201 hotspot:

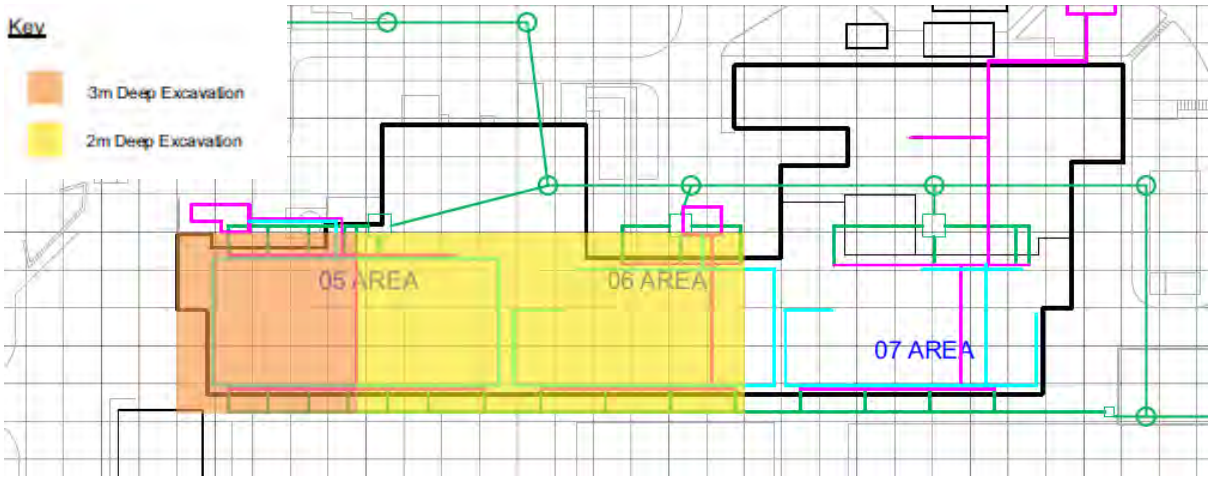
[4] For most areas of the site, contaminant concentrations in groundwater close to the line of the down gradient boundary beside the River Fergus were low to absent.

[5] The BH201 hotspot was considered as part of AEC2 in AECOM's 2017 Stage 2 report and in the Operational Report submitted to the EPA in 2022 as part of the IE licence review documentation.

- Bulk excavation of shallow soil for offsite thermal desorption targeting odorous constituents in the soil that could impact on future development, and backfilling with validated material;
- Apply MPE or similar technology to reduce the contaminants of concern in the underlying soil vapour and groundwater. Toluene and tetrahydrofuran (THF) are the contaminants of concern in AEC1 and toluene is the only contaminant of concern in the BH201 hotspot.

With regard to AEC1, the source area investigations undertaken in 2020 to inform the updated DQRA were also used by Geosyntec to define the lateral extent and depth of soil removal in AEC1 that would meet the stated remedial objectives for this area. The planned extent of shallow soil excavation in AEC1, which was subsequently implemented during 2023, is illustrated by the orange and yellow shaded areas in Insert Figure B below.

Insert Figure B – Extent of Soil Removal, AEC1



The shallow soil excavation in AEC1 and subsequent backfilling with Class 6F2 recycled aggregate was completed in late 2023.

Following reassessment of the CSM and remedial options for the BH201 hotspot, Geosyntec concluded that the observed toluene impacts in shallow soil as well as in the deeper soil and bedrock would best be addressed through MPE, negating the requirement for bulk excavation and off-site treatment of shallow soil from this area. This recommendation was subsequently adopted.

<u>Detailed Design of MPE Systems</u>

Detailed investigations were completed within the AEC1 footprint in Q1/Q2 2024 following completion of shallow soil excavation and backfilling, and also in the BH201 hotspot area. The primary aims of the investigations were to characterise the two source areas in terms of the

extent and concentrations of the key contaminants of concern, and to inform the design process for MPE.

The scope of work included the following:

- Installation of 22 groundwater monitoring wells within the former footprint of the 05/06 production buildings in AEC1 (11 No. in limestone bedrock and 11 No. in the overlying glacial till);
- Installation of 4 No. groundwater monitoring wells in the vicinity of BH201;
- Collection of 156 soil samples and 26 groundwater samples for laboratory analysis;
- Development of preliminary performance specifications for the MPE systems.

During Q2 2024, following completion of the source area characterisation investigations and assessment of the data, a programme of MPE pilot testing was conducted in both AEC1 and the BH201 hotspot. This work programme included (i) installation of four MPE remediation wells in AEC1 (two in the glacial till and two in the limestone bedrock) and one MPE remediation well in the BH201 hotspot, (ii) mobilisation of MPE pilot testing equipment and (iii) completion of MPE pilot testing on each remediation well individually over a four-week period.

