TRANSFER LICENCE

ABERGELE QUARRY

Supporting information 3047/TL
April 2024

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1 NON-TECHNICAL SUMMARY

Abergele Quarry is located c2.75 km southeast of the town of Abergele and has extracted limestone for many decades. Mineral extraction currently takes place above the watertable; however Planning Permission exists for extraction to an elevation of 58 metres Above Ordnance Datum (mAOD). Groundwater monitoring at the site indicates that the watertable beneath the quarry floor is at c82 mAOD, therefore dewatering will be necessary to allow the complete extraction of the permitted mineral. Hence, a transfer licence is sought to permit the required dewatering.

The proposed water management system is shown on *Drawing 3047/TL/01*. Groundwater inflow and incident rainfall will be directed to a sump at the base of the quarry void. Water will be pumped from the sump and out of the quarry void using a 6 inch pump. Water will then flow under gravity through pipes via the conveyor tunnel to the mineral processing area where it will be discharged off-site to the Nant Ddu watercourse.

A Groundwater Investigation Consent (GIC)was granted on 14th June 2023 and a meeting with NRW subsequently held (2nd August 2023). A copy of the correspondence with NRW is provided in *Appendix 3047/TL/A1*. It was agreed that a Hydrogeological Impact Assessment (HIA) should be produced to address the comments raised within the GIC. The HIA is provided as *Appendix 3047/TL/A3*.

2 ENVIRONMENTAL RISK ASSESSMENT

In accordance with Planning Condition 27 for Abergele Quarry, photographic monitoring of selected water features and groundwater levels has been undertaken since 2006. The surface water features identified for monitoring were based upon discussion and agreement between Heidelberg Materials and Natural Resources Wales (NRW). The most recent monitoring report is provided as *Appendix 3047/TL/A2*.

The potential impacts of the proposed dewatering on the water environment have been assessed in the HIA provided as *Appendix 3047/TL/A3*. The discharged water will comprise groundwater and rainfall. The groundwater component of the abstracted water is estimated to be 16 l/s (1,382 m^3/day). Guidance from NRW states that abstraction volumes of between 1,000 to 3,000 m^3/day require a minimum water features survey radius of 1.5 km. The HIA has assessed water features within a 2 km radius of the site. The abstracted volume of water that is derived from rainfall run-off would not change the radius of influence of the abstraction. As it will not be possible to separate the rainfall and groundwater components for the purpose of metering the abstraction, the combined volume of both groundwater and rainfall inflow has been included on the application.

The quality of the discharged water will be regulated by environmental permit CG0320601.

3 REQUIRED WATER VOLUMES

The discharge from the site will comprise a broadly consistent groundwater inflow, with varying amounts of rainfall run-off. The requested water volumes for the licence are therefore based on two situations to enable operational flexibility at the site: short duration, high discharge periods following storm events, and long-term (yearly) periods representing average rainfall conditions. Calculations are provided in Appendices 3047/HIA/A5 and 3047/HIA/A6 of the HIA.

The volume of groundwater ingress has been calculated using estimates of hydraulic conductivities representative of limestones and standard analytical methods. The groundwater ingress, at the maximum extent of quarry development, and using a 'bulk' hydraulic conductivity of 0.5 m/day is estimated to be 16 l/s.

The annual maximum water quantity requested has been calculated using the long-term average rainfall from the NRW rain gauge in Pensarn. The annual average run-off rate is estimated to be 6.5 l/s, giving a combined water ingress to the quarry void of 22 l/s (1900 m^3/day or 693,500 m^3/year). An abstraction volume of 700,000 m^3/year is sought to provide sufficient capacity to accommodate rainfall variations.

The daily, hourly and instantaneous rates provided on the application forms are to account for short duration storm events, where run-off volumes are likely to be greater than the long-term average. The maximum abstraction rate of the pump to be used for dewatering is anticipated to be 60 l/s (5,184 m^3/day), a rate which has been used to determine the maximum daily and hourly volumes. This rate of pumping is expected to only be required for a few days per year, therefore it is not considered to be appropriate to use this rate to determine the annual abstraction quantity. If water ingress of greater than 60 l/s occurs, then the excess water would be stored temporarily within the quarry sump and discharged once the rate of ingress decreases.

Abstraction volumes are therefore expected to vary between 16 l/s in dry conditions and 60 l/s in wet conditions.

Drawings: 3047/TL/01 Proposed Water Management

Appendices: 3047/TL/A1 NRW Correspondence
3047/TL/A2 Three-Yearly Monitoring Report (1742/MON-23 February 2024)
3047/TL/A3 Hydrogeological Impact Assessment 3047/HIA April 2024
3047/TL/A4 Letter of Authority

DRAWINGS

297000

376000

New discharge licence to Nant Ddu stream. Permit No. CG0320601.

Discharge route to follow access road and pass through conveyor tunnel.

Rainfall and groundwater pumped from sump within base of void.
Sump to be relocated within the limit of extraction as work progresses.
Quarry floor used for water storage during large storm events.

296960, 375587

296870, 375508

296849, 375304

297266, 375398

297099, 375138

297019, 375081

296832, 375075

296657, 375124

296657, 374961

375000

Nant Ddu Rd

Parc-y-Meirch Quarry

Dinorben

0 250 500 m

Legend

- Site Boundary
- Limit of extraction and abstraction
- Coordinates of abstraction bounding area
- Watercourse
- Culvert
- Proposed Discharge Route
- Lagoon

Scale correct at A3

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Client: Heidelberg Materials UK
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Title	Proposed Water Management		
Project	Abergele Quarry		
Drawing	3047/TL/01	Version	3
Date	Apr 2024	Scale	1:5,000

APPENDIX 3047/TL/A1

NRW Correspondence

Cyfoeth Naturiol Cymru
Natural Resources Wales

Dylan Ingram
Hafren Water
Barkers Chambers
Barker Street
Shropshire
SY1 1SB

Email: dylan.ingram@hafrenwater.com

Reference: PAN-021727

Date: 14/06/2023

Application for consent to investigate a groundwater source
Consent number: PAN-021727
Site: Abergele Quarry

Dear Mr Ingram,

I am pleased to enclose the consent, which you applied for under Section 32 of the Water Resources Act 1991, to investigate a groundwater source at the site shown above.

This consent is granted only for the purpose of investigating the quantity and quality of groundwater available, and to assess the effects that abstracting would have on surrounding water features and other water users. Issuing this consent does not guarantee that you will get an adequate supply of water, in terms of either quantity or quality.

The consent is not a licence to abstract water. After you have finished your investigations you will need to apply for an abstraction licence to continue abstracting groundwater. As part of this licence application you will have to send us a groundwater impact assessment report which must provide details of the results of the pumping test and an assessment of the effect your proposed abstraction would have on the water features highlighted in this consent. Issuing this consent does not guarantee that we will grant you an abstraction licence.

You must adhere to the conditions in this consent. Contravention of this consent, in particular using it for abstraction other than for the purpose of investigating quality or quantity of groundwater, will result in its immediate withdrawal. If appropriate, legal action may be taken.

Issues to consider when conducting your pumping test and updating your Hydrogeological Impact Assessment

Our Technical Specialist reviewed the information supplied with your GIC application, including the Hydrogeological Impact Assessment (HIA), dated March 2023, and has the following general comments, which should be considered alongside the issued Groundwater Investigation Consent (GIC).

1. The water features survey provided fails to identify at least 11 boreholes, springs and wells within the 2 km radius of the proposed groundwater

abstraction (quarry excavation). There are also several inconsistencies in the text of the HIA compared with the identified water features. We advise that a thorough on-site review of the water features is required to ensure that all relevant water features have been accounted for.

2. The estimated influx of groundwater with the base of the proposed excavation at 58 metres above Ordnance Datum (maOD) is based on an estimated hydraulic conductivity (K) of the limestone of 0.5 m/day. This estimate is subject to a high level of uncertainty due to the heterogeneity of fractures and solution features in the limestone. A reasonable estimate of the K of the limestone 24 m below the current water table and the subsequent influx of groundwater, can only be derived by conducting a pumping test.
3. Due to the nature of the Clwyd Limestone Group aquifer, as described in the HIA and elsewhere (specifically an aquifer with very low primary porosity, relatively low storage capacity, mainly in fractures and solution features, and responsiveness to rainfall), it is anticipated that lowering the current groundwater elevation by up to 24 m, in the area of the proposed excavation, may have a significant effect on water features in the vicinity of the quarry. A pumping test, as described in the GIC is required to assess this potential impact.

Any application for an abstraction licence will be assessed in accordance with the Clwyd Abstraction Licensing Strategy (ALS) (Natural Resources Wales / Water available in our catchments). This licensing strategy sets out how we will manage water resources in the catchment and provides you with information on how we will manage existing abstraction licences and water availability for further abstraction.

We never guarantee that we will issue a licence and any advice on your proposal is based on the information we have at the moment. Even if the source provides enough water, this does not mean you will automatically be granted a licence. Any licence we do issue will follow the abstraction licence strategy for the area, as explained above, and may mean you receive a licence for less water than you abstracted as part of your groundwater investigations. We cannot be held responsible for any subsequent changes in the law, or in the quality or availability of water, that could affect your proposal and any application you make in the future.

We expect to hear from you within 14 days of your consent expiring to let us know whether you will be applying for an abstraction licence or not. If we do not hear, we will assume that you are not proceeding with your application and will not be abstracting. If during a routine inspection you are found to be abstracting, legal action may be taken.

Yours sincerely
Sarah Senior
Water Resources Permitting Officer

Phone: 0300 065 4197
Email: sarah.senior@cyfoethnaturiolcymru.gov.uk
General Enquiries: 0300 065 3000

Dylan Ingman

From: Senior, Sarah <sarah.senior@cyfoethnaturiolcymru.gov.uk>
Sent: 25 August 2023 14:10
To: Dylan Ingman
Subject: FW: PAN-021727 - NRW follow up on meeting of 02/08/2023

Follow Up Flag: Follow up
Flag Status: Flagged

Good afternoon,
I was just looking at this email again while filing it and realised I cross-referenced options incorrectly, so the advice should read.

Options:

1. Proceed with undertaking the test pumping as per the GIC then use the data generated to inform your HIA to support an application for a transfer licence.
2. Apply for a transfer licence for the dewatering that would be required for all of the excavation work at the site (including that referred to in option 3). This application would need to include a revised HIA that includes detailed proposals for monitoring of groundwater and surface water features throughout the period of excavation and/or the duration of the licence. This application should include details of the smaller, short-term excavation, dewatering and back-filling (see option 3) that would precede the full excavation along with a plan for monitoring during this initial period. OR
3. Apply for a transfer licence to dewater the smaller area that needs excavating to provide a void in which to put boulder clay overburden to allow for the quarry extension. The duration of this licence would align with the time needed to dewater this void. An HIA with proposals for monitoring would also be required. If issued, it is anticipated that the data generated during this work would then be used to inform the HIA required to support the subsequent application for a transfer licence to allow for dewatering during the main excavation. We might still need to apply monitoring conditions etc to the longer term licence.

Sorry and I hope that hasn't caused you any confusion.
Sarah

Enw / Name - Sarah Senior
Teitl swydd / Job title – **Swyddog Trwyddedu Adnoddau Dwr 2** / Water Resources Permitting Officer 2
Adran / Department – **Tystiolaeth, Polisi a Thrwyddedu** / Evidence, Policy & Permitting
Rhif ffôn / Phone number – 0300 065 4197
Rhagenwau / Pronouns – **hi** / she/her

Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi.
Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay.

From: Senior, Sarah
Sent: 24 August 2023 13:49
To: Dylan Ingman <dylan.ingman@hafrenwater.com>
Cc: Jones, Ian (Geoscience) <ian.jones1@cyfoethnaturiolcymru.gov.uk>
Subject: PAN-021727 - NRW follow up on meeting of 02/08/2023

Good afternoon Dylan,
I am sorry that it has taken so long to get back to you on this application, but Geoscience have had a high level of staff absence recently due to planned annual leave and family bereavement.

Ian asked that I share his responses to your summary of the meeting (see below) and also suggest some options for you to get the dewatering at Abergele Quarry licenced.

Options:

1. Proceed with undertaking the test pumping as per the GIC then use the data generated to inform your HIA to support an application for a transfer licence.
2. Apply for a transfer licence for the dewatering that would be required for all of the excavation work at the site (including that referred to in option 2). This application would need to include a revised HIA that includes detailed proposals for monitoring of groundwater and surface water features throughout the period of excavation and/or the duration of the licence. This application should include details of the smaller, short-term excavation, dewatering and back-filling (see option 2) that would precede the full excavation along with a plan for monitoring during this initial period. OR
3. Apply for a transfer licence to dewater the smaller area that needs excavating to provide a void in which to put boulder clay overburden to allow for the quarry extension. The duration of this licence would align with the time needed to dewater this void. An HIA with proposals for monitoring would also be required. If issued, it is anticipated that the data generated during this work would then be used to inform the HIA required to support the subsequent application for a transfer licence to allow for dewatering during the main excavation. We might still need to apply monitoring conditions etc to the longer term licence.

Ian's thoughts on your notes of the meeting:

- Clarification is needed on the status of the water features identified within the GIC letter. *You explained that several of the water features identified as missing from the HIA by us are not present on the ground, so we requested that details of these be provided in a revised HIA. Related to this we also requested inclusion of the depths of all relevant boreholes and wells, as this information is important for understanding whether or not a borehole or well is monitoring the principal limestone aquifer or perhaps a perched water zone.*

- Clarification of the conceptual model is needed, and details required of linkages between the water features and the site. *You presented some pertinent information regarding why some faults may be acting as hydraulic barriers, helping to hydraulically isolate the quarry from the wider aquifer. However, we noted that this may not be the case if the water table was lowered 24m in the quarry, so monitoring water levels would still be required.*
- Review of the monitoring at the site could be undertaken to ensure that potential future impacts can be identified and understood. *We commented that if you need to add monitoring borehole(s) to ensure sufficient monitoring of groundwater then you should do so; these could be proposed in a revised HIA.*
- Test pumping within a borehole would give an unrepresentative view of the aquifer due to variability of the limestone aquifer and differences in scale between a borehole and a quarry void. But further information is required to understand the potential impacts during dewatering. *It is Geoscience's view that a licence application is unlikely to be successful without the support of either a pumping test as described in the GIC or sufficient monitoring of groundwater levels, surface water features and abstraction rates during excavation of the proposed quarry void or the smaller temporary quarry void described in the meeting.*
- Relatively rapid deepening of part of the quarry to the final depth is required to enable overburden stripping and its placement within the void, so that lateral extension of the quarry can occur. *We noted that placing 'impermeable' boulder clay in the temporary void may have unanticipated impacts on groundwater flow pathways, such as blocking major fractures and solution features; this needs to be considered in any monitoring plan as part of a revised HIA and licence application.* Monitoring during the deepening could be undertaken to understand the effects of dewatering and would allow a larger volume of aquifer to be tested, giving a more accurate representation of potential impacts. This monitoring could form the pumping test requested within the GIC. *We would not be able to issue a GIC for the work to excavate the initial void as these are only intended for short-term test pumping; this dewatering would need to be licenced by a short-term abstraction / transfer licence.*

If you would like to discuss further, then I can arrange a phone call/MS Teams meeting (although Ian will be on annual leave for a week from 28/08/2023 and back in the office from 04/09/2023). If, however, you are happy with the above, then information on how to apply for a transfer licence can be found on our website here – Natural Resources Wales / Apply for a water abstraction or impoundment licence
Or if you have any questions relating to a potential application, then we can provide advice via our pre-application service, details on how to make a request for pre-application advice is on our website here - Natural Resources Wales / Pre-application advice service for water abstraction and impoundment licences
Yours, Sarah

Enw / Name - Sarah Senior
Teitl swydd / Job title – **Swyddog Trwyddedu Adnoddau Dwr 2** / Water Resources Permitting Officer 2
Adran / Department – **Tystiolaeth, Polisi a Thrwyddedu** / Evidence, Policy & Permitting
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Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi.

Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay.

CONSENT TO INVESTIGATE A GROUNDWATER SOURCE

Section 32(3) Water Resources Act 1991 (as amended)

This **CONSENT** is issued by the Natural Resources Body for Wales (hereafter referred to as “Natural Resources Wales”) to:

Hanson Quarry Products Europe Ltd. (“the Consent Holder”)
Hanson House
14 Castle Hill
Maidenhead, Berkshire
SL6 4JJ

Company Registration Number: 00300002
Consent reference PAN-021727

This consent authorizes the Consent Holder to investigate a groundwater source described in the schedule of conditions and subject to the provisions of that schedule. The consent commences from the date of signature and shall remain in force until the date of expiry shown below.

"The Consent Holder" means the person (whether an individual or organisation) to whom consent is granted. Where the Consent Holder is two or more persons (e.g. a partnership) such persons shall be jointly and severally liable for the proper fulfilment of the conditions of this consent.

This consent is effective from the date below and expires on 31 March 2024.

Trystan James. Technical Team Leader Geoscience
14th June 2023

SCHEDULE OF CONDITIONS

1 Location

1.1 Underground strata comprising of Clwyd Limestone Group at National Grid Reference SH 96960, 75200 (approximate centre of quarry area to be worked and dewatered).

2 Construction details

2.1 A borehole (or boreholes) of sufficient depth and diameter to allow a step test (pumping test) to be conducted, sufficient to maintain drawdown of groundwater below the proposed maximum depth of the excavation (58 metres above Ordnance Datum [maOD]), or the groundwater elevation anticipated to be maintained in the deepest dewatering sump. Observation boreholes should be used to record groundwater elevations within the proposed area of excavation; use of only the abstraction borehole(s) to measure groundwater elevations is not acceptable.

Borehole(s) should be open (if rock is sufficiently competent) or screened across the entire saturated depth of the limestone, so as to not limit influx of groundwater.

2.2 Boreholes and wells must be provided with a means of measurement access (such as a dip tube) so that a cable dipper or automatic water level recorder can be lowered to measure the water level.

3 Maximum quantities of water to be abstracted during pumping test

3.1 The maximum discharge rate and daily volume of groundwater to be extracted will depend on the amount required to maintain steady state drawdown of groundwater at the depth required to dewater the proposed area of excavation to a depth of 58 mAOD (estimated drawdown of 24 m).

In any case, the maximum daily volume of abstracted groundwater cannot exceed 5,000 cubic metres (m^3, 5,000,000 litres). If > 5,000 m^3/day is required to maintain sufficient drawdown of the groundwater over the proposed area of excavation, then the Consent Holder is required to notify NRW immediately.

Note: (1) groundwater discharge rates and volumes should be measured with a calibrated in-line flow meter with totalizer; data should be recorded continuously by electronic means and/ or manually in a dedicated logbook at least once an hour. (2) a day means any period of 24 consecutive hours.

4 Duration and type of pumping test

4.1 The total duration of the pumping test includes a minimum of 5-days of monitoring prior to the start of pumping, the duration of pumping (not to exceed 8 days) and a minimum of 5 days of monitoring following cessation of pumping.

The pumping test should comprise of a step test to enable the required groundwater discharge (and impacts) to be estimated for several depths of excavation (dewatering); the number of steps should be decided by the Consent Holder. The duration of each step will depend on how long is required to reach steady state groundwater levels in the abstraction borehole(s), and observation boreholes and wells.

The final step, at which groundwater levels in the area of the proposed excavation, are to be maintained at the maximum depth of the proposed excavation (58 maOD), should be conducted until steady state groundwater levels have been achieved and confirmed for 3 days in all monitored boreholes and wells.

If after 5 days of steady state pumping, with groundwater levels maintained at 58 maOD in the proposed area of the excavation, steady state water levels are not achieved in all monitored boreholes and wells, then pumping must stop and water levels monitored for an additional 5 days.