The following mass recovery rates were achieved during the MPE pilot tests:

- AEC1 (Glacial Till): 0.3 g/m^3 peak vapour concentration; c. 0.4 kg/day mass recovery;
- AEC1 (Limestone): 2 g/m^3 peak vapour concentration; c. 1.1 kg/day mass recovery;
- BH201 hotspot: 2 g/m^3 peak vapour concentration; c. 2.9 kg/day mass recovery.

The results of the MPE pilot testing were used to design full-scale MPE well arrays for AEC1 and for the BH201 hotspot, and to refine the performance specifications for full-scale operation of the MPE systems. The planned layout of the full-scale MPE well arrays are shown in **Figures 2, 3 and 4** (appended).

It is anticipated that the MPE systems will operate in AEC1 over a period of between one and two years (2025/2026), and in the BH201 hotspot over a period of up to one year (2025).

2.3.3 AEC2 – Former Equalisation Basin

During 2017, a remedial strategy and preliminary remedial design was developed by AECOM for AEC2 - a former Equalisation Basin within the site's original effluent treatment plant, which was partially remediated in the 1990s. The remedial strategy is summarised in AECOM's Stage 2 report dated May 2019 and presented in the Operational Report submitted to the EPA in 2022 as part of the IE licence review documentation. Toluene and THF are the primary contaminants of concern in AEC2, as well as naproxen and ammoniacal nitrogen.

Two remedial options were outlined in the 2022 Operational Report; at that time further technical and commercial appraisal was required to determine which option would be selected for implementation:

- Option 1: Bulk excavation of soil for offsite thermal desorption, backfilling with validated material, and MPE or similar technology to reduce constituent of concern concentrations in underlying soil vapour and groundwater.
- Option 2: In-Situ Thermal Treatment (ISTT).

During the detailed design process conducted in 2022, a number of concerns were raised about the excavation option, in particular in relation to (i) the means of providing adequate foundations for the enclosure required over the area of excavation to control fugitive emissions to air, and (ii) ensuring the safety of workers within the proposed excavation, which was to extend to a depth of up to 8m below ground level.

As a result of these concerns, the main contractor (Indaver) was requested by Roche to conduct a comparative study between the source removal (excavation) option and ISTT. When the concerns surrounding the excavation option were taken into consideration, the study concluded that ISTT was the preferred option and it was subsequently decided to adopt ISTT as the remedial technology for AEC2.

During Q4 2022, Geosyntec completed a detailed investigation of AEC2, the aims of which were to better understand the distribution and overall mass of THF, toluene and other key contaminants in the subsurface, as well as collecting information on soil properties and shallow aquifer characteristics of importance to the ISTT design process. The investigation included the following tasks:

- Installation of 3 groundwater installations down-gradient of AEC2 to improve understanding of the groundwater conditions on its river side;
- Installation of 2 abstraction wells to facilitate hydraulic pumping tests;
- Installation of 6 additional groundwater monitoring wells targeting the basin backfill, the underlying estuarine deposits and epikarst;
- Advancement of 17 soil bores up to 10m deep aimed at further characterising the geological profile and contamination distribution in the basin backfill, overburden and epikarst;
- Two 8- hour pumping tests;
- Laboratory analysis of 78 soil samples and 32 groundwater samples.

The design Target Treatment Zone (TTZ) for ISTT in AEC2 was developed from the results of these investigations. The TTZ extends over the footprint of the former Equalisation Basin and extends vertically from 2m above Ordnance Datum (aOD) to -2.5m aOD, as illustrated by **Figure 5**.

At the time of writing, Indaver was in the process of selecting an ISTT contractor through a competitive tendering process. Once the ISTT contractor is selected, they will complete the detailed design process in consultation with Indaver and the Roche project team, which is scheduled to take place during the first half of 2025. Implementation of ISTT in AEC2 is scheduled to be completed during 2026.

2.3.4 Landfill

During 2017, a remedial strategy and preliminary remediation design was developed by AECOM for the landfill area, which is summarised in their Stage 2 report dated July 2018 and in the Operational Report submitted to the EPA in 2022 as part of the IE licence review documentation. The following remedial strategy was outlined in the 2022 Operational Report for the landfill area:

- Bulk excavation of all landfill material for offsite thermal treatment, and backfilling with validated material.

During 2022 and 2023, the design polishing phase was completed by Indaver in consultation with Roche, which included detailed characterisation of the waste in each cell and design of the planned enclosures and associated infrastructure.

Bulk excavation within the landfill area will proceed on a cell-by-cell basis, with an aim of removing all waste material and the associated leachate collection system in each cell. The expected depth of excavation in each cell is approximately 4 - 5 m below the cap liner.

Excavation of the waste cells will take place within temporary enclosures, which will operate under negative pressure. The excavated waste will be loaded into purpose-built shipping containers, which will be transported by road to the Port of Foynes and then by ship to a licensed waste treatment facility in the Netherlands.

Upon completion, the base of each excavation will be visually inspected and assessed with a PID for evidence of contamination. Where observed, an additional scrape of up to 300 mm will be removed. No deeper over-dig is proposed so that the integrity of the underlying estuarine clays is maintained. Once post-remediation soil sampling across the excavation base is completed[6], the landfill area will be restored to match the surrounding land levels, as far as is reasonably practicable, with a minimum of 1 m of cohesive fill above the cell bases, designed to minimise recharge to depth.

At the time of writing, enabling works were in progress across the landfill area. Excavation of waste from the first cell is due to commence during Q1 2025.

2.3.5 Stage 2 Reports

The following table presents a summary of the Stage 2 reports prepared for the site over the period 2018 through 2024. The most recent Stage 2 report for each area is highlighted in red text.

[6] Details of the post-remediation soil sampling programme for the landfill area will be submitted to the EPA for approval prior to its implementation, in accordance with Condition 6.20 of the IE licence.

Area of Site	Report title (reference)	Prepared by	Date
Former Production Areas & Effluent Treatment Area (AEC1 & AEC2): Development of Preliminary Remedial Strategy	Corrective Action and Feasibility Report – Production Area, AEC1 (60509749-061)	AECOM	Apr-19
	Corrective Action and Feasibility Report – Production Area, AEC2 (60509749-060)	AECOM	May-19
Former Production Buildings (AEC1) & BH201 Hotspot	AEC1 and BH201 Hotspot Source Area Investigation – Factual Report (ref: GCU0240030)	Geosyntec	May-24
	MPE Pilot Test & Full-Scale Design Report (ref: GCU0240032)	**Geosyntec**	**Sep-24**
Former Effluent Treatment Area (AEC2)	Geosyntec letter dated 20 October 2022 re transition from excavation to ISTT in AEC2 (ref: GCU0240009)	Geosyntec	Oct-22
	AEC2 Equalisation Basin Characterisation Study & ISTT Remediation Performance Specification (ref: GCU0240020)	**Geosyntec**	**Jan-23**
Landfill Area	Corrective Actions Feasibility and Design Report – Landfill Area (60509749-063)	AECOM	Jul-18

3 STAGE 3: CORRECTIVE ACTION IMPLEMENTATION & AFTERCARE

In this section, we discuss details of the planned implementation and aftercare stage of the project (Stage 3), including what we expect will be achieved by the planned remediation works programme in terms of improvements in groundwater quality. We also discuss in outline how post-remediation groundwater quality will be verified, the technical reports that will be generated during implementation of the remediation works programme and we present an outline project timeline.

3.1 AEC1 & BH201 Hotspot: Multi-Phase Extraction

The following outline programme is anticipated for MPE within AEC1 and the BH201 hotspot:

- Late 2024/early 2025: MPE system installation and testing;
- February 2025: MPE system commissioning;
- 2025-2026: MPE system operation, monitoring & optimisation;
- 2026-2027: Post-remediation groundwater monitoring.

As outlined earlier, the MPE system in AEC1 is expected to operate for a period of one to two years, and the MPE system in the BH201 hotspot is expected to operate for a period of up to one year. Operation of each system will continue until the contaminant mass recovery rate approaches an asymptote - i.e. the mass recovery rate reduces to a *de minimus* level whereby continued operation is unlikely to result in further environmental benefit.

Monitoring will be conducted on a regular basis during the operational phase of MPE to facilitate the following: (i) optimisation of MPE system performance (ii) on-going tracking of individual remedial well-specific contaminant mass recovery rates, plus cumulative mass recovered in liquid, vapour and dissolved phases, (iii) compliance with IE licence conditions with regard to emissions to the environment.

Following completion of MPE, it is envisaged that post-remediation groundwater monitoring will be completed on a quarterly basis from selected groundwater monitoring wells located within AEC1 and the BH201 hotspot, and also in the areas down-gradient of the two residual source areas. Details of the wells to be sampled and the frequency of monitoring will be submitted to the EPA for approval as the operational phase of MPE draws to a close.

It is expected that groundwater quality will equilibrate within 6 – 12 months of cessation of MPE and that following this period of equilibration, contaminant concentrations will be relatively low and remain relatively stable, without a clear upward or downward trend over time. With this in mind, a post-remediation monitoring period of approximately 12 months is envisaged – i.e. until equilibration of post-remediation groundwater quality has been observed.

MPE within AEC1 and the BH201 hotspot is expected to reduce concentrations of the contaminants of concern in groundwater by around 90% - i.e. one order of magnitude reduction. As such, residual concentrations of toluene in both areas, and THF in AEC1, up to 10-20 mg/l may be observed in some groundwater monitoring wells within the two treatment areas post-remediation.