4.2 The Consent Holder shall notify NRW if groundwater levels in any of the abstraction or observation boreholes fail to stabilise (reach steady state) as described in 4.1.

Note: (1) The terms "stabilised" or "steady state" with respect to groundwater levels means that groundwater levels have stopped trending lower or higher. Levels may fluctuate due to barometric pressure or other influences, but generally fluctuations should be < 50 mm. (2) "all monitored boreholes and wells" refers to all abstraction (pumped) boreholes, observation (non-pumping) boreholes and wells used to record water levels during the test (before, during and after pumping).

5 Water feature assessment

The pumping test should be designed to assess the effect of the abstraction on all identified water features and abstractions within a 2 km radius of the proposed abstraction. Water features include boreholes, wells, springs, issues, streams, ponds, and wetlands. Where possible, all boreholes, wells and springs used for private water supplies, within a 2 km radius of the proposed abstraction, should be identified and incorporated in the pumping test monitoring program. Other non-water supply water features, including boreholes, historic wells, springs, and surface water features should also be monitored, although where several similar features occur in proximity, then not all will require detailed monitoring.

Water features of potential concern were identified on Drawing 3047/HIA/02, Hafren Water Environmental Water Management., November 2022. Other water features of potential concern not explicitly identified on Drawing 3047/HIA/02 include:

- "Collects", pond at Kimmel Park; SH 97738 75652
- Two wells southwest of Kimmel Hall; SH 98484 74613
- St. Georges village well; SH 97249 75875
- Fardre Farm borehole; SH 96257 75480
- Bryn-y-Pin Mawr Farm borehole; SH 98254 73913
- Well; SH 96037 74929
- Issues (spring); SH 95956 374675
- Well at SH 96037 74929
- Well at Ysguboriau; SH 96806 74165
- Well at Ffynnon Wen; SH 96512 74033
- Spring at Glan y Gors; SH 96062 73982
- Well at Ty'n-y-ffynnon; SH 95425 74242

6 Discharge of water

6.1 The pumped water must be disposed of in such a way as to prevent re-circulation back to the aquifer.

6.2 Discharged water shall comprise only abstracted groundwater and not contain any other chemicals or substances, including suspended sediment, unless otherwise authorized by an environmental permit or registered exemption.

7 Notifying Natural Resources Wales following expiry of consent

7.1 You must notify us within 14 days of the expiry date of this consent to advise us if you intend to apply for a groundwater abstraction licence.

ADDITIONAL INFORMATION

Modification or removal of consent
This consent may be modified or revoked at any time by Natural Resources Wales.

Indemnity
We shall not be liable to pay for any of the testing nor for any of the consequences that may arise from this consent. The Consent Holder shall be responsible for making good and compensating for any loss, damage or injury (whether to persons or property, including water resources generally or derogation from individual sources of supply) resulting from this consent.

Right of access
Possession of this consent gives no rights of entry onto land. Permission to enter land or premises must be obtained from the owner or occupier

Interpretation of conditions
Condition 2.1 The borehole, well or spring catchpit should be constructed as detailed in the application form WRC.

Condition 4.1: sufficient data must be collected to enable analysis of aquifer properties and assess the long-term effects on identified water features.

Conditions 4.2 and 7 and for general queries the Consent Holder can contact:
Geoscience Team, Natural Resources Wales.
Tel: 0300 065 3000
Email: geoscience@cyfoethnaturiolcymru.gov.uk

Condition 5: The results of testing must be incorporated into a Hydrogeological Impact Assessment (HIA) to be submitted with any subsequent application for a groundwater abstraction licence. You must declare in this assessment if any complaints were received from nearby landowners or water users during the pumping test. We will expect you to carry out the pumping tests and produce a groundwater impact assessment in line with relevant guidance and best practice, including:

- British Standard ISO 14686 (2003) "Hydrometric determinations – pumping tests for water wells – considerations and guidelines for design, performance and use".

- Environment Agency (2012) 'Hydrogeological Impact Appraisal for groundwater abstractions

- Scottish Environment Protection Agency (2013). Regulatory Method (WAT-RM-24) Pumping Test Methodology

Condition 6.1 If groundwater is re-circulated back into the aquifer during the pumping test it may affect the monitoring results

Condition 6.2 Under the Environmental Permitting Regulations 2016 it is an offence to undertake a groundwater activity without an environmental permit, or having registered an exemption.

Condition 7.1 This consent provides an exemption allowing you to test the borehole under Section 32 of the Water Resources Act. After the consent expires you must not abstract more than $20m^3$ per day until you obtain an abstraction licence.

APPENDIX 3047/TL/A2

Three-Yearly Monitoring Report (1742/MON-23 February 2024)

hafrenwater
environmental water management

THREE-YEARLY MONITORING REPORT

2021-2023

ABERGELE QUARRY

Report Reference: 1742/MON-23
Final Version F1
February 2024

Report prepared for:

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GENERAL NOTES

Title of report: Three-yearly monitoring report

Site: Abergele Quarry

Report ref: 1742/MON-23

Date: February 2024

Version	Date	Issued to
Draft D1	14th February 2024	Heidelberg Materials UK
Final F1	29th February 2024	Heidelberg Materials UK

Author: Chris Ainscow BSc (Hons)
Dylan Ingman MESci MSc FGS
Reviewer: Chris Leake BSc MSc FGS

https://hafrenw.sharepoint.com/sites/HafrenWater/Shared Documents/General/Projects/Abergele (3047)/Abergele monitoring (1742)/Reports/3-year monitoring reports/2024 February/1742_MON_F1 (Feb 24).docx

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DRAWINGS

PHOTOGRAPHS

APPENDICES

1 BACKGROUND

1.1 Introduction

Planning Condition 27 of the extant Planning Permission required the installation of monitoring infrastructure to permit groundwater level measurements and maintenance of a photographic record of specific water features. This monitoring regime commenced in 2006 and is reported every three years.

The monitoring is intended to increase the understanding of the water environment in the vicinity of the quarry and therefore permit its long-term temporal variations to be determined. It also provides a factual basis on which assessment of the possible impacts of mineral extraction upon the local water environment can be made.

This report covers the period of January 2021 to December 2023.

Planning Condition 27

The planning condition to which this report relates states;

Within 3 months of the date of the grant of this permission, a scheme of ground and surface water monitoring shall be submitted to the mineral planning authority. That scheme shall include monitoring of surface and groundwater water drainage patterns and flows within one kilometre of the extension area boundary, at least every 3 years, by means of empirical survey during the summer and the winter periods. The results of that monitoring shall be assessed against the baseline survey data set out in section 9 of the Environmental Statement. The results shall be reported to the mineral planning authority within 6 months of completion of each monitoring exercise, together with an assessment of the significance of changes that have occurred in terms of hydrological, hydrogeological and ecological interests.

The scheme to be submitted shall make provision for addressing the derogation of any water supply as a consequence of the influence of the permitted operations.

1.2 Quarry development within the monitoring period

During the monitoring period mineral extraction was undertaken from the lower faces with extraction progressing down to 78 mAOD. In the southwest of the void, mineral extraction progressed to the limit of overburden stripping. An overburden strip was completed in 2023, with the stripped material placed within the northeast corner of the quarry void as part of the progressive restoration.

1.3 Water management

Water management at Abergele Quarry can be sub-divided into two areas; to the north and south of St Georges Lane. To the north is the mineral processing area, within which run-off is conveyed to a series of lagoons and discharged off-site. Within the active mineral extraction area, in the south of the site, the quarry void is free-draining. The floor of the quarry is situated above the watertable and the characteristics of the lithology are such that rainfall-derived water naturally infiltrates into the underlying strata. The limestone is fractured and fissured, with occasional enlarged features, including caves, being encountered during working. Water has not been encountered in any of the karst features.

To the north of St Georges Road, which sub-divides the site, surface water is conveyed northwards through the plant site and stockpile areas by gravity to a lagoon system, where it is stored temporarily. All site drainage water exits the site eastwards via the consented discharge point, from where it enters the local surface water drainage system.

2 MONITORING RESULTS

Details of the monitoring regime are discussed in the following sections.

2.1 Photographic record

Eight locations are designated for photographic monitoring. The locations are based upon the results of a water features survey and discussions with Natural Resources Wales (NRW) and are considered to be representative of the water environment in the vicinity of the quarry. The photographic monitoring locations are shown on *Drawing 1742/MON-23/01* and details of the locations are provided in *Appendix 1742/MON-23/A1*.

Six site visits were made to undertake the photographic records within the monitoring period. Details of the site visits are provided in *Table 1742/MON-23/T1*.

1742/MON-23/T1: Surface water monitoring visits		
Monitoring Period	**Season**	**Date**
2021	Summer	14th July 2021
2021	Winter	8th December 2021
2022	Summer	14th June 2022
2022	Winter	16th January 2023
2023	Summer	19th July 2023
2023	Winter	21st December 2023

Photographs of all the water features within the 3-year monitoring period and comments relating to each location at the time of the visit are included as *Photographs 1742/MON-23/P1 - P6*.

2.1.1 Comment on photographic monitoring

Location 1

Flow of approximately 0.25 l/s during summer months. The culvert containing the Nant Ddu stream contributes all of the flow to the channel. Lime-rich material from the bank has continued to extend into the channel.

During the winter months the water level in the channel is approximately 0.1 m to 0.2 m deep. The depth of the water is a result of vegetation and lime-rich material encrustment on the trash screen of the culvert. Flow is both from the Nant Ddu culvert and the old course of the stream. Tens of litres per second pass through the culvert. Water was discoloured during all visits.

Location 2

Flow of up to 0.25 l/s during the summer months. Flow within channel is occasionally low enough that flow is between small pools of standing water within the channel.

During the winter months the flow within the channel is sufficient to form a continuous channel. Flow was approximately 1 to 5 l/s.

Location 3

Occasional areas of damp ground within the channel during the summer months. Commonly the ground is dry.

During winter the ground within the channel was saturated and areas of standing water were present. Water was observed to be flowing continuously.

Location 4

During the summer months the depression is commonly dry, however a shallow waterbody formed in July 2021 following heavy rainfall. A small area of standing water was present in June 2022.

In the winter months the depression was consistently full of water. The ground surrounding the depression was also saturated. During January 2021 flow out of the depression was observed.

Location 5

No flow was observed within the channel during the summer months. The ground within the channel was dry during all of the visits.

Saturated soil and standing water were present within the channel during December 2021. No water was observed during subsequent winter visits.

Location 6

The water level within the pond varies during the summer months depending on antecedent rainfall. The trend in the water level variation is the same as that observed at Location 4.

During winter the waterbody was full and the surrounding soils saturated.

Location 7

Depression was dry during summer months. During July 2021 the soil within the outflow channel was moist, which is consistent with the wetter conditions observed at Locations 4 and 6 during the same visit.

Shallow water was present within the depression at the time of all visits during the winter. The water level was highest during December 2021.

Location 8

Flow from the culvert during the summer months was approximately 0.25 to 0.5 l/s. During July 2021 and June 2022 the water was discoloured white. Lime-rich sediment/precipitation lines the channel.

Flow during the winter months was approximately 15 to 60 l/s, with the highest flow occurring in December 2021. Discolouration of the water was observed during December 2021 and December 2023.

2.2 Groundwater level monitoring

Two groundwater level monitoring boreholes (P1 and P2) were installed within the quarry and its immediate vicinity in 2002. Groundwater level monitoring has also been undertaken in a borehole at Fadre Farm (P3) to the west of the quarry, since 2002. A fourth monitoring borehole (P4) was installed in late 2006 within the quarry void to increase the lateral coverage.

Groundwater levels have been monitored for a prolonged period and consequently a comprehensive, long-term data set exists.

The locations of the monitoring points are shown on *Drawing 1742/MON-23/01* and the data are provided in *Appendix 1742/MON-23/A2*.

2.2.1 Temporal distribution

Long-term (2002 - present)

A long run of groundwater level data exists, such that the characteristics of the local groundwater environment can be well defined. Groundwater level hydrographs are shown on *Drawings 1742/MON-23/02 and 1742/MON-23/03*.

Both short and long-term groundwater level fluctuations have been recorded. They are considered to be responses to variations in rainfall recharge or changes in the geometry of the limestone aquifer itself, as mineral extraction has progressed over time.

The hydrographs for boreholes P1 and P4 show broadly similar average groundwater levels, while levels at P2 are around 35 m lower than P1 and P4. At P3 they are around 40 m higher. A mapped geological fault lies between Borehole P3 and P1/P4; the large difference in groundwater elevation is considered to indicate that the fault acts as a barrier to flow.

A gradual decline in groundwater elevations of approximately 10 m occurred within borehole P3 between 2004 and 2007. In P4 a gradual decline of approximately 20 m was observed between 2007 and 2010. In P2 a rapid decline in groundwater level of approximately 10 m was recorded during 2010. The groundwater level in P1 has remained at a generally consistent elevation since the beginning of monitoring.

An increase in groundwater levels, of approximately 10 m, was recorded in boreholes P1 and P4 in early 2018. Groundwater increased in elevation to such an extent that it was similar to pre-2010 levels. A smaller and more gradual increase was recorded in P2 in late 2017. This response was not observed at Fadre Farm borehole (P4) to the west of the site. It is considered that the observed variations arose due to the progression of quarry workings.

Boreholes P2 and P4 generally follow similar long-term trends, with P1 recording a similar but muted trend. Fluctuations in P3 that are attributable to rainfall can be correlated with the other boreholes.

Within the 2021-2023 monitoring period

At the start of the monitoring period, groundwater levels fluctuated in response to rainfall, with the exception of P3. However, from May 2022 groundwater levels decreased rapidly in P2, P3 and P4. In P1 the decline was less. This trend is considered to be in response to a period of extended dry weather.

Groundwater elevations began to increase in July 2023 until the end of the year, with the exception of P3, which has been recorded as dry since June 2023.

Groundwater levels are therefore considered to be primarily related to rainfall variations. The aquifer in the vicinity of P1 is considered to have a higher storage capacity than that of the other boreholes, due to the more muted response to changes in rainfall. It is considered that geological faults act as barriers to groundwater flow, which is evidenced by notable differences in groundwater elevations within the boreholes away from the quarry void (ie P2 and P4).

2.2.2 Spatial groundwater level distribution

An overall northwards groundwater flow direction can be inferred. However, groundwater levels at Fadre Farm to the west of the quarry, are 30 to 40 m higher than those recorded within and adjacent to the quarry. These do not conform to the watertable elevation, which can be inferred to the east. This is considered to indicate the compartmentalisation of the aquifer by

the geological faults. The water level in P2 is approximately 40 m lower than that recorded in the quarry, which may indicate the presence of a fault to the north of the quarry void.

3 SUMMARY

3.1 Groundwater levels

Observed groundwater level variations during the monitoring period are primarily attributable to temporal variations in rainfall recharge. The difference in groundwater elevations in P3, to all the other boreholes, is considered to be due to the presence of a geological fault that acts as a barrier to flow. The muted response in P1, is considered to be due to a larger amount of storage in the aquifer surrounding the borehole.

3.2 Surface water

The significant depth to groundwater recorded within all the boreholes, indicates that surface water features close to the site are perched above the watertable within the Carboniferous Limestone.

Changes in water levels observed at the water features, during the monitoring period, can be attributed to antecedent rainfall conditions. These changes are most noticeable within the waterbodies.

There is no discernible change in the surface water features during the monitoring period when compared to the historic photographic records.

3.3 Water-supported ecology

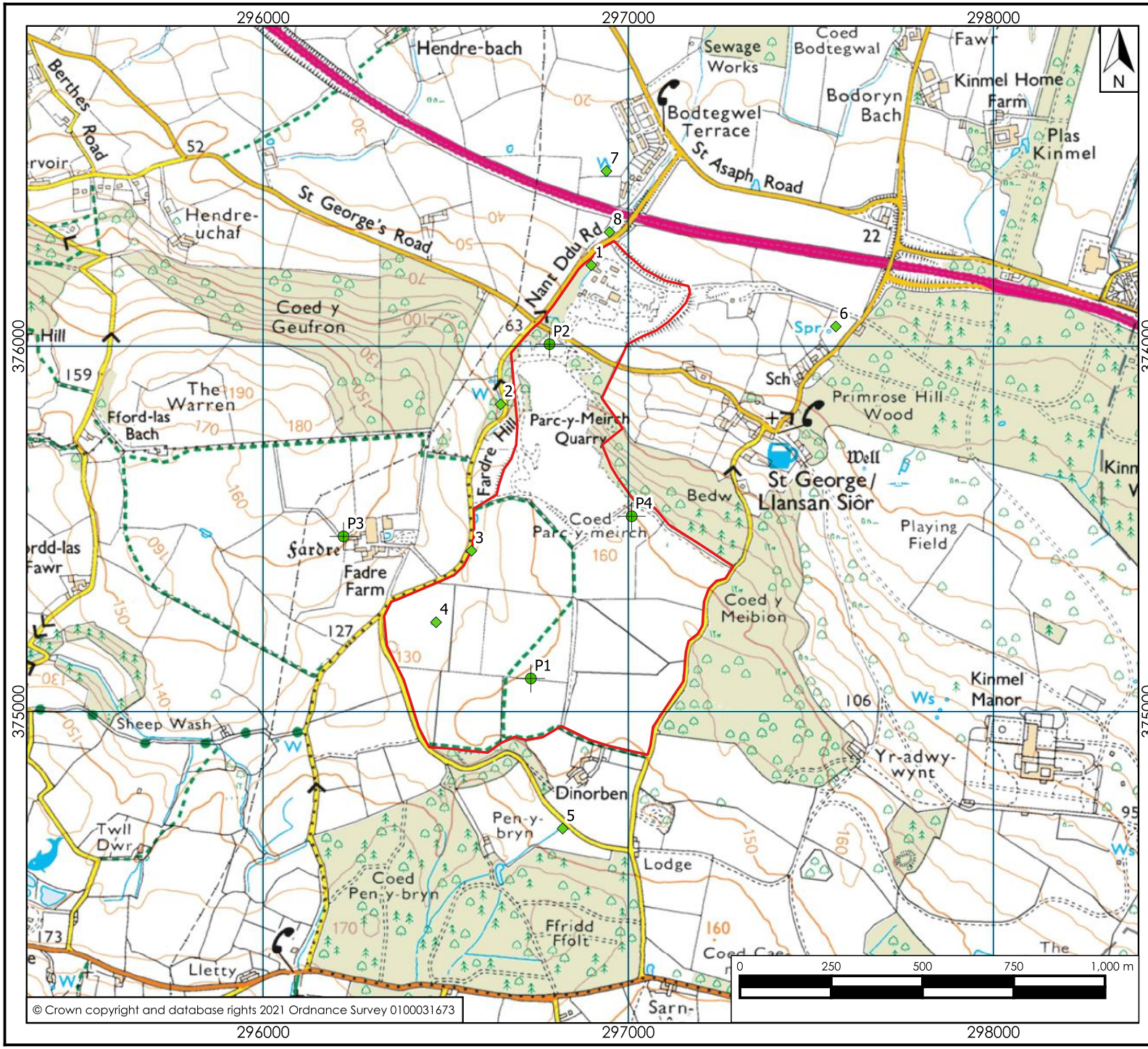
On the basis of the absence of impact upon groundwater or surface water, supported by both monitoring and photographic evidence, it can be concluded that there is no impact upon water-supported ecology.

3.4 Water supply

For the same reasons as those described above, there is no potential for adverse impacts upon local water supplies.

The drying of borehole P3 appears to be unconnected with the site, as the groundwater levels within the boreholes adjacent to the quarry have all recovered.