As already outlined, the dissolved-phase plumes of toluene associated with these two source areas, and THF in the case of AEC1, have been shown to be limited in extent. Before remediation they extended to less than 70 m downgradient of AEC1, and to only a few 10s of metres downgradient of the BH201 hotspot, with no impact on a wider environment. Immediately following remediation, these downgradient plumes are likely to remain at a similar scale, but with time are expected to be stable-to-declining in magnitude and extent, given the source mass removal exercises that have been completed. Given there is no risk to the River Fergus from the existing plumes there is no need to demonstrate a declining plume, just prove they are stable.

An application will be lodged with the EPA Licensing section early in 2027 to remove the Phase 1 area from the IE licence boundary, which includes AEC1 and the BH201 hotspot. This process will be completed in consultation with the EPA Enforcement section.

3.2 AEC2: In-Situ Thermal Treatment

The following outline programme is anticipated for ISTT within AEC2 (former Equalisation Basin):

- Late 2024: ISTT contractor selection
- Q1/Q2 2025: Detailed design & procurement;
- Q3/Q4 2025: System installation and testing;

- Q1/Q2 2026: ISTT system operation & monitoring;
- 2026-2027: Post-remediation groundwater monitoring.

ISTT is an aggressive remedial technique that is effective for source areas containing volatile and/or semi-volatile organic compounds. It involves heating the soil and groundwater within the TTZ to the highest boiling point of the contaminants of concern, which has the effect of volatilising the contaminants within the soil and groundwater. The vapour-phase contaminants then migrate up through the soil column and are collected using a soil vapour extraction (SVE) system. The system is operated until mass recovery rates reduce to a relatively low level.

The ISTT system at AEC2 is expected to operate for a period of approximately six months. Operation of the system will continue until the contaminant mass recovery rate for toluene (which has the highest boiling point of the contaminants of concern and therefore takes longer to remove) reduces by 90-95% compared with the peak mass recovery rate observed during the heating phase.

Similar to MPE, monitoring will be conducted on a regular basis during the operational phase of ISTT to facilitate: (i) optimisation of system performance (ii) on-going tracking of contaminant mass recovery rates and cumulative mass recovered in vapour and dissolved phases, (iii) compliance with IE licence conditions with regard to emissions to the environment.

Following completion of ISTT, it is envisaged that post-remediation groundwater monitoring will be completed on a quarterly basis from selected groundwater monitoring wells located within AEC2, and also in the area down-gradient of the residual source area. Details of the wells to be sampled and the frequency of monitoring will be submitted to the EPA for approval as the operational phase of ISTT draws to a close.

It is expected that groundwater quality within the TTZ and in the EK below the TTZ will equilibrate within about 12 months of cessation of ISTT. The positive effects of ISTT may take some time to be seen in groundwater quality downgradient of the source area due to the low hydraulic gradients present in this area of the site; however in time, a downward trend in key contaminant concentrations is expected in downgradient groundwater. With this in mind, a post-remediation monitoring period of up to two years is envisaged.

It is anticipated that upon completion of ISTT in AEC2, residual concentrations of key contaminants in soil and groundwater within the TTZ will be relatively low, and that contaminant concentrations in groundwater in the underlying epikarst will have reduced by approximately 90% (i.e. one order of magnitude reduction). As such, concentrations of toluene, THF, and also dichloromethane (DCM) of up to 1 – 2 mg/l may be expected in EK groundwater within the footprint of the Equalisation Basin following completion of ISTT, with lower concentrations and a downward trend observed over time in the downgradient area.

3.3 Landfill: Removal of Waste & Off-Site Treatment

The following outline programme is anticipated for the remediation works programme in the landfill area, noting that enabling works has already started:

- Q3/Q4 2024: Enabling works;
- Q1 2025 – Q2 2027: Waste removal & reinstatement;
- Q3 2027: Demobilisation.

Following completion of remediation in the landfill area, it is envisaged that post-remediation groundwater monitoring will be completed on a quarterly basis from selected groundwater monitoring wells located within the landfill area (noting that some existing monitoring wells currently used for IE licence monitoring will need to be decommissioned during the remediation works programme, and a small number of new wells may need to be installed following completion of remediation), and also in the downgradient riverbank area. If practicable, post-remediation groundwater monitoring may commence in parts of the landfill area where remediation is complete, prior to the overall works programme being completed. Details of the wells to be sampled and the frequency of monitoring will be submitted to the EPA for approval prior to commencement of the post-remediation monitoring programme.

The key contaminants of concern in groundwater in the landfill area are THF and ammoniacal nitrogen. It is expected that removal of waste from the landfill area will result in a reduction in THF and ammoniacal nitrogen concentrations in groundwater underlying the landfill and in downgradient groundwater. Because hydraulic gradients across the landfill area are very low, it is expected to take some time for the positive effects of remediation to be observed. However, a downward trend in both THF and ammoniacal nitrogen should be evident in below landfill cell monitoring wells within 1 – 2 years of waste removal, and downgradient of the key H2 cell area. Reductions in ammoniacal nitrogen concentrations may be slower and less marked, given the contribution of ammoniacal nitrogen from natural organic materials in the estuarine deposits.