DRAWINGS



Legend

- Site Boundary
- Monitoring Boreholes
- Photographic Monitoring Locations

1. Stream in Nant Ddu by quarry entrance.
2. Stream in Nant Ddu
3. Headwaters of Nant Ddu Stream
4. Pwll Fadre
5. Sinkhole
6. Pond/Spring
7. Pond/Spring
8. Stream at Culvert by the A55

Scale correct at A4

Client	Heidelberg Materials UK
Title	Location of Monitoring Points
Project	Abergele Quarry
Drawing	1742/MON-23/01
Version	1
Date	Feb 2024
Scale	1:15,000

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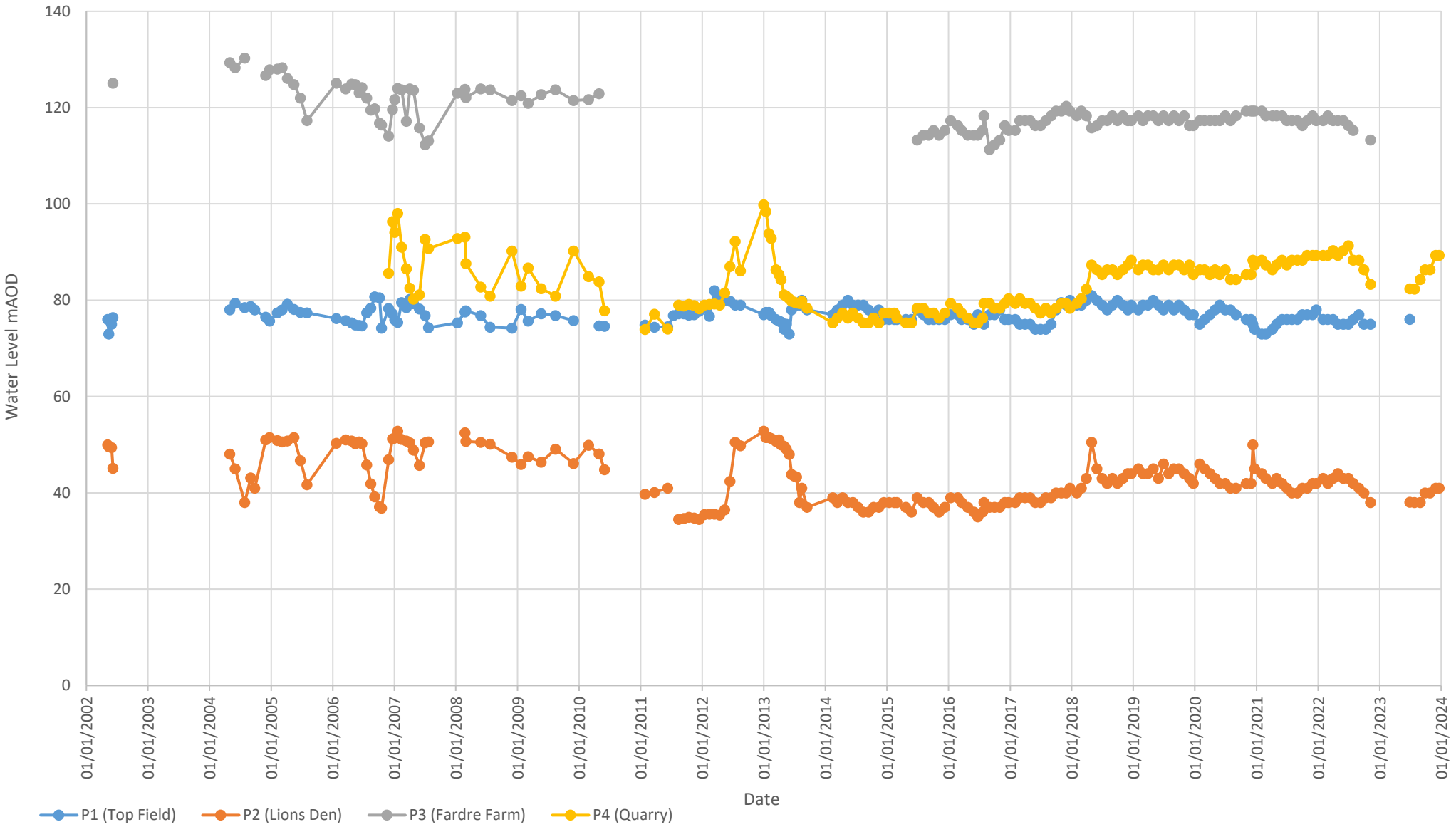

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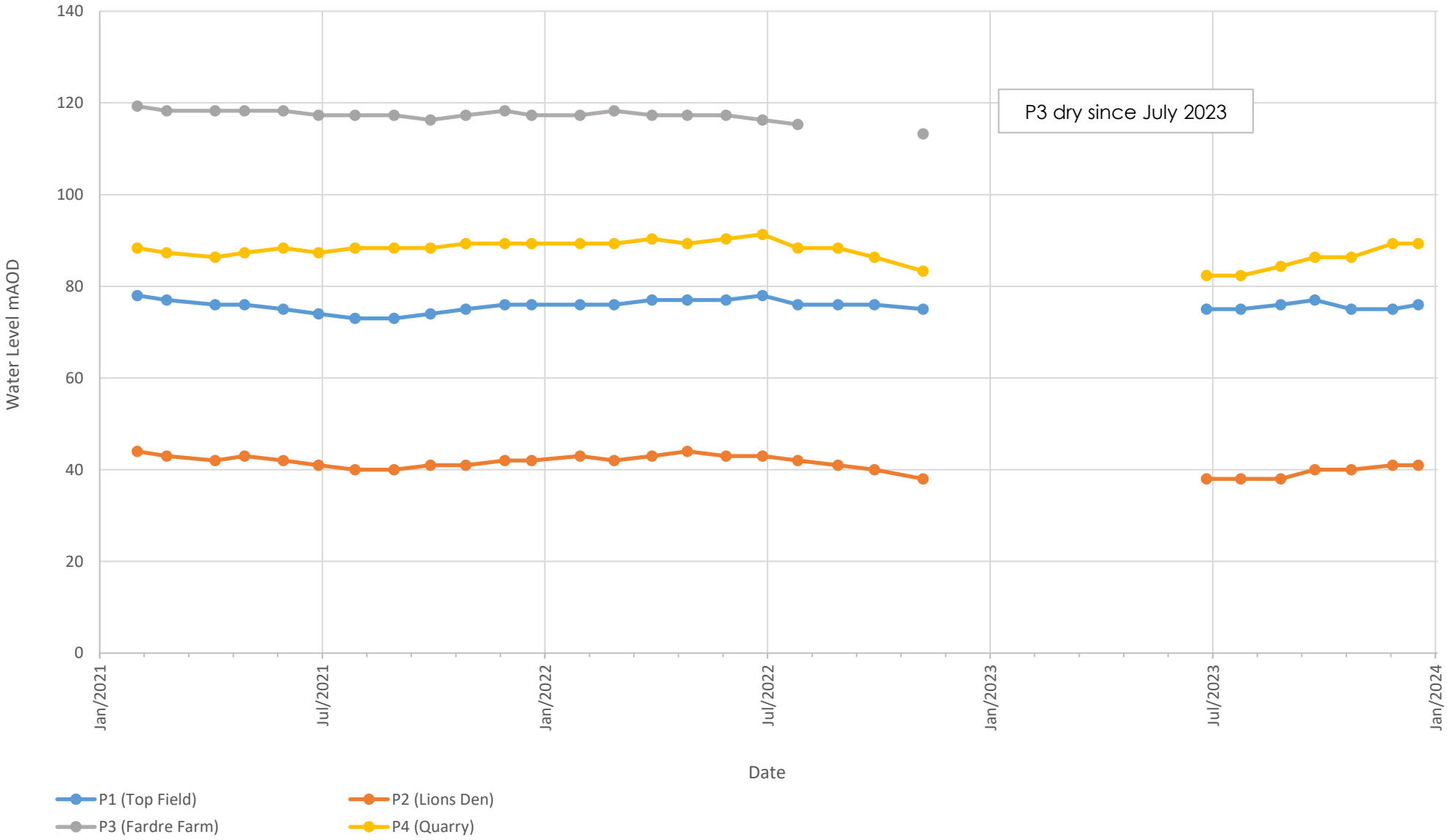
Client	Heidelberg Materials UK
Title	Groundwater Hydrographs 2002 - 2023
Project	Abergele Quarry
Drawing	1742/MON-23/02
Version	1
Date	Feb-24
Scale	N/A



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Client	Heidelberg Materials UK
Title	Groundwater Hydrographs 2021 - 2023
Project	Abergele Quarry
Drawing	1742/MON-23/03
Version	1
Date	Feb-24
Scale	N/A

PHOTOGRAPHS

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FILE NOTE

Author: Dylan Ingman ***Date***: 14/07/2021

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 14th July 2021 Antecedent conditions: Warm and dry with occasional heavy rainfall Weather on site was warm and clear
One	Culvert containing Nant Ddu stream releasing less than ¼ l/s. Similar amount of flow along streambed. Precipitation from the east bank has continued and has started to encroach on the grated culvert.
Two	Slow trickle/ trace of flow in watercourse. Some pooling of water in places. Bits of fly tipping in stream.
Three	Some boggy/moist soil but also areas of baked/dried soil. No standing water.
Four	Standing water c.5cm deep. No flow out of depression. Live grass at base of depression indicating no prolonged flooding.
Five	Completely dry. Channel fully vegetated.
Six	Depression filled to rim with water. Duckweed established across surface of water.
Seven	Damp/moist soil. No standing water. Moist/boggy ground along outflow route.
Eight	Up to ½ l/s flow. Precipitation within culvert and on streambed. Precipitation on the concrete supporting the culvert (mainly above the outlet) indicating calcium rich water flow around the culvert.

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Client	Heidelberg Materials UK
Title	Photographic Record July 2021 - Location 1
Project	Abergele Quarry
Drawing	1742/MON-23/P1
Version	1
Date	Feb-24
Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 2		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2018 - Location 3		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2021 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P1	Version	1
Date	Feb-24	Scale	N/A

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FILE NOTE

Author: Dylan Ingman ***Date***: 08/12/2021

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 8th December 2021 Antecedent conditions: Wet and windy (Storm Barra) Weather on site rain showers and strong wind
One	Plastic culvert contributing c. 0.5 l/s flow consistently, with larger flows sloshing down culvert. Flow of c. 60 l/s through larger culvert. Water very discoloured within both the streambed and from the plastic culvert. Water depth c. 20cm. Plant debris around trash screen causing some raising of the water level.
Two	Steady flow of approximately 5l/s. Some discoloration of water.
Three	Steady flow of water of c. 2 l/s. Grass at base of channel. Water is clear.
Four	Water level at rim of depression. Flow out of depression beginning to occur. Live grass at base of depression indicating no prolonged flooding.
Five	Boggy ground and some standing water within channel. Slow flowing water towards top of channel.
Six	Depression filled to rim with water. Duckweed and grass present across waterbody. Boggy ground surrounding feature.
Seven	Single body of standing water within feature. No flow out of waterbody. Boggy ground in surrounding area.
Eight	Flow of c. 60 l/s. Water depth approximately half diameter of culvert, partly due to leaves caught within screen. Water discoloured. Fallen tree within channel downstream causing ponding, but not restricting flow.

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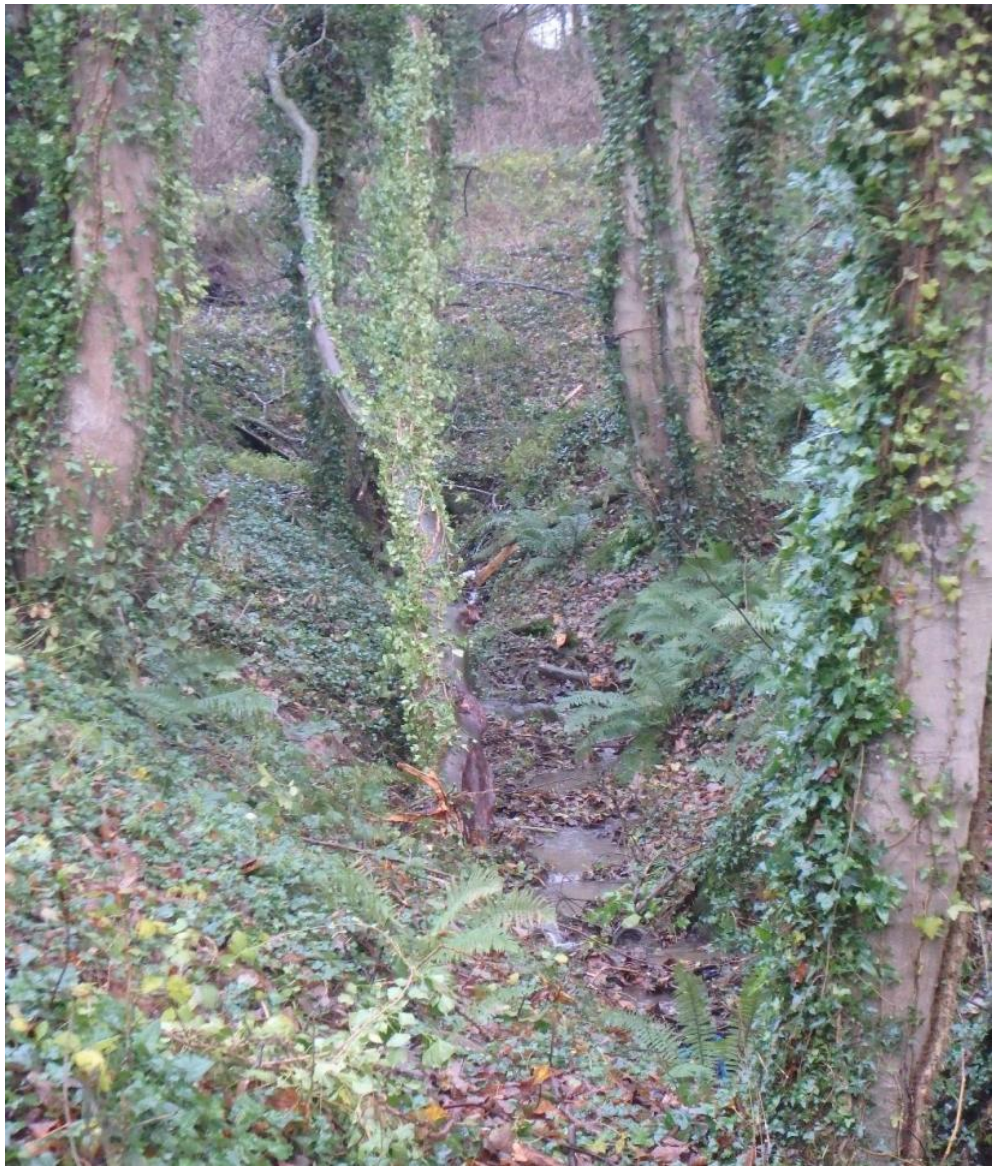
Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 1		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A



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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 2		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 3		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record December 2021 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P2	Version	1
Date	Feb-24	Scale	N/A

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environmental water management

FILE NOTE

Author: Dylan Ingman ***Date***: 14/06/2022

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 14th June 2022 Antecedent conditions: Warm and dry Weather on site was warm and overcast
One	<0.25 l/s flow. Flow equally from old course of stream and plastic culvert.
Two	Approx 0.1 l/s flow. Areas of standing water within channel. Soil within channel saturated.
Three	Densely vegetated with grass. Soil saturated at base. No flowing water.
Four	No water within depression. Feature completely covered in grass.
Five	Channel vegetated. No running water and soil within channel dry.
Six	Standing water approx. 10 – 20 cm deep.
Seven	Some small areas of standing water and saturated soils.
Eight	<0.25 l/s flow. Carbonate being deposited at base of channel.

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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 1		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record June 22 - Location 2		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 3		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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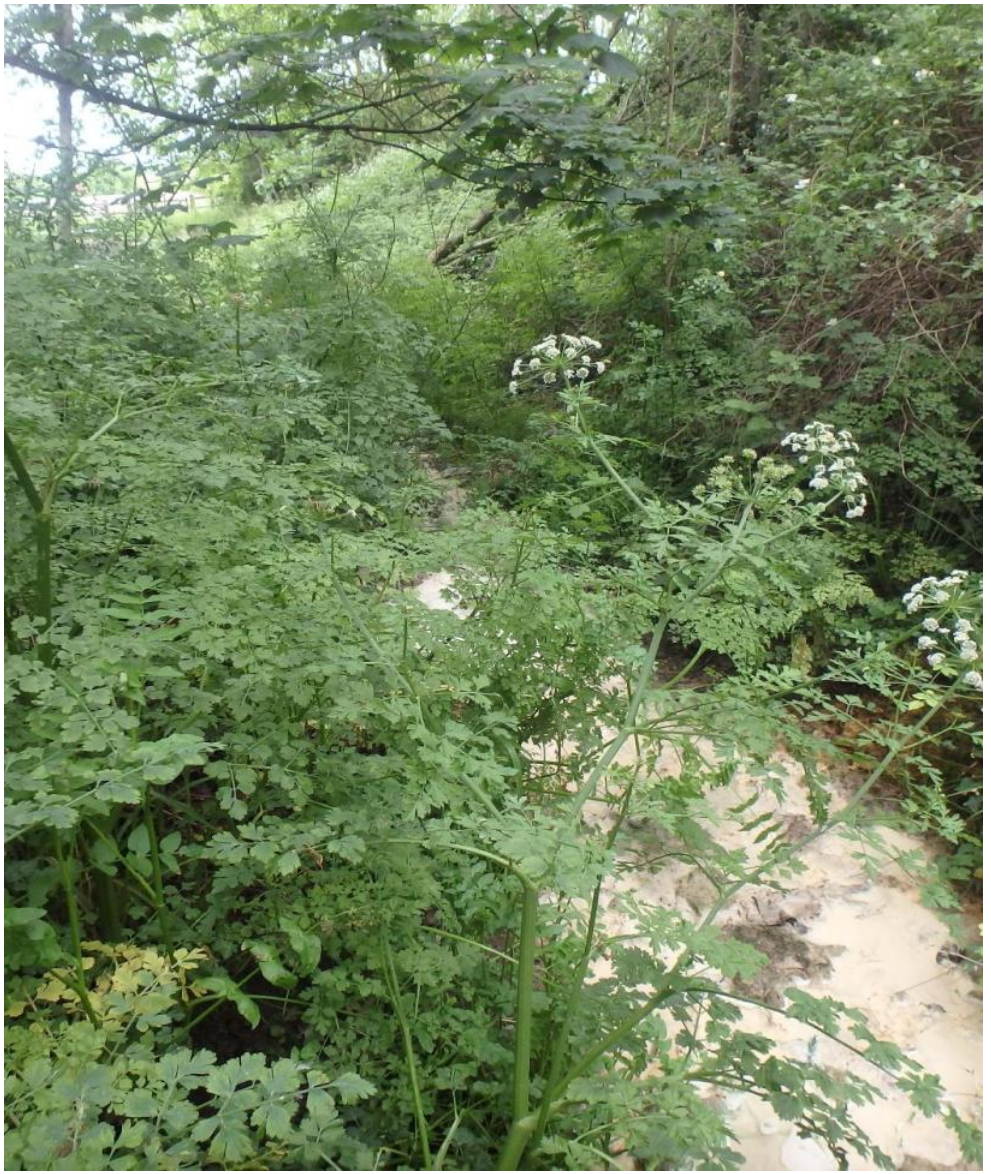
Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A



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Client	Heidelberg Materials UK		
Title	Photographic Record June 2022 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P3	Version	1
Date	Feb-24	Scale	N/A

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FILE NOTE

Author: Chris Ainscow ***Date***: 16/01/2023

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 16th January 2023 Antecedent conditions: Cold and dry with occasional heavy rainfall Weather on site was cold and dry
One	Culvert containing Nant Ddu stream releasing approximately 3 l/s. Flow estimated at 10 l/s along streambed. Precipitation from the east bank has continued and has started to encroach on the grated culvert. This created a damming effect with water pooling behind the eastern side and passing through the culvert via the western bank.
Two	A continuous gentle flow in the watercourse, approximately 1 m/s. Bits of fly tipping in across the bank and in the stream.
Three	Continuous flow of clear water. Vegetation debris occupying areas of the channel.
Four	Standing water occupying the capacity of the waterbody. No flow out of depression. Small areas of standing water in the wider vicinity, with much of the soil saturated across the field.
Five	Completely dry. Channel fully vegetated.
Six	Depression filled to rim with water. Surrounding areas very wet under foot.
Seven	Some standing water within the spring, saturated soil in the outflow route. No overflowing water.
Eight	Up to 15 l/s flow. Precipitation within culvert and on streambed. Channel looks like it has been cleared near to the culvert. Water flow was clear. Precipitation on the concrete supporting the culvert (mainly above the outlet) indicating calcium rich water flow around the culvert.

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023- Location 1		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK
Title	Photographic Record January 2023 - Location 2
Project	Abergele Quarry
Drawing	1742/MON-23/P4
Version	1
Date	Feb-24
Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 3		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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E: info@hafrenwater.com • *T*: 01743 355 770

Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record January 2023 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P4	Version	1
Date	Feb-24	Scale	N/A

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FILE NOTE

Author: Dylan Ingman ***Date***: 19/07/2023

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 19th July 2023 Antecedent conditions: Warm and dry with strong downpours Weather on site was warm and overcast, gradually clearing
One	Culvert containing Nant Ddu stream discharging approximately 0.25 l/s. No other flow into streambed. Soils deposited along western side of channel likely due to runoff from fields adjacent to Nant Ddu Road discharging through culvert. Lime material from east bank forming 'cake' on trash screen – appears to have been in place since Jan 23 visit.
Two	No continuous flow or standing water. Sediment in riverbed is saturated. Channel overgrown.
Three	No running or standing water. Bed is dry and grassed over.
Four	Depression is predominantly dry and grassed. Very small area of standing water at edge, likely due to ponding of rainwater due to intensity of antecedent storms.
Five	Completely dry. Channel fully vegetated.
Six	Depression partly filled with water covered by duckweed. Surrounding soil saturated.
Seven	Soils in area saturated, but no standing water present.
Eight	Approximately 0.25l/s flow. Channel is very overgrown, with lime rich material deposited on riverbed. Material is present to approximately 2m into the culvert.

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023- Location 1		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK
Title	Photographic Record July 2023 - Location 2
Project	Abergele Quarry
Drawing	1742/MON-23/P5
Version	1
Date	Feb-24
Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 3		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials UK		
Title	Photographic Record July 2023 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P5	Version	1
Date	Feb-24	Scale	N/A

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FILE NOTE

Author: Chris Ainscow ***Date***: 21/12/2023

Project: Abergele monitoring ***cc***:

Photographic record – site visit notes

Photographic monitoring location	Date: 21st December 2023 Antecedent conditions: Cold and strong winds with spells of heavy rainfall
One	Culvert containing Nant Ddu stream releasing approximately 2 l/s. Flow estimated at 10 l/s along streambed. Precipitation from the east bank has continued and has started to encroach on the grated culvert. This created a damming effect with water pooling behind the eastern side and passing through the culvert via the western bank.
Two	A continuous gentle flow in the watercourse. Bits of fly tipping across the bank and in the stream.
Three	Continuous flow of clear water. Vegetation debris occupying areas of the channel.
Four	Standing water occupying the capacity of the waterbody. No flow out of depression. Small areas of standing water in the wider vicinity, with much of the soil saturated across the field.
Five	Completely dry. Channel fully vegetated.
Six	Depression filled to rim with water. Surrounding areas very wet under foot.
Seven	Some standing water within the spring, saturated soil in the outflow route. No overflowing water.
Eight	Up to 15 l/s flow. Precipitation within culvert and on streambed. Vegetation debris surrounding culvert casing. Water flow was cloudy. Precipitation on the concrete supporting the culvert (mainly above the outlet) indicating calcium rich water flow around the culvert.

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Client	Heidelberg Materials		
Title	Photographic Record December 2023- Location 1		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 2		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials
Title	Photographic Record December 2023 - Location 3
Project	Abergele Quarry
Drawing	1742/MON-23/P6
Version	1
Date	Feb-24
Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 4		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 5		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 6		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 7		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

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Client	Heidelberg Materials		
Title	Photographic Record December 2023 - Location 8		
Project	Abergele Quarry		
Drawing	1742/MON-23/P6	Version	1
Date	Feb-24	Scale	N/A

APPENDIX 1742/MON-23/A1

Photographic record locations

Location one

Feature: The watercourse in Nant Ddu Valley within the landholding of Hanson immediately to the south of the quarry entrance

NGR: SH 96898 76222

Elevation: c42 mAOD

Location two

Feature: Stream in Nant Ddu Valley, 500 m southwest of the quarry entrance

NGR: SH 96650 75842

Elevation: 105 mAOD

Location three

Feature: Headwaters of stream within Nant Ddu Valley, 200 m south of location two

NGR: SH 96570 75441

Elevation: 128 mAOD

Location four

Feature: Small, well vegetated pond known as Pwll Fardre

NGR: SH 96473 75245

Elevation: 135 mAOD

Location five

Feature: Stream feeding into a sinkhole, in an area known as Pen-y-bryn

NGR: SH 96820 74680

Elevation: 146 mAOD

Location six

Feature: Small spring-fed pond, 50 m to the west of the road between St George and the A55

NGR: SH 97568 76055

Elevation: 32 mAOD

Location seven

Feature: Small, overgrown spring-fed pond, situated in farmland some 50 m west of the residential properties in Bodtegwel Terrace

NGR: SH 96940 76480

Elevation: 26 mAOD

Location eight

Feature: Stream as it emerges from a culvert close to the A55

NGR: SH 96948 76313

Elevation: 36 mAOD

APPENDIX 1742/MON-23/A2

Groundwater level monitoring data

	Top field		Lions Den		Fardre Farm		Quarry	
Piezo no.	**P1**		**P2**		**P3**		**P4**	
Easting	**296733**		**296784**		**296220**		**297009**	
Northing	**375091**		**376006**		**375480**		**375535**	
Cap (mAOD)	**151**		**54**		**148.28**		**124.323**	
Date	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**
07/05/2002	81.0	**70.0**	4.0	**50.0**				
14/05/2002	74.5	**76.5**	4.4	**49.6**				
30/05/2002	74.9	**76.1**	4.6	**49.4**				
08/06/2002	75.0	**76.0**	8.9	**45.1**	23.2	**125.1**		
01/05/2004	74.6	**76.4**	6.0	**48.0**	19	**129.3**		
01/06/2004	75.0	**76.0**	9.0	**45.0**	20.0	**128.3**		
29/07/2004	75.0	**76.0**	16.0	**38.0**	18.0	**130.3**		
01/09/2004	78.0	**73.0**	10.9	**43.1**				
26/09/2004	76.0	**75.0**	13.0	**41.0**				
30/11/2004	74.6	**76.4**	3.0	**51.0**	21.6	**126.7**		
23/12/2004	73.0	**78.0**	2.5	**51.5**	20.4	**127.9**		
07/02/2005	71.6	**79.4**	3.1	**50.9**	20.3	**128.0**		
07/03/2005	72.5	**78.5**	3.4	**50.6**	20.0	**128.3**		
07/04/2005	72.3	**78.7**	3.2	**50.8**	22.2	**126.1**		
16/05/2005	73.0	**78.0**	2.5	**51.5**	23.5	**124.8**		
24/06/2005	74.5	**76.5**	7.3	**46.7**	26.3	**122.0**		
01/08/2005	75.3	**75.7**	12.3	**41.7**	31.0	**117.3**		
23/01/2006	73.6	**77.4**	3.7	**50.3**	23.2	**125.1**		
20/03/2006	73.0	**78.0**	3.0	**51.0**	24.4	**123.9**		
24/04/2006	71.8	**79.2**	3.2	**50.8**	23.4	**124.9**		
16/05/2006	72.9	**78.1**	3.8	**50.2**	23.5	**124.8**		
08/06/2006	73.5	**77.5**	3.4	**50.6**	25.2	**123.1**		
23/06/2006	73.6	**77.4**	3.8	**50.2**	24.1	**124.2**		
22/07/2006	74.8	**76.2**	8.2	**45.8**	26.3	**122.0**		
15/08/2006	75.2	**75.8**	12.1	**41.9**	28.8	**119.5**		
08/09/2006	75.7	**75.3**	14.8	**39.2**	28.5	**119.8**		
06/10/2006	76.1	**74.9**	16.9	**37.1**	31.5	**116.8**		
18/10/2006	76.2	**74.8**	17.2	**36.8**	31.9	**116.4**		
29/11/2006	76.3	**74.7**	7.1	**46.9**	34.2	**114.1**	38.7	**85.6**
22/12/2006	73.6	**77.4**	2.8	**51.2**	28.7	**119.6**	28.0	**96.3**
05/01/2007	72.6	**78.4**	2.6	**51.4**	26.6	**121.7**	30.2	**94.1**
22/01/2007	70.3	**80.7**	1.2	**52.8**	24.3	**124.0**	26.3	**98.0**
14/02/2007	70.5	**80.5**	2.9	**51.1**	24.6	**123.7**	33.3	**91.0**
15/03/2007	76.8	**74.2**	3.2	**50.8**	31.1	**117.2**	37.8	**86.5**
03/04/2007	72.7	**78.3**	3.6	**50.4**	24.4	**123.9**	41.8	**82.5**
25/04/2007	73.8	**77.2**	5.1	**48.9**	24.7	**123.6**	44.1	**80.2**
30/05/2007	75.1	**75.9**	8.3	**45.7**	32.5	**115.8**	43.2	**81.1**
03/07/2007	75.6	**75.4**	3.6	**50.4**	36.0	**112.3**	31.7	**92.6**
24/07/2007	71.5	**79.5**	3.4	**50.6**	35.2	**113.1**	33.6	**90.7**
11/01/2008	72.5	**78.5**			25.3	**123.0**	31.5	**92.8**
25/02/2008	70.8	**80.2**	1.5	**52.5**	24.5	**123.8**	31.2	**93.1**
01/03/2008	71.7	**79.3**	3.3	**50.7**	26.2	**122.1**	36.7	**87.6**
28/05/2008	72.8	**78.2**	3.5	**50.5**	24.4	**123.9**	41.6	**82.7**
23/07/2008	74.2	**76.8**	3.9	**50.1**	24.6	**123.7**	43.5	**80.8**
29/11/2008	76.7	**74.3**	6.6	**47.4**	26.8	**121.5**	34.1	**90.2**
23/01/2009	75.7	**75.3**	8.1	**45.9**	25.8	**122.5**	41.4	**82.9**
06/03/2009	73.4	**77.6**	6.5	**47.5**	27.4	**120.9**	37.6	**86.7**
21/05/2009	73.2	**77.8**	7.6	**46.4**	25.6	**122.7**	41.9	**82.4**
15/08/2009	74.2	**76.8**	4.9	**49.1**	24.6	**123.7**	43.5	**80.8**
29/11/2009	76.6	**74.4**	7.9	**46.1**	26.8	**121.5**	34.1	**90.2**
27/02/2010	76.8	**74.2**	4.1	**49.9**	26.6	**121.7**	39.4	**84.9**
30/04/2010	72.9	**78.1**	5.9	**48.1**	25.4	**122.9**	40.5	**83.8**
01/06/2010	75.3	**75.7**	9.2	**44.8**			46.5	**77.8**
27/01/2011	73.8	**77.2**	14.3	**39.7**			50.4	**73.9**
25/03/2011	74.2	**76.8**	13.9	**40.1**			47.2	**77.1**
11/06/2011	75.2	**75.8**	13.0	**41.0**			50.3	**74.0**
15/07/2011								

15/08/2011	76.3	**74.7**	19.5	**34.5**			45.3	**79.0**
15/09/2011	76.4	**74.6**	19.3	**34.7**			45.5	**78.8**
15/10/2011	76.2	**74.8**	19.1	**34.9**			45.2	**79.1**
15/11/2011	76.6	**74.4**	19.2	**34.8**			45.4	**78.9**
15/12/2011	76.5	**74.5**	19.5	**34.5**			46.1	**78.2**
15/01/2012	74.2	**76.8**	18.5	**35.5**			45.3	**79.0**
14/02/2012	73.8	**77.2**	18.4	**35.6**			45.2	**79.1**
15/03/2012	73.8	**77.2**	18.4	**35.6**			45.1	**79.2**
15/04/2012	74.1	**76.9**	18.6	**35.4**			45.3	**79.0**
15/05/2012	74.0	**77.0**	17.5	**36.5**			42.8	**81.5**
15/06/2012	73.3	**77.7**	11.6	**42.4**			37.3	**87.0**
15/07/2012	72.5	**78.5**	3.5	**50.5**			32.1	**92.2**
15/08/2012	74.3	**76.7**	4.2	**49.8**			38.2	**86.1**
01/01/2013	69.0	**82.0**	1.2	**52.8**			24.5	**99.8**
14/01/2013	70.5	**80.5**	2.5	**51.5**			25.9	**98.4**
01/02/2013	71.0	**80.0**	2.5	**51.5**			30.5	**93.8**
14/02/2013	71.2	**79.8**	2.7	**51.3**			31.5	**92.8**
14/03/2013	72.0	**79.0**	3.3	**50.7**			38.0	**86.3**
01/04/2013	72.0	**79.0**	3.0	**51.0**			39.0	**85.3**
14/04/2013	74.0	**77.0**	4.0	**50.0**			40.0	**84.3**
01/05/2013	73.5	**77.5**	4.3	**49.7**			43.2	**81.1**
15/05/2013	73.5	**77.5**	4.9	**49.1**			43.5	**80.8**
01/06/2013	74.2	**76.8**	6.0	**48.0**			44.0	**80.3**
14/06/2013	75.0	**76.0**	10.2	**43.8**			44.5	**79.8**
01/07/2013	75.3	**75.7**	10.5	**43.5**			44.7	**79.6**
14/07/2013	75.5	**75.5**	10.7	**43.3**			44.9	**79.4**
01/08/2013	77.0	**74.0**	16.0	**38.0**			45.0	**79.3**
14/08/2013	76.0	**75.0**	13.0	**41.0**			44.5	**79.8**
14/09/2013	78.0	**73.0**	17.0	**37.0**			46.0	**78.3**
14/02/2014	73.0	**78.0**	15.0	**39.0**			49.0	**75.3**
14/03/2014	72.0	**79.0**	16.0	**38.0**			48.0	**76.3**
14/04/2014	72.0	**79.0**	15.0	**39.0**			47.0	**77.3**
14/05/2014	72.0	**79.0**	16.0	**38.0**			48.0	**76.3**
14/06/2014	71.0	**80.0**	16.0	**38.0**			47.0	**77.3**
14/07/2014	73.0	**78.0**	17.0	**37.0**			48.0	**76.3**
15/08/2014	74.0	**77.0**	18.0	**36.0**			49.0	**75.3**
15/09/2014	73.0	**78.0**	18.0	**36.0**			49.0	**75.3**
15/10/2014	72.0	**79.0**	17.0	**37.0**			48.0	**76.3**
15/11/2014	71.0	**80.0**	17.0	**37.0**			49.0	**75.3**
15/12/2014	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
15/01/2015	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
15/02/2015	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
01/03/2015	73.0	**78.0**	16.0	**38.0**			48.0	**76.3**
23/04/2015	74.0	**77.0**	17.0	**37.0**			49.0	**75.3**
27/05/2015	73.0	**78.0**	18.0	**36.0**			49.0	**75.3**
30/06/2015	75.0	**76.0**	15.0	**39.0**	35.0	**113.3**	46.0	**78.3**
05/08/2015	75.0	**76.0**	16.0	**38.0**	34.0	**114.3**	46.0	**78.3**
07/09/2015	75.0	**76.0**	16.0	**38.0**	34.0	**114.3**	47.0	**77.3**
05/10/2015	75.0	**76.0**	17.0	**37.0**	33.0	**115.3**	47.0	**77.3**
06/11/2015	75.0	**76.0**	18.0	**36.0**	34.0	**114.3**	48.0	**76.3**
11/12/2015	75.0	**76.0**	17.0	**37.0**	33.0	**115.3**	47.0	**77.3**
14/01/2016	73.0	**78.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**
26/02/2016	74.0	**77.0**	15.0	**39.0**	32.0	**116.3**	46.0	**78.3**
19/03/2016	75.0	**76.0**	16.0	**38.0**	33.0	**115.3**	47.0	**77.3**
25/04/2016	75.0	**76.0**	17.0	**37.0**	34.0	**114.3**	48.0	**76.3**
31/05/2016	75.0	**76.0**	18.0	**36.0**	34.0	**114.3**	49.0	**75.3**
24/06/2016	75.0	**76.0**	19.0	**35.0**	34.0	**114.3**	49.0	**75.3**
22/07/2016	74.0	**77.0**	18.0	**36.0**	33.0	**115.3**	48.0	**76.3**
30/07/2016	74.0	**77.0**	16.0	**38.0**	30.0	**118.3**	45.0	**79.3**
31/08/2016	75.0	**76.0**	17.0	**37.0**	37.0	**111.3**	45.0	**79.3**
30/09/2016	75.0	**76.0**	17.0	**37.0**	36.0	**112.3**	46.0	**78.3**
31/10/2016	76.0	**75.0**	17.0	**37.0**	35.0	**113.3**	46.0	**78.3**
30/11/2016	74.0	**77.0**	16.0	**38.0**	32.0	**116.3**	45.0	**79.3**
23/12/2016	75.0	**76.0**	16.0	**38.0**	33.0	**115.3**	44.0	**80.3**
31/01/2017	76.0	**75.0**	16.0	**38.0**	33.0	**115.3**	45.0	**79.3**
28/02/2017	74.0	**77.0**	15.0	**39.0**	31.0	**117.3**	44.0	**80.3**
31/03/2017	74.0	**77.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**
29/04/2017	73.0	**78.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**