4 REPORTING SCHEDULE & MILESTONES

It is proposed that concise quarterly progress reports are submitted to the EPA during the period the remediation works programme is in progress (i.e. Q1 2025 through to Q2 2027). Each report will present a brief factual account of the progress made on each of the active strands of the site remediation project during the preceding quarter. These reports will be submitted during the month following the end of each quarter.

In addition, the following Stage 3 detailed closure reports will be prepared following completion of each strand of active remediation:

Area	Remediation Strategy	Preliminary submission date of closure report
AEC1: Production buildings (shallow soil)	Removal and off-site treatment of soil	Q1 2025
AEC1 & BH201 hotspot	Multi-Phase Extraction	Q1 2027
AEC2: Equalisation Basin	In-Situ Thermal Treatment	Q4 2026
Landfill	Removal and off-site treatment of waste	Q4 2027

Following completion of remediation in each of the areas, a post-remediation groundwater monitoring report will be prepared on a quarterly basis. These reports will focus on residual contaminant concentrations and concentration trends in each of the source areas and down-gradient areas compared with pre-remediation baseline concentrations.

In addition to the above, an Independent Closure Audit (ICA) report will be prepared for the Phase 1 area in support of the planned removal of this area from the licensed boundary in Q4 2026. A second ICA report will be prepared for the final IE licence surrender application, which is scheduled to be submitted to the EPA during late 2027.

As mentioned earlier, an outline project programme showing the three strands of site remediation and incorporating the above schedule of progress, closure, post-remediation groundwater monitoring and ICA reports, is shown in **Figure 1**.

* * * * * *

Geosyntec
consultants

F I G U R E S

FIGURE 1 - OUTLINE PROJECT SCHEDULE & REPORTING SCHEDULE

Geosyntec consultants

Task No.	Description	Q2 2024			Q3 2024			Q4 2024			Q1 2025			Q2 2025			Q3 2025			Q4 2025			Q1 2026			Q2 2026			Q3 2026			Q4 2026			Q1 2027			Q2 2027			Q3 2027			Q4 2027			Q1 2028			Q2 202
	REPORTS & MILESTONES																																																
1	Roadmap to IEL surrender incl. remedial strategy (meetings)																																															
2	Quarterly reporting - progress vs programme																																															
3	Technical amendment/licence surrender applications																																															
4	EPA site exit audit - Phase 1 area																																															
5	EPA site exit audit - Phase 2 area																																															
B	**AEC1 & ALSO BH201 AREA (MPE PROJECT)**																																															
1	Source area characterisation																																															
2	MPE pilot testing																																															
3	Detailed design/system build/mobilisation																																															
4	Full scale system installation, testing & commissioning																																															
5	System operation, maintenance & monitoring**																																															
6	System shut-down, demobilisation																																															
7	Post-remediation GW monitoring***																																															
8	Closure report (Geosyntec)																																															
9	Area available for licence surrender application																																															
C	**EFFLUENT TREATMENT AREA (ISTT PROJECT)**																																															
1	ISTT contractor tendering/procurement																																															
2	Design polishing																																																
3	Equipment purchase & shipping																																															
4	Installation, testing & commissioning																																															
5	System operation, maintenance & monitoring																																															
6	System shut-down, demobilisation																																															
7	Closure report (Indaver)																																															
8	Post-remediation GW monitoring***																																															
9	Closure report (Geosyntec)																																															
10	Area available for licence surrender application																																															
D	**LANDFILL**																																															
1	Enabling works																																																
2	Waste removal																																															
3	Demobilisation																																															
4	Closure report (Indaver)																																															
5	Post-remediation GW monitoring***																																															
6	Closure report (Geosyntec)																																															
7	Area available for licence surrender application																																															
	Notes:																																																
	** Period of MPE operation could be shorter than 2 yrs particularly in BH201 area.																																															
	*** Duration subject to EPA agreement																																															

N

PD-GT-07		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
7 - 45	379	871
ND	23	52

PD-GT-09		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
45 - 94	571	<5
ND	113	240

PD-GT-08		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
ND - 120	ND	<5
ND - 70	8	10

PD-GT-06		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
7 - 68	266	<5
ND	51	2

MPE-GT-01	
Jun 24 Pre-Pilot Testing	July 2024 Post-Pilot Testing
GW (µg/l)	GW (µg/l)
26,325	<5
609	238

PD-GT-05		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
9 - 148	14,307	<5
ND	102	148

PD-GT-03		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
ND - 12,282	19,254	19,094
ND	244	417

PD-GT-04		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
8 - 8,882	105,857	99,272
ND - 1,360	716	1,712

PD-GT-01		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
24 - 208,544	230,000	90,358
282 - 1,925	69,000	24,572