31/05/2017	75.0	**76.0**	16.0	**38.0**	32.0	**116.3**	46.0	**78.3**
30/06/2017	75.0	**76.0**	16.0	**38.0**	32.0	**116.3**	47.0	**77.3**
31/07/2017	75.0	**76.0**	15.0	**39.0**	31.0	**117.3**	46.0	**78.3**
31/08/2017	76.0	**75.0**	15.0	**39.0**	30.0	**118.3**	47.0	**77.3**
30/09/2017	76.0	**75.0**	14.0	**40.0**	29.0	**119.3**	46.0	**78.3**
31/10/2017	76.0	**75.0**	14.0	**40.0**	29.0	**119.3**	45.0	**79.3**
30/11/2017	77.0	**74.0**	14.0	**40.0**	28.0	**120.3**	45.0	**79.3**
22/12/2017	77.0	**74.0**	13.0	**41.0**	29.0	**119.3**	46.0	**78.3**
31/01/2018	77.0	**74.0**	14.0	**40.0**	30.0	**118.3**	45.0	**79.3**
28/02/2018	76.0	**75.0**	13.0	**41.0**	29.0	**119.3**	44.0	**80.3**
29/03/2018	73.0	**78.0**	11.0	**43.0**	30.0	**118.3**	42.0	**82.3**
30/04/2018	71.5	**79.5**	3.5	**50.5**	32.5	**115.8**	37.0	**87.3**
31/05/2018	72.0	**79.0**	9.0	**45.0**	32.0	**116.3**	38.0	**86.3**
30/06/2018	71.0	**80.0**	11.0	**43.0**	31.0	**117.3**	39.0	**85.3**
31/07/2018	72.0	**79.0**	12.0	**42.0**	31.0	**117.3**	38.0	**86.3**
31/08/2018	72.0	**79.0**	11.0	**43.0**	30.0	**118.3**	38.0	**86.3**
29/09/2018	71.0	**80.0**	12.0	**42.0**	31.0	**117.3**	39.0	**85.3**
31/10/2018	70.0	**81.0**	11.0	**43.0**	30.0	**118.3**	38.0	**86.3**
30/11/2018	71.0	**80.0**	10.0	**44.0**	31.0	**117.3**	37.0	**87.3**
21/12/2018	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	36.0	**88.3**
31/01/2019	73.0	**78.0**	9.0	**45.0**	30.0	**118.3**	38.0	**86.3**
28/02/2019	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	37.0	**87.3**
29/03/2019	71.0	**80.0**	10.0	**44.0**	30.0	**118.3**	37.0	**87.3**
30/04/2019	72.0	**79.0**	9.0	**45.0**	30.0	**118.3**	38.0	**86.3**
31/05/2019	73.0	**78.0**	11.0	**43.0**	31.0	**117.3**	38.0	**86.3**
29/06/2019	72.0	**79.0**	8.0	**46.0**	30.0	**118.3**	37.0	**87.3**
31/07/2019	73.0	**78.0**	10.0	**44.0**	31.0	**117.3**	38.0	**86.3**
31/08/2019	72.0	**79.0**	9.0	**45.0**	30.0	**118.3**	37.0	**87.3**
30/09/2019	72.0	**79.0**	9.0	**45.0**	31.0	**117.3**	37.0	**87.3**
31/10/2019	71.0	**80.0**	10.0	**44.0**	30.0	**118.3**	38.0	**86.3**
30/11/2019	72.0	**79.0**	11.0	**43.0**	32.0	**116.3**	37.0	**87.3**
23/12/2019	73.0	**78.0**	12.0	**42.0**	32.0	**116.3**	39.0	**85.3**
31/01/2020	72.0	**79.0**	8.0	**46.0**	31.0	**117.3**	38.0	**86.3**
28/02/2020	73.0	**78.0**	9.0	**45.0**	31.0	**117.3**	38.0	**86.3**
31/03/2020	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	39.0	**85.3**
30/04/2020	73.0	**78.0**	11.0	**43.0**	31.0	**117.3**	38.0	**86.3**
29/05/2020	74.0	**77.0**	12.0	**42.0**	31.0	**117.3**	39.0	**85.3**
30/06/2020	74.0	**77.0**	12.0	**42.0**	30.0	**118.3**	38.0	**86.3**
31/07/2020	76.0	**75.0**	13.0	**41.0**	31.0	**117.3**	40.0	**84.3**
01/09/2020	75.0	**76.0**	13.0	**41.0**	30.0	**118.3**	40.0	**84.3**
02/11/2020	74.0	**77.0**	12.0	**42.0**	29.0	**119.3**	39.0	**85.3**
30/11/2020	73.0	**78.0**	12.0	**42.0**	29.0	**119.3**	39.0	**85.3**
11/12/2020	72	**79.0**	4	**50.0**	29	**119.3**	36	**88.3**
21/12/2020	73	**78.0**	9	**45.0**	29	**119.3**	37	**87.3**
01/02/2021	73	**78.0**	10	**44.0**	29	**119.3**	36	**88.3**
25/02/2021	74	**77.0**	11	**43.0**	30	**118.3**	37	**87.3**
06/04/2021	75	**76.0**	12	**42.0**	30	**118.3**	38	**86.3**
30/04/2021	75	**76.0**	11	**43.0**	30	**118.3**	37	**87.3**
01/06/2021	76	**75.0**	12	**42.0**	30	**118.3**	36	**88.3**
30/06/2021	77	**74.0**	13	**41.0**	31	**117.3**	37	**87.3**
30/07/2021	78	**73.0**	14	**40.0**	31	**117.3**	36	**88.3**
31/08/2021	78	**73.0**	14	**40.0**	31	**117.3**	36	**88.3**
30/09/2021	77	**74.0**	13	**41.0**	32	**116.3**	36	**88.3**
29/10/2021	76	**75.0**	13	**41.0**	31	**117.3**	35	**89.3**
30/11/2021	75	**76.0**	12	**42.0**	30	**118.3**	35	**89.3**
22/12/2021	75	**76.0**	12	**42.0**	31	**117.3**	35	**89.3**
31/01/2022	75	**76.0**	11	**43.0**	31	**117.3**	35	**89.3**
28/02/2022	75	**76.0**	12	**42.0**	30	**118.3**	35	**89.3**
31/03/2022	74	**77.0**	11	**43.0**	31	**117.3**	34	**90.3**
29/04/2022	74	**77.0**	10	**44.0**	31	**117.3**	35	**89.3**
31/05/2022	74	**77.0**	11	**43.0**	31	**117.3**	34	**90.3**
30/06/2022	73	**78.0**	11	**43.0**	32	**116.3**	33	**91.3**
29/07/2022	75	**76.0**	12	**42.0**	33	**115.3**	36	**88.3**
31/08/2022	75	**76.0**	13	**41.0**			36	**88.3**
30/09/2022	75	**76.0**	14	**40.0**			38	**86.3**
09/11/2022	76	**75.0**	16	**38.0**	35	**113.3**	41	**83.3**
30/06/2023	76	**75.0**	16	**38.0**			42	**82.3**
28/07/2023	76	**75.0**	16	**38.0**			42	**82.3**
30/08/2023	75	**76.0**	16	**38.0**			40	**84.3**
27/09/2023	74	**77.0**	14	**40.0**			38	**86.3**
27/10/2023	76	**75.0**	14	**40.0**			38	**86.3**
30/11/2023	76	**75.0**	13	**41.0**			35	**89.3**
21/12/2023	75	**76.0**	13	**41.0**			35	**89.3**
Min	**69.0**	**70.0**	**1.2**	**34.5**	**18.0**	**111.3**	**24.5**	**73.9**
Max	**81.0**	**82.0**	**19.5**	**52.8**	**37.0**	**130.3**	**50.4**	**99.8**
Mean	**74.0**	**77.0**	**11.0**	**43.0**	**29.4**	**118.9**	**41.0**	**83.3**
Range	**12.0**	**12.0**	**18.3**	**18.3**	**19.0**	**19.0**	**25.9**	**25.9**

APPENDIX 3047/TL/A3

Hydrogeological Impact Assessment 3047/HIA April 2024

hafrenwater
environmental water management

HYDROGEOLOGICAL IMPACT ASSESSMENT FOR PROPOSED DEWATERING AT ABERGELE QUARRY

Report Reference: 3047/HIA
Version F5
April 2024

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GENERAL NOTES

Title of report: Hydrogeological Impact Assessment

Site: Abergele Quarry

Report ref: 3047/HIA

Date: April 2024

Version	Date	Issued to
Draft version D1	March 2021	Siobhan Hall
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https://hafrenw.sharepoint.com/sites/HafrenWater/Shared Documents/General/Projects/Abergele (3047)/Reports/HIA update for GIC/Reports/3047 HIA vn F5.docx

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1 INTRODUCTION

1.1 Background

Limestone has been extracted at Abergele Quarry, Conwy for many decades. Mineral extraction is currently undertaken above the watertable; however Planning Permission exists to extract to an elevation of 58 metres Above Ordnance Datum (mAOD), which is below the recorded groundwater elevation.

A transfer licence is required from Natural Resources Wales (NRW) to facilitate dewatering of the quarry void and to enable complete and safe extraction of mineral to the permitted depth.

Following discussion with NRW, it was agreed that a Hydrogeological Impact Assessment (HIA) should be prepared to assess the impacts of the proposed dewatering before a transfer licence can be issued.

Hafren Water has been involved with various aspects of water management and assessment of the water environment at Abergele Quarry for more than 15 years, and consequently has a detailed understanding of the site. Hafren Water was commissioned to undertake the requisite assessment and has prepared this Hydrogeological Impact Assessment (HIA).

1.2 Location

Abergele Quarry ('the site') is located approximately 2.5 km southeast of Abergele town centre in the county of Conwy, North Wales. The east-west trending A55 trunk road approaches to within 100 m of the northern site boundary and access to the site is gained from a minor road.

The site is divided into two areas north and south of St George's Road. The northern area includes the mineral processing plant, offices, welfare facilities and ancillary operations. The latter includes the conveyor tunnel and the active quarry void.

The surrounding area predominantly comprises fields. The nearest village, St George, is approximately 350 m north of the quarry void, on St George's Road.

The site location is shown on *Drawing 3047/HIA/01*.

1.3 Scope of assessment

The scope of the assessment includes:

- Determination of baseline conditions of the water environment at the site and its environs
- Identification of potential impacts of the proposed dewatering upon the extant water environment
- Assessment of the magnitude and significance of potential impacts of mineral extraction and the proposed subsequent restoration on water features
- Derivation of appropriate mitigation measures for any identified potential impacts

1.4 Data sources

The characteristics of the water environment have been investigated with the use of existing published data and reports, assessment of site data, and experience of other sites in broadly similar settings. The data sources used in the investigation are listed below:

British Geological Survey (BGS)

- Geological mapping data accessed through the BGS Web Feature Service
- Geological 1:63,360 Map Sheet 95: Superficial and Bedrock Deposits
- Geological borehole logs
- Hydrogeology of Wales: Carboniferous aquifers - the Carboniferous Limestone aquifer http://nora.nerc.ac.uk/id/eprint/513064/1/Hydrogeology%20of%20Wales.pdf

Natural Resources Wales (NRW)

- Rainfall data
- Licensed abstraction data
- Groundwater investigation consent PAN-021727, 14th June 2023

Natural Resources Wales via the lle.gov. wales website

- Discharge consent outlets
- Statutory and Non-statutory sites
- Sites of ecological and conservation interest
- Priority habitats
- Active and historic waste management/landfill and Environmental Permit data
- Aquifer designations and groundwater source protection zone data

Ordnance Survey (OS)

- 1:25,000 scale, Explorer Sheet 264

Conwy County Borough Council

- Private water supplies

Heidelberg Materials (formerly Hanson UK)

- Permitted Area and Ownership Boundary Plans
- Plan of development phasing and restoration
- Groundwater monitoring data
- Borehole logs

Online Resources

- Ffynnon Gemig – St George's Well, Llansansior, Abergele (Accessed November 2023) https://wellhopper.wales/2017/11/18/ffynnon-gemig-st-georges-well-llansansior-abergele/
- Ffynnon Llansansior, Eirlys Gruffydd (Accessed November 2023) http://www.ffynhonnaucymru.org.uk/llan_sain_si%C3%B4r.htm

1.5 Methodology

Baseline conditions of the water environment have been defined by the collation and analysis of existing data and field observations. The potential effects of the proposed dewatering upon the extant water environment have been assessed by reference to the baseline data and a series of matrices developed to ensure a rigorous and consistent approach to the assessment of potential impacts. Mitigation measures have been proposed, where appropriate.

The method of assessment is detailed further in *Appendix 3047/HIA/A7*.

2 BASELINE CONDITIONS

2.1 Landform

The quarry is located on a northeast facing escarpment that trends approximately ESE to WNW. The escarpment forms a topographic divide between an upland area to the south and the coastal plain to the north. The coastline is located approximately 3.5 km to the north of the quarry. The foot of the escarpment is located at an elevation of approximately 30 mAOD, while the top is c160 mAOD.

The mineral extraction area, in the south, is located close to the top of the escarpment. The mineral processing plant, quarry offices and ancillary operations are located in the northern section of the site, at the base of the escarpment. The haul road crosses the steepest part of the escarpment and connects the northern and southern quarry areas.

The extraction area has been worked to a depth of approximately 80 mAOD.

2.2 Hydrology

2.2.1 Watercourses

The site is within the catchment of the River Gele, the headwaters of which are located to the southwest of the site (*Drawing 3047/HIA/02)*. Its nearest tributary (Nant y Creigiau) rises approximately 400 m southwest of the site boundary. This tributary flows towards the northwest and joins with other tributaries c2 km west of the site to form the main channel of the River Gele. The river flows eastwards, passing the site approximately 3 km to its north.

The closest watercourse to the site is located in the Nant Ddu valley, which parallels the western site boundary. It flows northwards and is culverted on the western margins of the mineral processing and stocking area, re-emerging to again parallel the western boundary. It is culverted beneath the quarry entrance road, then crosses beneath the minor road in a deep culvert before re-emerging and flowing northwards, being again culverted beneath the A55. The watercourse continues northwards and enters an extensive drainage ditch system, which is located within the low-lying coastal plain.

The drainage within the coastal plain is managed by the Towyn Drainage District.

The River Elwy passes approximately 2 km from the south of the site. A small tributary to the River Elwy, Nant Luke, rises c900 m south of the site. Both the River Elwy and River Gele join the River Clwyd which passes c5 km northeast of the site and discharges to the sea at Kinmel Bay.

2.2.2 Waterbodies

The drainage characteristics of the majority of the geology in the vicinity of the quarry are such that waterbodies are generally scarce. A small pond is located approximately 350 m south of the site boundary on elevated ground.

Small ponds are located within the site, close to the northern and western site boundaries and form part of the site water management system.

A group of fishing ponds is located 1.1 km southwest of the site and a single pond 1 km southeast.

2.2.3 Springs and issues

Five springs have been identified on 1:25,000 scale OS mapping within a 2 km radius of the site. The closest is located approximately 640 m northeast of the site boundary and is used as photographic monitoring location 6 (Section 2.2.4). The remaining four springs are located between 870 m and 1.7 km away and are in the catchment of Nant y Creigiau.

Three springs/issues have been identified close to the site during walkovers and are monitored as part of the photographic monitoring, these are locations 3, 4 and 7 (Section 2.2.4). The locations of these features are shown on *Drawing 3047/HIA/02*.

2.2.4 Surface water monitoring

In accordance with Planning Condition 27, regular photographic monitoring of selected surface water features has been undertaken since 2006. The features identified for monitoring were based upon discussion and agreement between Heidelberg Materials (formerly Hanson UK) and Natural Resources Wales, and their predecessors.

The locations of the photographic monitoring points are given in *Table 3047/HIA/T1*. The water features show a marked change in flow between summer and winter as a result of rainfall variations. No long-term changes in the nature of these water features have been observed in relation to the working of the quarry.

3047/HIA/T1: Photographic monitoring locations

Location	Feature	Coordinates
1	Stream in Nant Ddu by quarry entrance	296898 376222
2	Stream in Nant Ddu	296650 375842
3	Headwaters of Nant Ddu stream	296570 375441
4	Pwll Fardre	296473 375245
5	Sinkhole	296820 374680

3047/HIA/T1: Photographic monitoring locations		
Location	**Feature**	**Coordinates**
6	Pond/Spring	297568 376055
7	Pond/Spring	296940 376480
8	Stream at Culvert by the A55	296948 376313

2.2.5 Rainfall

Monthly total rainfall data have been obtained from the NRW gauging station located at Pensarn, approximately 3.5 km northwest of the site (National Grid Reference (NGR) SH 951 788).

Rainfall data was also provided by NRW for a gauge at St Asaph, approximately 2.45 km southeast of the site boundary. However, the monthly mean appears to be heavily skewed by a large number of potentially erroneous zero values, giving long-term averages 10 times lower than the St Asaph values. Hence the data are not included herein.

The long-term average (LTA) monthly rainfall is shown in *Table 3047/HIA/T2*.

3047/HIA/T2: Long-term average monthly rainfall (mm)												
Period	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1997-2020	59	50	44	42	42	46	48	60	57	69	78	81

2.2.6 Surface water abstractions

Licensed abstractions

There are no licensed water abstractions within 2 km of the site boundary.

Unlicensed abstractions

Four private water supplies have been identified within 3 km of the site by Conwy County Borough Council. The locations are presented on *Drawing 3047/HIA/02* and are summarised in *Table 3047/HIA/T3*.

3047/HIA/T3: Unlicensed surface water abstractions				
Reference	**Abstraction source**	**Use**	**Coordinates of abstraction**	**Distance/direction of abstraction from site**
PW4-75	Spring	Domestic	297025 373260	1.7 km S
PW4-76	Spring	Domestic	296978 373233	1.7 km S
Col Archive 37	Spring	Domestic	297472 372134	2.8 km S

3047/HIA/T3: Unlicensed surface water abstractions				
Reference	**Abstraction source**	**Use**	**Coordinates of abstraction**	**Distance/direction of abstraction from site**
PW4-196	Spring	Domestic	298328 372380	2.8 km SW

2.3 Sites of ecological and conservation interest

2.3.1 Statutory sites

There are no statutory sites within 2 km of the site boundary. The entire coastline, c5 km north of the site, is defined as the Liverpool Bay SPA.

Coedydd ac Ogofau Elwy a Meirchion is a designated SAC and SSSI, which is located approximately 5.5 km from the site downstream on the River Elwy.

2.3.2 Non-statutory sites

There are no non-statutory sites within 2 km of the site.

Fragmented priority habitats are present between 1 km and 2 km west and southwest of the site and comprise lowland heathland and grassland.

Great Crested Newts are reportedly present within ponds near to the site.

The locations of these sites are shown on *Drawing 3047/HIA/02*.

2.4 Landfill sites

No active landfill sites exist within a 2 km radius of the site boundary.

There is one historic landfill present 0.7 km southwest of the site at Moelfre and a second 1.3 km to the north at Gofe. The Moelfre landfill was a relatively small site for inert waste and closed at the end of 1990. At Gofe, industrial, commercial and household waste was deposited with the last input in 1985.

The locations of the sites are shown on *Drawing 3047/HIA/02*.

2.5 Geology

2.5.1 Regional

The regional bedrock geology comprises a vertically and laterally extensive sequence of northerly dipping, sedimentary strata of Silurian to Permian age. The oldest strata, the Elwy Formation, comprises predominantly silty mudstones and forms the extensive area of high

ground to the south of the quarry. It is overlain with a marked disconformity by the basal beds of the Carboniferous sequence, the Ffernant Formation. This, in turn, is overlain by the Clwyd Limestone Group, which constitutes the economic mineral at Abergele Quarry.

3047/HIA/T4: Regional stratigraphy				
	Group	**Formation**		**Lithology (thickness)**
Superficial	Quaternary Deposits		Tidal Flat Deposits	Clay, silt, sand
			Alluvium	Clay, silt, sand and gravel
			Till	Diamicton (clay, sand, silt, gravel)
Solid	Permian	Kinnerton Sandstone Formation		Sandstone
	Carboniferous	Coal Measures	Warwickshire Group	Mudstone, siltstone and sandstone
			Clwyd Limestone Group	Limestone
		Ffernant Formation		Mudstone, siltstone and sandstone
	Silurian	Elwy Formation		Silty mudstone and subordinate sandstones

The foot of the escarpment on which the quarry is situated marks the transition to mudstones, siltstones and sandstones of the Warwickshire Group. The Permian Kinnerton Sandstone group occurs further to the north within the coastal plain.

Alluvium and Tidal flats deposits constitute superficial deposits on the coastal plain. Glacial till forms the predominant cover over areas other than the coastal plain, only being absent from isolated areas on top of the escarpment.

Several laterally extensive southwest–northeast and north-south orientated geological faults are present within the Carboniferous Limestone in the vicinity of the quarry. Shorter faults with less displacement are also present, generally running NNE–SSW.

The geological setting is shown on *Drawings 3047/HIA/03a and 3047/HIA/03b*. The geological succession is given in *Table 3047/HIA/T4*.

2.5.2 Local

The Clwyd Limestone Group is the dominant bedrock lithology in the vicinity of the quarry. It is a generally massive limestone with poorly developed bedding. It is described by the BGS as being 'a diverse range of limestone facies with subordinate sandstone and mudstone units.'

No faults cross the site, however the quarry is located within a fault block that closely bounds the site to the northwest (170 m), south (820 m) and east (1 km).

Karstification of the limestone is evidenced by relict caves, which are occasionally encountered within the quarry and sinkholes to its south.

2.6 Hydrogeology

2.6.1 Groundwater levels

Monitoring of groundwater elevations has been undertaken monthly since 2002 at the boreholes shown on *Drawing 3047/HIA/03a*. The data are included within *Appendix 3047/HIA/A1 and* hydrographs are presented on *Drawing 3047/HIA/04*.

The hydrographs for boreholes P1 and P4 show similar average groundwater levels (*Table 3047/HIA/T5*), while levels at P2 are around 35 m lower than P1 and P4. At P3 they are around 40 m higher. A mapped geological fault lies between Borehole P3 and P1/P4; the large difference in groundwater elevation is considered to indicate that the fault acts as a barrier to flow.

A gradual decline in groundwater elevations of approximately 10 m occurred within borehole P3 between 2004 and 2007. In P4 a gradual decline of approximately 20 m was observed between 2007 and 2010. In P2 a rapid decline in groundwater level of approximately 10 m was recorded during 2010. The groundwater level in P1 has remained at a generally consistent elevation since the beginning of monitoring.

An increase in groundwater levels, of approximately 10 m, was recorded in boreholes P1 and P4 in early 2018. Groundwater increased in elevation to such an extent that it was similar to pre-2010 levels. A smaller and more gradual increase was recorded in P2 in late 2017. This response was not observed at Fadre Farm borehole (P4) to the west of the site. It is considered that the observed variations arose due to the progression of quarry workings.

Boreholes P2 and P4 generally follow similar long-term trends, with P1 recording a similar but muted trend. Fluctuations in P3 that are attributable to rainfall can be correlated with the other boreholes.

A rapid decline in groundwater levels occurred within P2, P3 and P4 following May 2022. In P1 the decline was less. This trend is considered to be in response to an extended period of dry weather. The water levels have subsequently increased since June 2023 following an extended wet period. In February 2024 the water level in P1 was the highest recorded, in P2, P3, P4 the water level was the highest since 2021, 2010 and 2013 respectively.

The recorded depth to groundwater indicates that surface water features close to the site are perched above the watertable within the Carboniferous Limestone.

A summary of the monitoring boreholes is given in *Table 3047/HIA/T5*.

3047/HIA/T5: Monitoring borehole data					
Borehole	**Ground level (mAOD)**	**Borehole depth (m)**	**Average water level (mAOD)**	**Maximum water level (mAOD)**	**Minimum water level (mAOD) (excluding 'dry' readings)**
P1	151	115	77.0	83.0	70.0
P2	54	30	42.9	52.8	34.5
P3	148.28	65*	118.9	130.3	111.3
P4	124.32	104	83.5	99.8	73.9
*minimum depth, it is suspected that this depth is the depth of the pump					

2.6.2 Groundwater abstractions

Licensed abstractions

There are no licensed groundwater abstractions within 2 km of the site.

Unlicensed abstractions

Conwy County Borough Council holds records of three unlicensed abstractions (less than 20 m^3/d) within 2 km of the site. Details are provided in *Table 3047/HIA/T6* and their locations are shown on *Drawing 3047/HIA/03a*.

3047/HIA/T6: Unlicensed groundwater abstractions				
Council ref	**Source**	**Purpose**	**Coordinates**	**Distance/direction from extension area**
PW4-244	Clwyd Limestone Group	Domestic	295529 375743	1.1 km W
PW4-157	Clwyd Limestone Group	Domestic	295392 375745	1.2 km W
PW4-243	Clwyd Limestone Group	Domestic	295488 375345	855 m W

Wells on OS mapping

Twenty-one 'wells' have been identified from 1:25,000 OS mapping within a 2 km radius of the site boundary. However, the wells marked on OS maps commonly also include springs and seepages and they do not necessarily indicate that the feature is used for water supply.

The 'wells' can be approximately spilt into two groups; one associated with the northeast facing limestone escarpment that divides the site, and the second to the south of the site, which approximately correlate with faults in the mudstones and siltstones.

In the group associated with the escarpment, the nearest feature is located 65 m west of the site boundary on Fardre Hill. This appears to be a spring that rarely flows; a small amount of flow has been observed following a prolonged period of exceptionally high rainfall, however flow has never been observed subsequently. The feature located 170 m north of the site boundary is a spring and is used as photographic monitoring location 7 (Section 2.2.4). One well, noted as historical/archaeological, is located 450 m northeast of the boundary. Six wells are located around Kinmel Manor between 690 m and 1.5 km east of the site. A well is located 1.8 km southeast of the site near Bryn-y-pin.

The remaining ten 'wells' are located to the south of the site associated with the Ffernant and Elwy Formations. The closest of the wells is located 380 m southwest of the site boundary, at the boundary of the Clwyd Limestone.

2.6.3 Aquifer status

The limestone underlying the site is classified as a Principal Aquifer by NRW. This is defined as rocks that have high intergranular and/or fracture permeability, meaning that they usually provide a high level of water storage. They may support water supply and/or river baseflow on a strategic scale.

The site is not located within a Source Protection Zone (SPZ).

The Till is defined by NRW as a Secondary (Undifferentiated) Aquifer, a category used where it has not been possible to attribute either category A or B to a rock type.

2.7 Features identified by NRW

During discussion with NRW regarding obtaining a transfer licence, a number of water features were identified by NRW in their response on 14th June 2023 as potentially being at risk of impact from the proposed dewatering. These features are addressed below. Their locations are shown on *Drawing 3047/HIA/02*.

3047/HIA/T7: Water features identified by NRW			
Council ref	**Coordinates**	**Distance/direction from extension area**	**Comment**
"Collects" pond at Kinmel Park	297738 375652	535 m NE	Further comment provided below

3047/HIA/T7: Water features identified by NRW			
Council ref	**Coordinates**	**Distance/direction from extension area**	**Comment**
Two wells southwest of Kinmel Hall	298484 374613	1.4 km E	Identified on OS mapping, see Section 2.6.2
St. Georges village well	297249 375875	285 m NE	Further comment provided below
Fadre Farm Borehole	296257 375480	330 m W	Used as monitoring borehole 'P3', see Section 2.6.1
Bryn-y-Pin Mawr Farm borehole	298254 373913	1.5 km SE	Underlain by Elwy Formation
Issues (spring)	295956 374675	540 m SW	Associated with headwaters of Nant y Creigiau
Well	296037 374929	380 m SW	Identified on OS mapping, see Section 2.6.2
Well at Ysguboriau	296806 374165	795 m S	Underlain by Elwy Formation
Well at Ffynnon Wen	296512 374033	860 m S	Identified on OS mapping, see Section 2.6.2
Spring at Glan y Gors	296062 373982	1.0 km SSW	Identified as well on OS mappings, see Section 2.6.2
Well at Ty'n-y-fynnon	295425 374242	1.2 km SW	Identified as well on OS mapping, see Section 2.6.2

'St Georges Well' is the historic well noted on OS mapping in Section 2.6.2. The well was historically associated with the blessing of horses and comprises two asymmetric stone basins, water flows into the smaller basin (for people) and then into the larger basin (for horses). A stone overflow channel conveys water northwards from the larger of the ponds. The well was restored in the 1970s but has since fallen back into disrepair. It is located in the grounds of Kinmel Park and inaccessible to the public.

St Georges village well (as identified in *Table 3047/HIA/T7*) is present on historic OS mapping from the 1870s. The well is located on the edge of St George's Road next to Bryn Iolo, a pond is also indicated nearby. On the OS map published in 1900, the well is still present; however, by the 1950s the well is not present on mapping. Currently, on the side of the road that the well is indicated to be located, is a surface water drainage ditch lined by semi mature trees and a low stone wall. A water mains pipe, which is evident from hydrants, also parallels this side of the road. Visits to the area by Hafren Water personnel following periods of heavy rainfall have not identified any groundwater seepages in the apparent area of the well. The well therefore no longer appears to be present.

The 'Collects' at Kinmel Park is identifiable on historic mapping from the 1870s. The map shows the area as a pond, however from aerial photos the area now appears to comprise boggy/marshy ground. An overflow channel also appears to be present, which would convey water northwards.

The abstractions at Ysguboriau and Bryn-y-Pin Mawr Farm are underlain by the Elwy Formation, which is considered to be an aquiclude beneath the Clwyd Limestone.

2.8 Conceptual hydrogeology

The limestone forms an aquifer, which possesses very low primary porosity but stores and transmits groundwater within fissures and fractures. Although the limestone continues northwards at depth beneath the Permian deposits, the active groundwater system within the limestone is considered likely to be restricted. It extends only from the southern limit of the limestone close to the summit of the escarpment to the south of the quarry, to the point in the north where it is overlain by both superficial and Permian deposits. The latter is an east-west boundary, situated approximately 100-300 m to the north of the site boundary. The base of the active groundwater system in the vicinity of the quarry is taken as the elevation of the base of the escarpment, approximately 40 mAOD, where groundwater discharge from springs is common.

Monitoring borehole data indicates a northwards groundwater flow direction in the immediate vicinity of the quarry. The groundwater elevation recorded at the Fadre Farm borehole to the west of the quarry is significantly higher than all the others. This borehole is situated on the opposite side of a major fault to the quarry, from which it can be inferred that the fault forms a low permeability barrier. The geological faults in the area are therefore considered to laterally restrict the influence of the quarry.

Rainfall occurring directly on to the limestone and run-off from low permeability strata to the south of the quarry will recharge the aquifer. The presence of Diamicton over the majority of the limestone will significantly reduce the volume of recharge that can occur. On the basis of the limited area of the limestone outcrop and the restricted recharge due to the superficial geology it is considered that the total volume of groundwater within the mass of the limestone will be relatively small.

The characteristics of the lithology and the presence of several large faults in the vicinity of the quarry are such that the site is located within a discrete aquifer block, which is relatively small and hydraulically isolated.

3 PERMITTED DEVELOPMENT

3.1 Mineral extraction

The current permissions allow limestone extraction to a depth of 58 mAOD. The next stage of mineral extraction will be undertaken in four phases. The initial phase will comprise the deepening of the existing void to 58 mAOD. This will provide sufficient void space to enable overburden stripped from subsequent phases to be placed within the void. The overburden will be placed within the void to restore it to calcareous grassland. Mineral extraction will subsequently progress southwards in three phases, with stripped overburden being placed behind the advancing extraction. Mineral will be transported to the conveyor system by dumper.

The phasing of the permitted extraction is shown in *Appendix 3047/HIA/A2*.

3.2 Restoration

Restoration of the quarry is undertaken concurrently with mineral extraction and is progressing southwards. The quarry void will be backfilled to approximately 60 mAOD, with overburden also placed in the northeast and southwest extent of the site as embankments across the benches to create shallower, more natural-looking gradients. The site will be returned to calcareous grassland. A waterbody will be allowed to form at the base of the void.

The restoration plan is shown in *Appendix 3047/HIA/A3*.

3.3 Water management

3.3.1 During mineral extraction

a) Current

Water management can be sub-divided into two areas. Within the active mineral extraction area, the quarry void is free-draining. The floor of the quarry is currently situated above the watertable and the characteristics of the lithology are such that rainfall-derived water dissipates naturally to the underlying strata; the limestone is fractured and fissured, with occasional enlarged features being encountered during working.

To the north of St Georges Road, surface water flows northwards through the plant site and stockpile areas by gravity, to a lagoon system, where it is temporarily stored. All site drainage water exits the site eastwards, via the consented discharge point, from where it enters the local surface water drainage system.

Details of the discharge consent are shown on the plan in *Appendix 3047/HIA/A4*.

b) Future, sub-watertable working

When working beneath the watertable, vertical dissipation of water from the quarry void will be precluded and active management will be required. The volumes of water to be managed, derived from rainfall and groundwater, have been calculated, as discussed below.

i) *Average water ingress volumes*

The volume of rainfall-derived water entering the quarry void at the maximum extent of permitted development has been calculated using the Rational Method and is given in *Table 3047/HIA/T7*. Multiplying the rainfall catchment by the total rainfall gives a worst-case (ie maximum) volume of water.

The volume of groundwater ingress has been calculated using estimates of hydraulic conductivities representative of limestones and standard analytical methods. The groundwater ingress, at the maximum extent of quarry development, and using a hydraulic conductivity of 0.5 m/day is estimated to be 16 l/s. The calculation method, data and outputs are included in *Appendix 3047/HIA/A5*.

The calculated total average volume of water ingress to the quarry void at the maximum extent of permitted development is 22.1 l/s which equates to 1,908 m³/day. Discharge of water would be to the Nant Ddu Stream.

ii) *Ingress during storm events*

Water inflow to the quarry void has been calculated for a 24-hour duration, 1 in 10-year storm event and a 16-hour, 1 in 2-year storm event. A maximum discharge rate of 60 l/s will be adopted (approximately one 6" pump). Where inflow during a storm event exceeds the discharge rate, the excess water would temporarily be stored within the quarry void.

Storm inflow volumes are shown in *Appendix 3047/HIA/A6* and summarised in *Table 3047/HIA/T8*.

3047/HIA/T8: Required water storage volume during storm events			
Storm event return period	**Duration (hrs)**	**Net run-off (l/s)**	**Required storage (m³)**
1 in 10-year	24	139	12027
1 in 2-year	16	111	6402

3.3.2 Following restoration

After the cessation of mineral extraction active water management will cease and the quarry void will start to fill with water. It is anticipated that it will fill to a level of 74 mAOD, based upon groundwater monitoring data.

Rainfall within the restored landscape in the south of the quarry will all flow to the waterbody. Hydraulic continuity between the waterbody and unworked limestone will be retained so that its water level will naturally regulate.

4 ASSESSMENT OF IMPACTS

4.1 Methodology

An assessment of the potential effects of the proposed dewatering on the water environment within the site and its surrounds has been undertaken.

Potential impacts to the baseline and current conditions were assessed. Short-term (operational) and long-term (post-restoration) phases of site development were considered. The following factors were considered:

- Magnitude of the impact
- Spatial extent of the impact
- Frequency of the impacts
- Timescale over which the impact may occur
- Cumulative impacts
- Sensitivity of the receiving environment

Mitigation measures and residual impacts have been considered as part of the assessment. The method of assessment is detailed in *Appendix 3047/HIA/A7* together with the matrices used to provide a robust method of assessment. Mitigation measures and residual impacts are discussed in Section 5.

4.2 Baseline sensitivity

The characteristics of the baseline water environment have been used to form a basis on which the impact assessment can be undertaken.

The site is located within the catchment of the River Gele. At its closest approach the River Gele is approximately 2 km from the site. A stream, the Nant Ddu, parallels the western site boundary and ultimately discharges into the River Gele, via a pumping station. No water-dependent statutory sites of ecological interest are located within 1 km downstream of the site extension. Great Crested Newts are reportedly present within nearby ponds. There are no surface water abstractions within 2 km of the site.

The site is located on the Clwyd Limestone Formation, which is designated as a Principal Aquifer by NRW. The Till in the area is identified as a Secondary (Undifferentiated) Aquifer. There are no licensed groundwater abstractions within 2 km of the site. Wells and springs are frequent along the limestone escarpment, however those down-gradient of the site are not used as a water supply and do not supply ecologically sensitive sites.

Based on the above hydrological, hydrogeological and environmental factors, and using the criteria detailed in *Appendix 3047/HIA/A7, it is considered that the baseline catchment sensitivity is 'Low'.*

4.3 Potential impacts during mineral extraction

4.3.1 Comment

Two situations have been assessed: working above and below the watertable. The nature of drainage within the quarry void will change as soon as sub-watertable working commences as its current, free-draining characteristics will no longer apply and active water management will be required.

4.3.2 Surface water flows

Current

Active water management is not undertaken on-site, therefore there is no means for site operations to impact surface water flows.

The surface waters are of 'Low' sensitivity. Potential impacts are 'Negligible' in magnitude; therefore the significance of potential impact is classed as 'None'.

Sub-watertable

The watercourses and waterbodies in the vicinity of the site are not in hydraulic continuity with groundwater within the limestone. Therefore, working beneath the watertable is not anticipated to impact flows. Discharge of water will be controlled by a discharge consent and a trigger level system, which will mitigate any impacts of increasing flows.

The surface waters are of 'Low' sensitivity. Potential impacts are 'Negligible' in magnitude; therefore the significance of potential impact is classed as 'None'.

4.3.3 Surface water abstractions

Current and sub-watertable

There are no surface water abstractions within 2 km of the site, *therefore the significance of potential impact is classed as 'None'.*

4.3.4 Groundwater levels

Current

A detailed analysis of groundwater levels is undertaken within the 3-yearly monitoring reports, which are submitted to the Planning Authority. The latest 3-yearly monitoring report

(1742/MON-21, February 2021) identified that groundwater levels since 2002, when monitoring began, are primarily related to variations in rainfall, with minor variations due to changes in the geometry of the aquifer as mineral extraction has progressed.

It is considered that the impact on groundwater levels is 'Low' and the significance of effect 'Minor'. No mitigation measures are considered necessary.

Sub-watertable

As mineral extraction proceeds beneath the watertable groundwater flow will be induced into the quarry void and there would be an accompanying reduction in groundwater levels in the surrounding limestone. However, the distance over which these effects could occur would be limited due to the quarry being situated in a discrete aquifer block. The watercourses in the area are located above the watertable and therefore would not be impacted by lowering of the groundwater level.

The spring adjacent to the western site boundary is considered likely to be associated with the discharge of perched groundwater.

St Georges Well and the springs to the north of the site are all considered to be down-gradient; however these features are self-contained and do not provide supply to abstractions or ecologically sensitive sites. Furthermore, two of these locations are used as photographic monitoring locations, which would enable any impacts to be realised.

The three wells at Kinmel Manor are across groundwater gradient and are therefore at a lower risk from the effects of dewatering. Furthermore, Kinmel Manor has remained empty since 2001, therefore it is considered unlikely that the wells are in use. The 'collects' located in the grounds of Kinmel Park appear to have largely silted up. These are therefore considered to not be sensitive receptors.

All of the other features identified within the area are either located on the opposite side of a fault, which are interpreted to be acting as barriers to flow, or are located on the mudstone and siltstone strata, and are therefore not in hydraulic continuity with the site.

It is considered that the impact on groundwater levels is 'Low' and the significance of effect 'Minor'. No mitigation measures are considered necessary.

4.3.5 Designated sites of ecological interest

Current and sub-watertable

The watercourses and waterbodies in the area are considered to be perched above the groundwater. There are no water-dependent sites of ecological interest within a 2 km radius of the site.

The magnitude of impact is considered to be 'Negligible' and the significance of potential impact is classed as 'None'.

4.4 Potential impacts following restoration

4.4.1 Groundwater levels

Once active water management has ceased groundwater levels will start to recover to their pre-development levels. Although their final rest groundwater levels may differ slightly from the pre-development situation, due to presence of the void, the small magnitude of change and absence of groundwater-supported features is such that the significance of any variation will be extremely small.

The magnitude of impact on long-term groundwater levels is considered to be 'Low' therefore the significance of potential impact is classed as 'Minor'.

4.4.2 Groundwater flow

Clayey overburden will be placed within the quarry void to restore the site. This is considered likely to have a lower bulk hydraulic conductivity than the limestone. However, the overburden would only be placed on the base of the quarry and on two sides of the void. Groundwater would therefore be able to flow around the overburden, and as such groundwater flow would not be impeded.

The magnitude of impact on long-term surface water flows is considered to be 'Low' therefore the significance of potential impact is classed as 'Minor'.