PD-GT-10		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
13 - 121	3,322	12,261
185 - 5,939	8,446	24,121

PD-GT-02		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
14 - 97	16,527	18,326
87 - 2,680	13,309	26,181

PD-GT-11		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
52 - 731	48,057	29,130
1,040 - 25,567	184,341	232,724

MPE-GT-02	
Jun 24 Pre-Pilot Testing	July 2024 Post-Pilot Testing
GW (µg/l)	GW (µg/l)
67,773	20,169
50,746	14,210

PD-GT-07
PD-GT-09
PD-GT-08
PD-GT-06
PD-GT-05
MPE-GT-01
PD-GT-03
PD-GT-04
PD-GT-01
PD-GT-02
PD-GT-10
MPE-GT-02
PD-GT-11

Key:

PD-GT-01 New Glacial Till Installations

MPE-GT-02 MPE Pilot Test Location Wells

Extent of Excavation

Existing MPE pilot testing well to be used in full-scale remediation

Proposed full-scale MPE wells based on 4m radius of influence

Pre Pilot Testing (May 2024)

Tol Toluene in Soil (µg/kg)

THF Tetrahydrofuran in Soil (µg/kg)

Pre Pilot Testing (May 2024)

Tol Toluene in Groundwater (µg/l)

THF Tetrahydrofuran in Groundwater (µg/l)

Post Pilot Testing (July 2024)

Tol Toluene in Groundwater (µg/l)

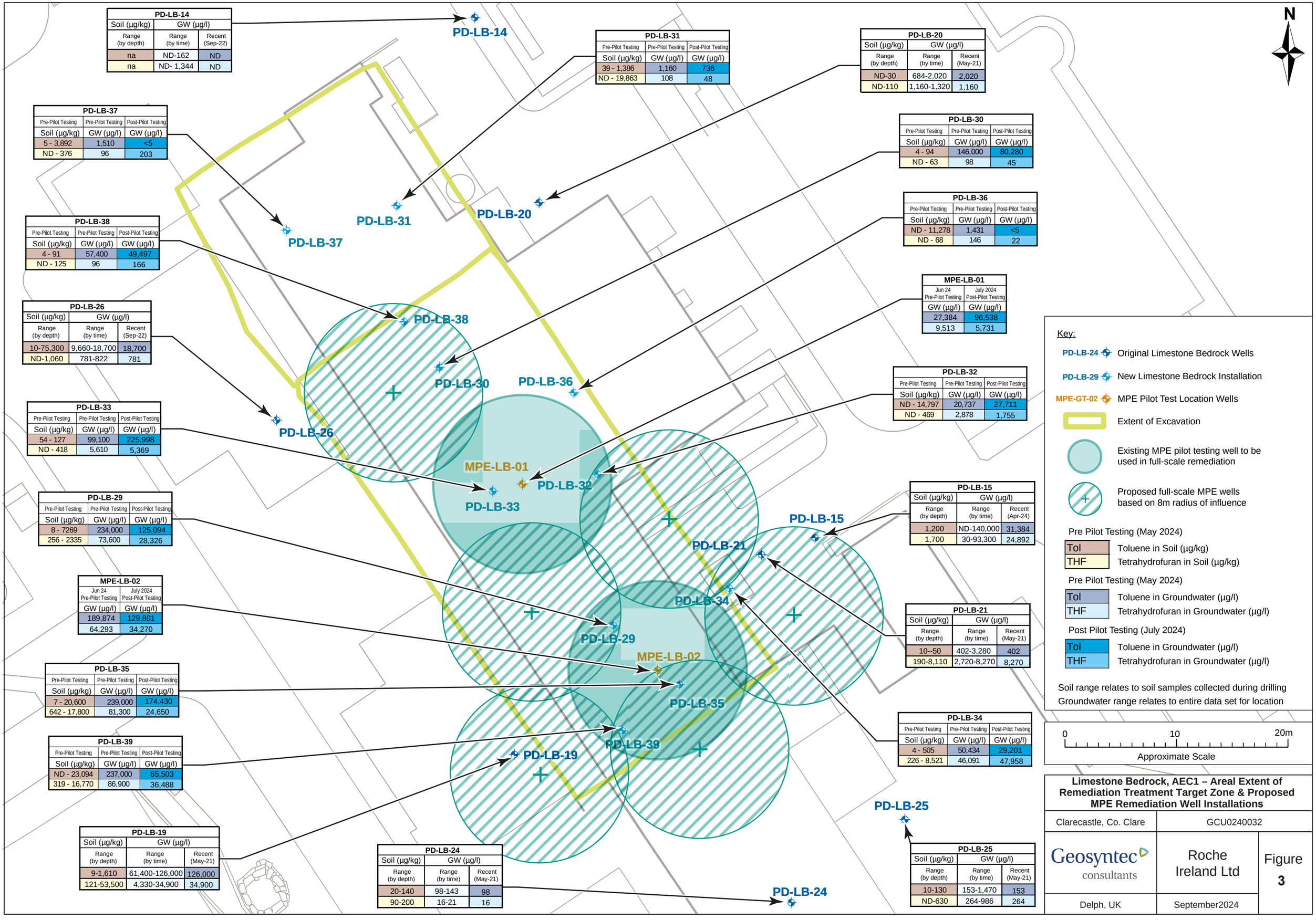
THF Tetrahydrofuran in Groundwater (µg/l)

0 10 20m

Approximate Scale

Glacial Till, AEC1 – Areal Extent of Remediation Treatment Target Zone & Proposed MPE Remediation Well Installations

Clarecastle, Co. Clare	GCU0240032	
Geosyntec consultants	Roche Ireland Ltd	Figure 2
Delph, UK		



PD-LB-14

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (Sep-22)
na	ND-162	ND
na	ND- 1,344	ND

PD-LB-31

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
39 - 1,386	1,160	736
ND - 19,863	108	48

PD-LB-20

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
ND-30	684-2,020	2,020
ND-110	1,160-1,320	1,160

PD-LB-37

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
5 - 3,892	1,510	<5
ND - 376	96	203

PD-LB-30

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
4 - 94	146,000	80,280
ND - 63	98	45

PD-LB-38

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
4 - 91	57,400	49,497
ND - 125	96	166

PD-LB-36

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
ND - 11,278	1,431	<5
ND - 68	146	22

MPE-LB-01

Jun 24 Pre-Pilot Testing	July 2024 Post-Pilot Testing
GW (µg/l)	GW (µg/l)
27,384	96,538
9,513	5,731

PD-LB-26

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (Sep-22)
10-75,300	9,660-18,700	18,700
ND-1,060	781-822	781

PD-LB-32

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
ND - 14,797	20,737	27,711
ND - 469	2,878	1,755

PD-LB-33

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
54 - 127	99,100	225,998
ND - 418	5,610	5,369

PD-LB-15

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (Apr-24)
1,200	ND-140,000	31,384
1,700	30-93,300	24,892

PD-LB-29

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
8 - 7269	234,000	125,094
256 - 2335	73,600	28,326

PD-LB-21

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
10-50	402-3,280	402
190-8,110	2,720-8,270	8,270

MPE-LB-02

Jun 24 Pre-Pilot Testing	July 2024 Post-Pilot Testing
GW (µg/l)	GW (µg/l)
189,874	129,801
64,293	34,270

PD-LB-35

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
7 - 20,600	239,000	174,430
642 - 17,800	81,300	24,650

PD-LB-34

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
4 - 505	50,434	29,201
226 - 8,521	46,091	47,958

PD-LB-39

Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
ND - 23,094	237,000	65,503
319 - 16,770	86,900	36,488

PD-LB-19

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
9-1,610	61,400-126,000	126,000
121-53,500	4,330-34,900	34,900

PD-LB-24

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
20-140	98-143	98
90-200	16-21	16

PD-LB-25

Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
10-130	153-1,470	153
ND-630	264-986	264

Limestone Bedrock, AEC1 – Areal Extent of Remediation Treatment Target Zone & Proposed MPE Remediation Well Installations

Clarecastle, Co. Clare	GCU0240032	
Geosyntec consultants	Roche Ireland Ltd	Figure 3
Delph, UK	September2024	

SB03	
Soil (µg/kg)	
Range (by depth)	
21-45	
ND	

ET-EK-15		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
39 - 162	4,278	<5
ND	5	2

SB02	
Soil (µg/kg)	
Range (by depth)	
829-5,550	
ND-6,610	

ET-EK-07P		
Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
ns	ND-16	16
ns	ND-26	ND

ET-LB-07P		
Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
ns	7-9	7
ns	ND-21	ND

ET-EK-16		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
136 - 511	196,353	101,373
69 - 560	90	101

BH201		
Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
ND-600,000	126,000-337,366	151,495
ND-17,000	36-5,171	70

ET-EK-17		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
12,425 - 150,446	252,149	ns
147 - 449	66	ns

SB06	
Soil (µg/kg)	
Range (by depth)	
32-131	
ND	

ET-EK-14		
Pre-Pilot Testing	Pre-Pilot Testing	Post-Pilot Testing
Soil (µg/kg)	GW (µg/l)	GW (µg/l)
9,570 - 164,000	260,809	203,533
ND	137	207

ET-LB-06P		
Soil (µg/kg)	GW (µg/l)	
Range (by depth)	Range (by time)	Recent (May-21)
ns	ND-16,200	ND
ns	ND-100	ND

MPE-EK-01	
Jun 24 Pre-Pilot Testing	July 2024 Post-Pilot Testing
GW (µg/l)	GW (µg/l)
18,680	110,191
84	365