5 MITIGATION MEASURES, RESIDUAL IMPACTS and CUMULATIVE IMPACTS

5.1 Introduction

Potential impacts of the permitted works on the water environment have been assessed, as discussed above. Where potential impacts have been identified, mitigation measures are proposed as below.

5.2 During mineral extraction

5.2.1 Photographic monitoring

The photographic monitoring scheme at the nearby surface water features will continue to be undertaken for the duration of mineral extraction. The surveys will continue to be undertaken during summer and winter, and monitoring reports will be submitted three-yearly.

5.2.2 Groundwater monitoring plan

Groundwater monitoring is currently undertaken monthly at four boreholes; the results are presented and discussed in the three-yearly report.

Borehole P1 will be lost during the lateral extension of the quarry, therefore a replacement location is proposed. An additional groundwater monitoring borehole is proposed to the east of the site to improve lateral coverage. Details of the proposed boreholes are provided in *Table 3047/HIA/T9*. Monitoring of the new boreholes would be undertaken monthly, and the results reported within the three-yearly monitoring report.

3047/HIA/T9: Proposed monitoring borehole locations			
Borehole	**Coordinates**	**Proposed depth***	**Comment**
P5	296598 375125	88 mbgl (55 mAOD)	Replacement for P1
P6	297149 375152	105 mbgl (55m mAOD)	Provide coverage to east of extraction area
*Ground elevation estimated			

Three-yearly monitoring reports are currently produced for the site which includes assessment of groundwater levels and photographic monitoring of surface water features. It is proposed to produce the reports annually for the first 3 years after the commencement of dewatering. At the end of the first period, an assessment will be undertaken to determine whether returning to the existing 3 yearly monitoring cycle would be suitable or whether an updated scheme of monitoring needed to be agreed to allow the effects of dewatering to be monitored.

5.3 Cumulative impacts

There are no other quarries or proposed large developments in the vicinity to be considered in assessing any cumulative effects on the water environment.

6 SUMMARY AND CONCLUSIONS

Limestone has been extracted at Abergele Quarry for many decades. Mineral extraction is currently undertaken above the watertable; however Planning Permission exists to extract to an elevation of 58 mAOD, which is below it. This report has been prepared in support of a transfer licence application to enable dewatering of the quarry.

The site is located on an escarpment comprising the Clwyd Limestone Group. The limestone is fractured, which currently allows effective drainage of rainwater through the quarry floor. Karstic features are present within the limestone, however these are situated above the watertable and are sediment filled.

Water management requirements will change when working beneath the watertable; it will be necessary to discharge larger volumes of water off-site. The volumes of water at the maximum extent of quarry development have been calculated and are discussed within the report. It will be necessary to provide temporary storage within the quarry void for water generated during storm events, to allow discharge off-site at an acceptable, regulated rate.

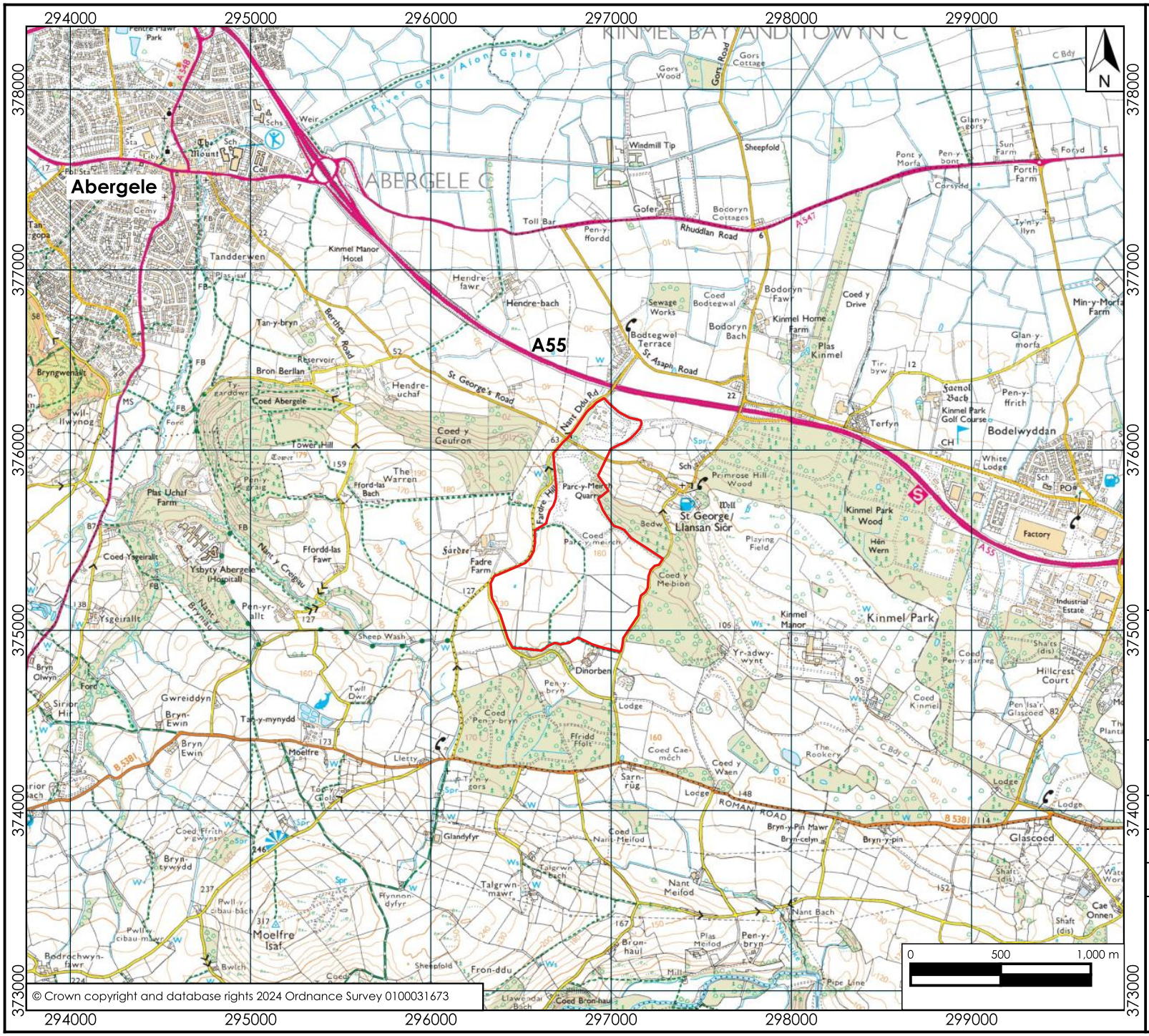
An assessment of impacts of the current operations and future sub-watertable extraction has been undertaken. Potential impacts have been assessed against the current conditions around the site, while impacts following restoration have been assessed against the pre-development condition.

The overall effects of dewatering on the water environment are generally benign, due to the hydrogeological compartmentalisation of the aquifer, absence of abstractions down-gradient of the site and the perched nature of nearby surface water features. This results in no, or minimal, hydraulic continuity between the site and nearby receptors. The continuation of the good working methods currently adopted, and modification of the water management system to accommodate larger volumes of water, will ensure that future working can be undertaken without detriment to the water environment.

The extant photographic monitoring program will continue to be undertaken throughout the lifetime of the quarry, which will enable any impacts to nearby water features to be identified. New monitoring boreholes have been proposed to ensure that the network will provide representative data to assess any effects of dewatering.

After the completion of mineral extraction active water management will cease and this, combined with re-vegetation of the site, will ensure that the long-term effects on water features will be minimal.

DRAWINGS



Legend

Site Boundary

Scale correct at A4

Client	Heidelberg Materials UK
Title	Site Location
Project	Abergele Quarry
Drawing	3047/HIA/01
Version	1
Date	Jan 2024
Scale	1:30,000

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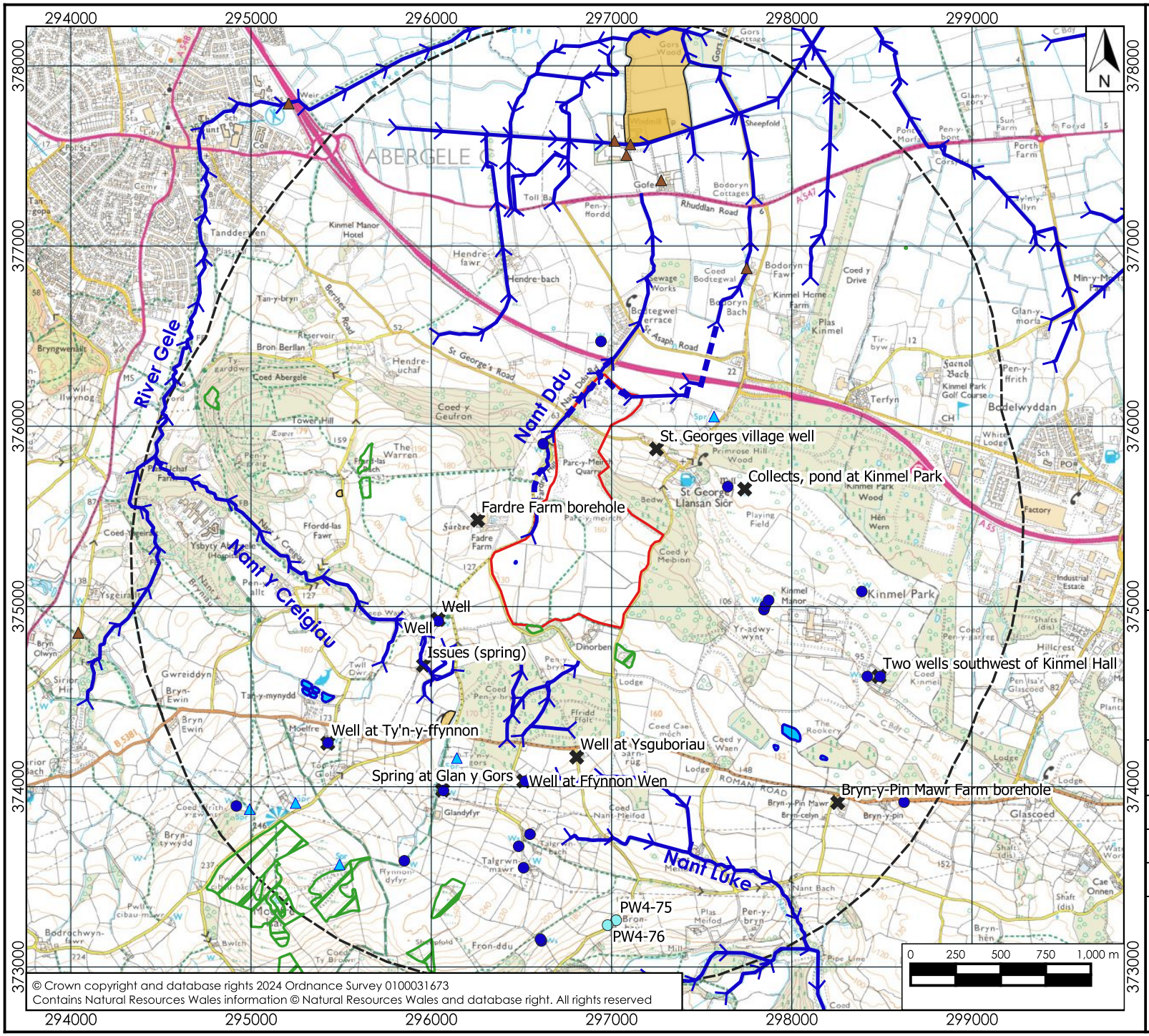

Legend

- Site Boundary
- 2km Buffer
- Priority Habitat
- Historic Landfill
- Discharge Consent

Water Features

- Waterbody
- Spring
- Well (from OS mapping)
- Watercourse
- Culvert
- Private Water Supply (Spring)
- Water feature identified by NRW

Scale correct at A4

Client	Heidelberg Materials UK
Title	Water Features & Designated Sites
Project	Aberegele Quarry
Drawing	3047/HIA/02
Version	2
Date	Jan 2024
Scale	1:30,000

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293000 294000 295000 296000 297000 298000 299000 300000

378000 377000 376000 375000 374000

Approx. Line of Section

ABERGELE

PW4-157 PW4-244 PW4-243 P1 P2 P3 P4

0 1,000 2,000 m

N

Legend

- Site Boundary
- Monitoring Borehole
- Private Well

Bedrock Geology

- Fault Inferred
- Kinnerton Sandstone Formation
- Warwickshire Group
- Clwyd Limestone Group
- Ffernant Formation
- Elwy Formation

Cross Section Key
d5-6 - Coal Measures
d3a - Clwyd Limestone Group
b7a - Elwy Formation
b6a - Denbigh Grits Formation

SECTION 1

W.12°S. E.12°N. W.1°S. E.1°N.

Pant Farm Bryn-y-Maen Llysfaen R.Dulas Cefn-yr-ogof ABERGELE Glan-y-gors R. Clwyd Marian Cwm Pwllhalog

Vale of Clwyd

SEA LEVEL -1200 FEET

Not to Scale

Approximate Site Location

Scale correct at A3

Client	Heidelberg Materials UK
Title	Regional Bedrock Geology
Project	Abergele Quarry
Drawing	3047/HIA/3a
Version	2
Date	Jan 2024
Scale	1:25,000

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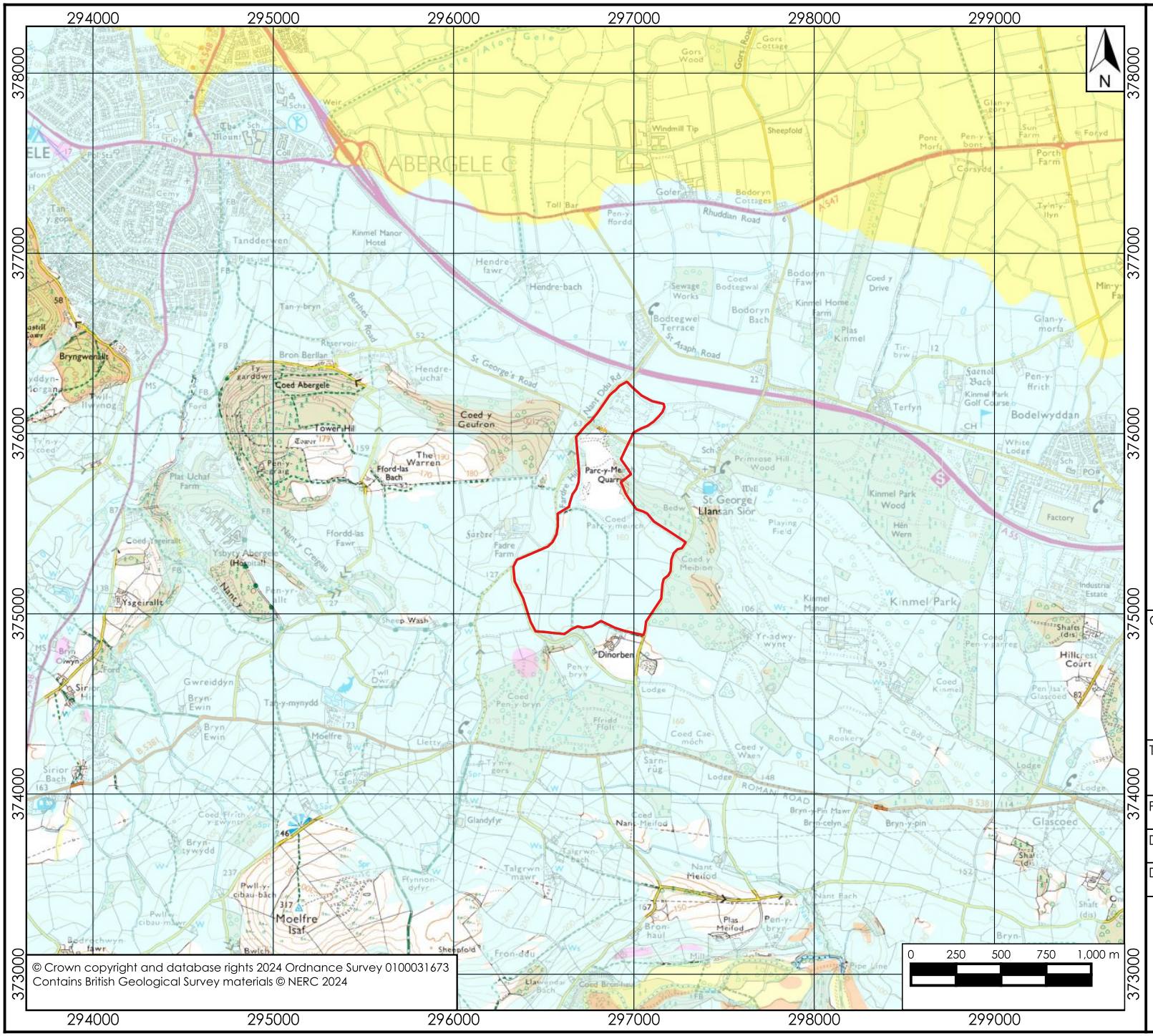

Legend

- Site Boundary

Superficial Deposits

- Alluvium
- Till (Diamicton)
- Glaciofluvial Deposits

Scale correct at A4

Client	Heidelberg Materials UK
Title	Superficial Geology
Project	Abergele Quarry
Drawing	3047/HIA/03b
Version	2
Date	Jan 2024
Scale	1:30,000

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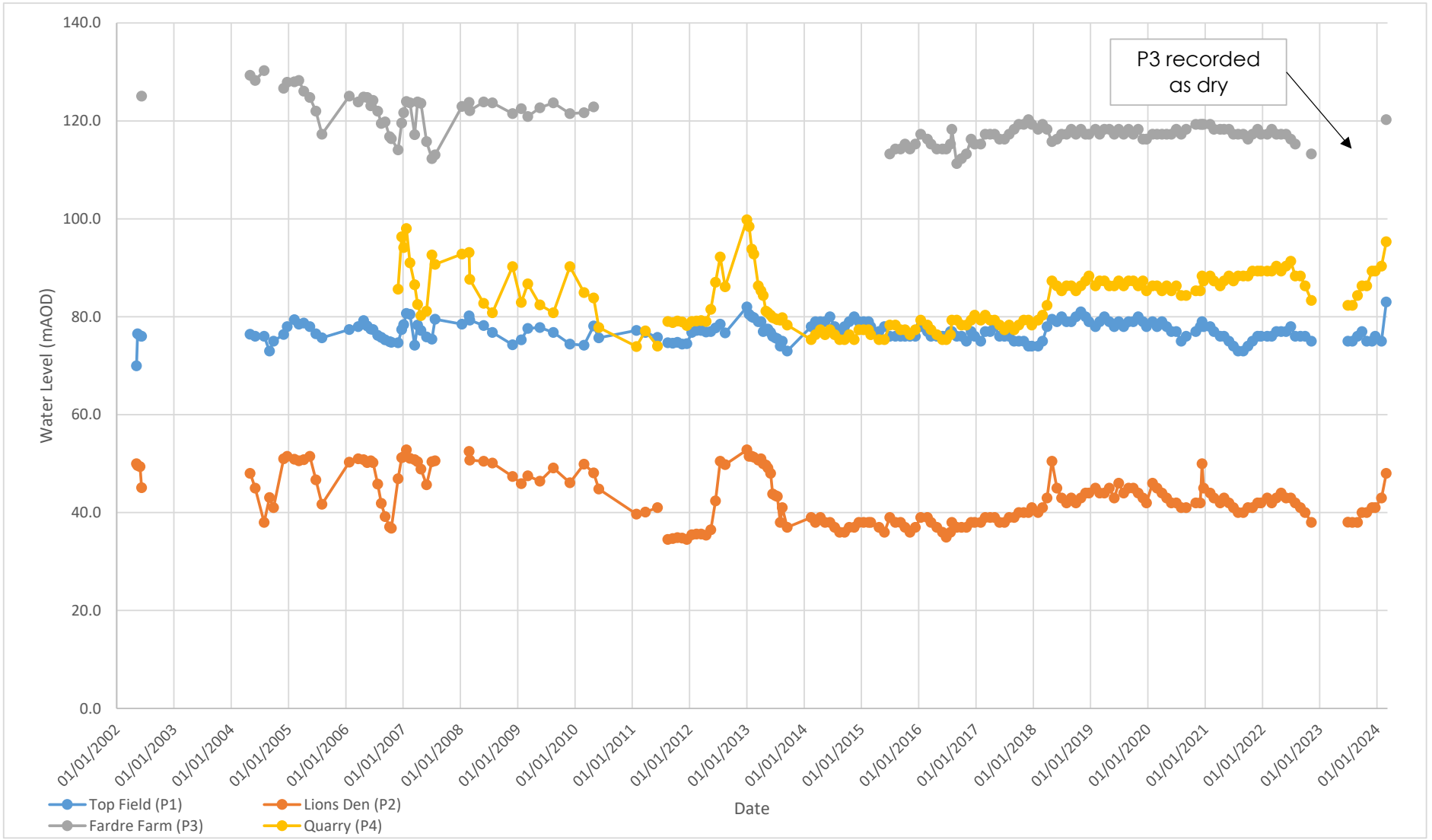