SB02
ET-EK-15
SB03
ET-EK-07P
ET-LB-07P
BH201
ET-EK-16
MPE-EK-01
ET-EK-14
ET-EK-17
SB06
ET-LB-06P
ET-EK-06P

PLANT NORTH
TRUE NORTH

Key:

- ET-EK-17 — New Epikarst Installations
- MPE-EK-02 — MPE Pilot Test Location Wells
- ET-LB-07P — Well Screened Predominantly in Limestone Bedrock (LB)
- ET-EK-07P — Well Screened Predominantly in Epikarst (EK)
- Existing MPE pilot testing well to be used in full-scale remediation
- Proposed full-scale MPE wells based on 5m radius of influence

Pre Pilot Testing (May 2024)

- Tol — Toluene in Soil (µg/kg)
- THF — Tetrahydrofuran in Soil (µg/kg)

Pre Pilot Testing (May 2024)

- Tol — Toluene in Groundwater (µg/l)
- THF — Tetrahydrofuran in Groundwater (µg/l)

Post Pilot Testing (July 2024)

- Tol — Toluene in Groundwater (µg/l)
- THF — Tetrahydrofuran in Groundwater (µg/l)

ns = Not Sampled
(water level not recovered post Pilot Testing)

Soil range relates to soil samples collected during drilling

Groundwater range relates to entire data set for location

0 10 20m
Approximate Scale

Epikarst, BH201 Area – Areal Extent of Remediation Treatment Target Zone & Proposed MPE Remediation Well Installations

Clarecastle, Co. Clare	GCU0240032	
Geosyntec consultants	Roche Ireland Ltd	Figure 4
Delph, UK	September 2024	

SOUTH
B

APPROXIMATE LOCATION OF FORMER EQUALISATION BASIN

NORTH
B'

mAOD

SB40 | ET-EK-12 | ET-BF-16 | SB27 | PABH51 | ET-BF-15 | ET-EK-13 | PABH54 | SB35 | SB37

5.02m | 4.96m | 4.95m | 4.91m | 4.91m | 4.82m | 4.99m | 5.01m

2,620 / 2,250
176 / 133
282 / 78
3.71m
2.71m
THF = 6,320
Toluene = <5
<50 / 28
THF = 268
Toluene = 29
2.22m
<50 / 12
MG

14,200 / 5,970
12,200 / 3,150
2,270 / 1,700
1,900 / 399
7,930 / 5,550
>41,700 / 40
3,580 / 115,200
322,000 / 168,000
ED

? ?
>>269,000 / 63
208 / 7
718,000 / 1,340
THF = 26,500
Toluene = 214,000
>>1,310,000 / >>152,000
376
EK

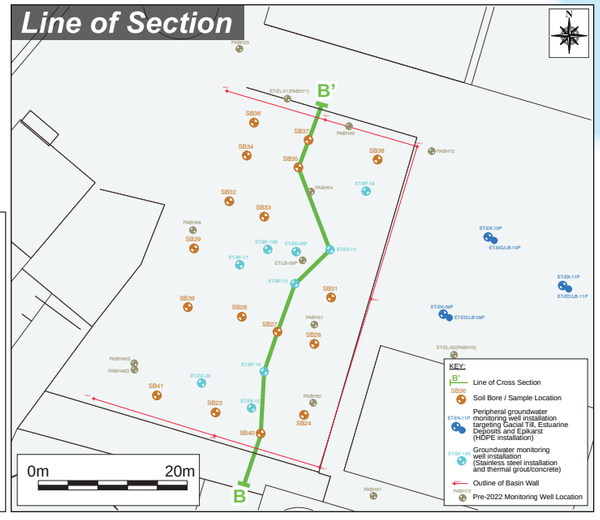
THF = 33,000
Toluene = 3,120

223 / 20
79,600 / 8,550
2,940 / 30
THF = 161
Toluene = 2,650
140 / 14
THF = 11,500
Toluene = 15,800
GT
<50 / 28
EK
LB

VERTICAL PROFILE OF REMEDIATION TREATMENT TARGET ZONE

0 — 10
APPROXIMATE HORIZONTAL SCALE (m)

Line of Section



KEY:

Geology
- Made Ground (MG)
- Estuarine Silts/Clays (ED)
- Glacial Till (GT)
- Epikarst (EK)
- Limestone Bedrock (LB)

Soil µg/kg. - THF | Soil µg/kg. - Toluene | Groundwater Results - µg/l

- MG Groundwater Elevation
- EK Groundwater Elevation
- LB Groundwater Elevation

Groundwater Well Installation Screen Depth

Concrete / Inferred base of former equalisation basin

AEC2 - Vertical Profile of Remediation Target Treatment Zone

Clarecastle, Co. Clare	GCU0240020	
Geosyntec consultants	Roche Ireland Ltd	Figure 5
Dublin, UK	January 2023	