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Client	Heidelberg Materials UK
Title	Groundwater Hydrographs 2002 - 2024
Project	Abergele Quarry
Drawing	3047/HIA/04
Version	3
Date	Apr-24
Scale	N/A

APPENDIX 3047/HIA/A1

Groundwater level data

	Top field		Lions Den		Fardre Farm		Quarry	
Piezo no.	**P1**		**P2**		**P3**		**P4**	
Easting	**296733**		**296784**		**296220**		**297009**	
Northing	**375091**		**376006**		**375480**		**375535**	
Cap (mAOD)	**151**		**54**		**148.28**		**124.323**	
Date	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**	**Depth to water (m)**	**Groundwater level (mAOD)**
07/05/2002	81.0	**70.0**	4.0	**50.0**				
14/05/2002	74.5	**76.5**	4.4	**49.6**				
30/05/2002	74.9	**76.1**	4.6	**49.4**				
08/06/2002	75.0	**76.0**	8.9	**45.1**	23.2	**125.1**		
01/05/2004	74.6	**76.4**	6.0	**48.0**	19	**129.3**		
01/06/2004	75.0	**76.0**	9.0	**45.0**	20.0	**128.3**		
29/07/2004	75.0	**76.0**	16.0	**38.0**	18.0	**130.3**		
01/09/2004	78.0	**73.0**	10.9	**43.1**				
26/09/2004	76.0	**75.0**	13.0	**41.0**				
30/11/2004	74.6	**76.4**	3.0	**51.0**	21.6	**126.7**		
23/12/2004	73.0	**78.0**	2.5	**51.5**	20.4	**127.9**		
07/02/2005	71.6	**79.4**	3.1	**50.9**	20.3	**128.0**		
07/03/2005	72.5	**78.5**	3.4	**50.6**	20.0	**128.3**		
07/04/2005	72.3	**78.7**	3.2	**50.8**	22.2	**126.1**		
16/05/2005	73.0	**78.0**	2.5	**51.5**	23.5	**124.8**		
24/06/2005	74.5	**76.5**	7.3	**46.7**	26.3	**122.0**		
01/08/2005	75.3	**75.7**	12.3	**41.7**	31.0	**117.3**		
23/01/2006	73.6	**77.4**	3.7	**50.3**	23.2	**125.1**		
20/03/2006	73.0	**78.0**	3.0	**51.0**	24.4	**123.9**		
24/04/2006	71.8	**79.2**	3.2	**50.8**	23.4	**124.9**		
16/05/2006	72.9	**78.1**	3.8	**50.2**	23.5	**124.8**		
08/06/2006	73.5	**77.5**	3.4	**50.6**	25.2	**123.1**		
23/06/2006	73.6	**77.4**	3.8	**50.2**	24.1	**124.2**		
22/07/2006	74.8	**76.2**	8.2	**45.8**	26.3	**122.0**		
15/08/2006	75.2	**75.8**	12.1	**41.9**	28.8	**119.5**		
08/09/2006	75.7	**75.3**	14.8	**39.2**	28.5	**119.8**		
06/10/2006	76.1	**74.9**	16.9	**37.1**	31.5	**116.8**		
18/10/2006	76.2	**74.8**	17.2	**36.8**	31.9	**116.4**		
29/11/2006	76.3	**74.7**	7.1	**46.9**	34.2	**114.1**	38.7	**85.6**
22/12/2006	73.6	**77.4**	2.8	**51.2**	28.7	**119.6**	28.0	**96.3**
05/01/2007	72.6	**78.4**	2.6	**51.4**	26.6	**121.7**	30.2	**94.1**
22/01/2007	70.3	**80.7**	1.2	**52.8**	24.3	**124.0**	26.3	**98.0**
14/02/2007	70.5	**80.5**	2.9	**51.1**	24.6	**123.7**	33.3	**91.0**
15/03/2007	76.8	**74.2**	3.2	**50.8**	31.1	**117.2**	37.8	**86.5**
03/04/2007	72.7	**78.3**	3.6	**50.4**	24.4	**123.9**	41.8	**82.5**
25/04/2007	73.8	**77.2**	5.1	**48.9**	24.7	**123.6**	44.1	**80.2**
30/05/2007	75.1	**75.9**	8.3	**45.7**	32.5	**115.8**	43.2	**81.1**
03/07/2007	75.6	**75.4**	3.6	**50.4**	36.0	**112.3**	31.7	**92.6**
24/07/2007	71.5	**79.5**	3.4	**50.6**	35.2	**113.1**	33.6	**90.7**
11/01/2008	72.5	**78.5**			25.3	**123.0**	31.5	**92.8**
25/02/2008	70.8	**80.2**	1.5	**52.5**	24.5	**123.8**	31.2	**93.1**
01/03/2008	71.7	**79.3**	3.3	**50.7**	26.2	**122.1**	36.7	**87.6**
28/05/2008	72.8	**78.2**	3.5	**50.5**	24.4	**123.9**	41.6	**82.7**
23/07/2008	74.2	**76.8**	3.9	**50.1**	24.6	**123.7**	43.5	**80.8**
29/11/2008	76.7	**74.3**	6.6	**47.4**	26.8	**121.5**	34.1	**90.2**
23/01/2009	75.7	**75.3**	8.1	**45.9**	25.8	**122.5**	41.4	**82.9**
06/03/2009	73.4	**77.6**	6.5	**47.5**	27.4	**120.9**	37.6	**86.7**
21/05/2009	73.2	**77.8**	7.6	**46.4**	25.6	**122.7**	41.9	**82.4**
15/08/2009	74.2	**76.8**	4.9	**49.1**	24.6	**123.7**	43.5	**80.8**
29/11/2009	76.6	**74.4**	7.9	**46.1**	26.8	**121.5**	34.1	**90.2**
27/02/2010	76.8	**74.2**	4.1	**49.9**	26.6	**121.7**	39.4	**84.9**
30/04/2010	72.9	**78.1**	5.9	**48.1**	25.4	**122.9**	40.5	**83.8**
01/06/2010	75.3	**75.7**	9.2	**44.8**			46.5	**77.8**
27/01/2011	73.8	**77.2**	14.3	**39.7**			50.4	**73.9**
25/03/2011	74.2	**76.8**	13.9	**40.1**			47.2	**77.1**
11/06/2011	75.2	**75.8**	13.0	**41.0**			50.3	**74.0**
15/07/2011								

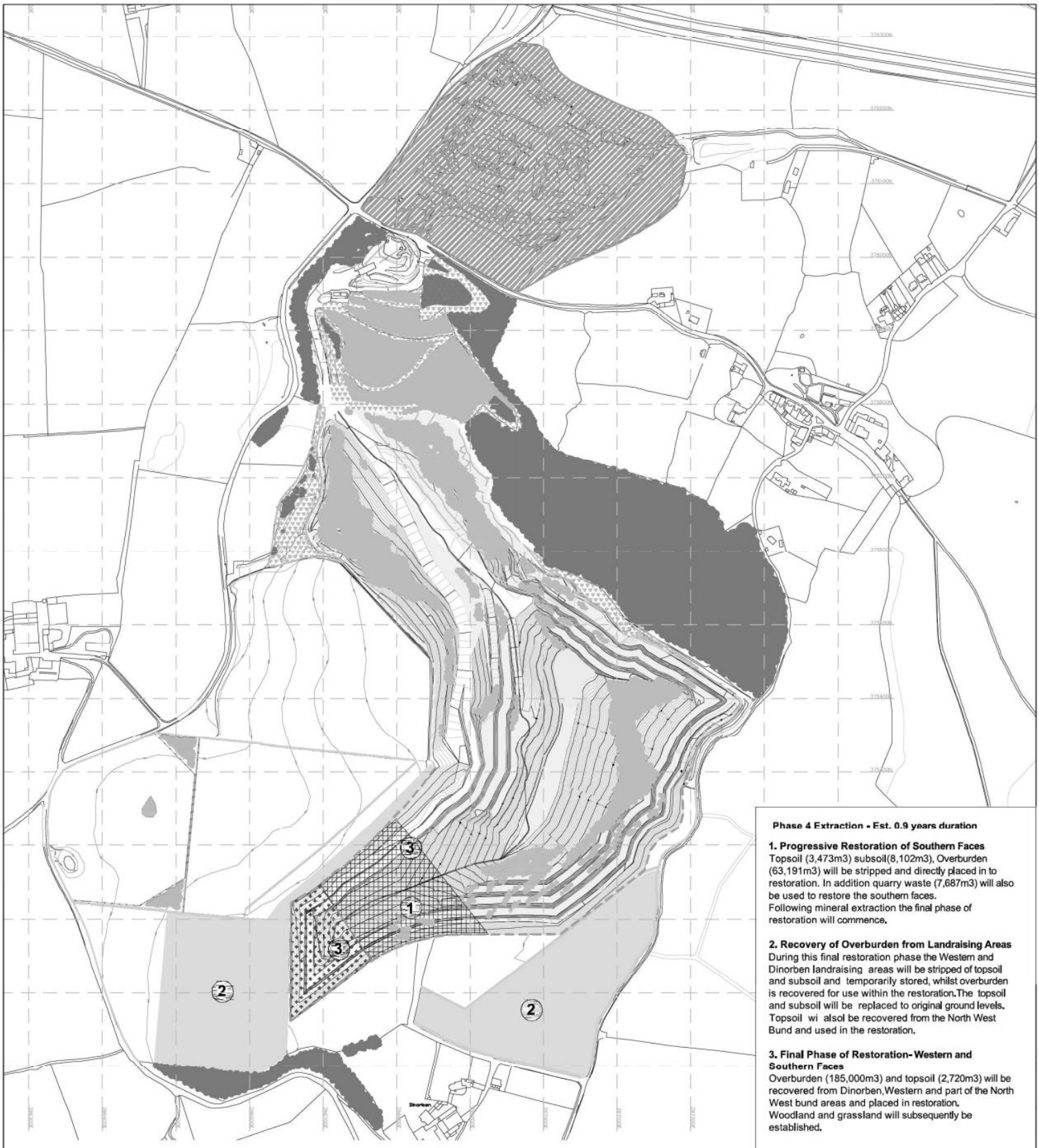
15/08/2011	76.3	**74.7**	19.5	**34.5**			45.3	**79.0**
15/09/2011	76.4	**74.6**	19.3	**34.7**			45.5	**78.8**
15/10/2011	76.2	**74.8**	19.1	**34.9**			45.2	**79.1**
15/11/2011	76.6	**74.4**	19.2	**34.8**			45.4	**78.9**
15/12/2011	76.5	**74.5**	19.5	**34.5**			46.1	**78.2**
15/01/2012	74.2	**76.8**	18.5	**35.5**			45.3	**79.0**
14/02/2012	73.8	**77.2**	18.4	**35.6**			45.2	**79.1**
15/03/2012	73.8	**77.2**	18.4	**35.6**			45.1	**79.2**
15/04/2012	74.1	**76.9**	18.6	**35.4**			45.3	**79.0**
15/05/2012	74.0	**77.0**	17.5	**36.5**			42.8	**81.5**
15/06/2012	73.3	**77.7**	11.6	**42.4**			37.3	**87.0**
15/07/2012	72.5	**78.5**	3.5	**50.5**			32.1	**92.2**
15/08/2012	74.3	**76.7**	4.2	**49.8**			38.2	**86.1**
01/01/2013	69.0	**82.0**	1.2	**52.8**			24.5	**99.8**
14/01/2013	70.5	**80.5**	2.5	**51.5**			25.9	**98.4**
01/02/2013	71.0	**80.0**	2.5	**51.5**			30.5	**93.8**
14/02/2013	71.2	**79.8**	2.7	**51.3**			31.5	**92.8**
14/03/2013	72.0	**79.0**	3.3	**50.7**			38.0	**86.3**
01/04/2013	72.0	**79.0**	3.0	**51.0**			39.0	**85.3**
14/04/2013	74.0	**77.0**	4.0	**50.0**			40.0	**84.3**
01/05/2013	73.5	**77.5**	4.3	**49.7**			43.2	**81.1**
15/05/2013	73.5	**77.5**	4.9	**49.1**			43.5	**80.8**
01/06/2013	74.2	**76.8**	6.0	**48.0**			44.0	**80.3**
14/06/2013	75.0	**76.0**	10.2	**43.8**			44.5	**79.8**
01/07/2013	75.3	**75.7**	10.5	**43.5**			44.7	**79.6**
14/07/2013	75.5	**75.5**	10.7	**43.3**			44.9	**79.4**
01/08/2013	77.0	**74.0**	16.0	**38.0**			45.0	**79.3**
14/08/2013	76.0	**75.0**	13.0	**41.0**			44.5	**79.8**
14/09/2013	78.0	**73.0**	17.0	**37.0**			46.0	**78.3**
14/02/2014	73.0	**78.0**	15.0	**39.0**			49.0	**75.3**
14/03/2014	72.0	**79.0**	16.0	**38.0**			48.0	**76.3**
14/04/2014	72.0	**79.0**	15.0	**39.0**			47.0	**77.3**
14/05/2014	72.0	**79.0**	16.0	**38.0**			48.0	**76.3**
14/06/2014	71.0	**80.0**	16.0	**38.0**			47.0	**77.3**
14/07/2014	73.0	**78.0**	17.0	**37.0**			48.0	**76.3**
15/08/2014	74.0	**77.0**	18.0	**36.0**			49.0	**75.3**
15/09/2014	73.0	**78.0**	18.0	**36.0**			49.0	**75.3**
15/10/2014	72.0	**79.0**	17.0	**37.0**			48.0	**76.3**
15/11/2014	71.0	**80.0**	17.0	**37.0**			49.0	**75.3**
15/12/2014	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
15/01/2015	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
15/02/2015	72.0	**79.0**	16.0	**38.0**			47.0	**77.3**
01/03/2015	73.0	**78.0**	16.0	**38.0**			48.0	**76.3**
23/04/2015	74.0	**77.0**	17.0	**37.0**			49.0	**75.3**
27/05/2015	73.0	**78.0**	18.0	**36.0**			49.0	**75.3**
30/06/2015	75.0	**76.0**	15.0	**39.0**	35.0	**113.3**	46.0	**78.3**
05/08/2015	75.0	**76.0**	16.0	**38.0**	34.0	**114.3**	46.0	**78.3**
07/09/2015	75.0	**76.0**	16.0	**38.0**	34.0	**114.3**	47.0	**77.3**
05/10/2015	75.0	**76.0**	17.0	**37.0**	33.0	**115.3**	47.0	**77.3**
06/11/2015	75.0	**76.0**	18.0	**36.0**	34.0	**114.3**	48.0	**76.3**
11/12/2015	75.0	**76.0**	17.0	**37.0**	33.0	**115.3**	47.0	**77.3**
14/01/2016	73.0	**78.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**
26/02/2016	74.0	**77.0**	15.0	**39.0**	32.0	**116.3**	46.0	**78.3**
19/03/2016	75.0	**76.0**	16.0	**38.0**	33.0	**115.3**	47.0	**77.3**
25/04/2016	75.0	**76.0**	17.0	**37.0**	34.0	**114.3**	48.0	**76.3**
31/05/2016	75.0	**76.0**	18.0	**36.0**	34.0	**114.3**	49.0	**75.3**
24/06/2016	75.0	**76.0**	19.0	**35.0**	34.0	**114.3**	49.0	**75.3**
22/07/2016	74.0	**77.0**	18.0	**36.0**	33.0	**115.3**	48.0	**76.3**
30/07/2016	74.0	**77.0**	16.0	**38.0**	30.0	**118.3**	45.0	**79.3**
31/08/2016	75.0	**76.0**	17.0	**37.0**	37.0	**111.3**	45.0	**79.3**
30/09/2016	75.0	**76.0**	17.0	**37.0**	36.0	**112.3**	46.0	**78.3**
31/10/2016	76.0	**75.0**	17.0	**37.0**	35.0	**113.3**	46.0	**78.3**
30/11/2016	74.0	**77.0**	16.0	**38.0**	32.0	**116.3**	45.0	**79.3**
23/12/2016	75.0	**76.0**	16.0	**38.0**	33.0	**115.3**	44.0	**80.3**
31/01/2017	76.0	**75.0**	16.0	**38.0**	33.0	**115.3**	45.0	**79.3**
28/02/2017	74.0	**77.0**	15.0	**39.0**	31.0	**117.3**	44.0	**80.3**
31/03/2017	74.0	**77.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**
29/04/2017	73.0	**78.0**	15.0	**39.0**	31.0	**117.3**	45.0	**79.3**

31/05/2017	75.0	**76.0**	16.0	**38.0**	32.0	**116.3**	46.0	**78.3**
30/06/2017	75.0	**76.0**	16.0	**38.0**	32.0	**116.3**	47.0	**77.3**
31/07/2017	75.0	**76.0**	15.0	**39.0**	31.0	**117.3**	46.0	**78.3**
31/08/2017	76.0	**75.0**	15.0	**39.0**	30.0	**118.3**	47.0	**77.3**
30/09/2017	76.0	**75.0**	14.0	**40.0**	29.0	**119.3**	46.0	**78.3**
31/10/2017	76.0	**75.0**	14.0	**40.0**	29.0	**119.3**	45.0	**79.3**
30/11/2017	77.0	**74.0**	14.0	**40.0**	28.0	**120.3**	45.0	**79.3**
22/12/2017	77.0	**74.0**	13.0	**41.0**	29.0	**119.3**	46.0	**78.3**
31/01/2018	77.0	**74.0**	14.0	**40.0**	30.0	**118.3**	45.0	**79.3**
28/02/2018	76.0	**75.0**	13.0	**41.0**	29.0	**119.3**	44.0	**80.3**
29/03/2018	73.0	**78.0**	11.0	**43.0**	30.0	**118.3**	42.0	**82.3**
30/04/2018	71.5	**79.5**	3.5	**50.5**	32.5	**115.8**	37.0	**87.3**
31/05/2018	72.0	**79.0**	9.0	**45.0**	32.0	**116.3**	38.0	**86.3**
30/06/2018	71.0	**80.0**	11.0	**43.0**	31.0	**117.3**	39.0	**85.3**
31/07/2018	72.0	**79.0**	12.0	**42.0**	31.0	**117.3**	38.0	**86.3**
31/08/2018	72.0	**79.0**	11.0	**43.0**	30.0	**118.3**	38.0	**86.3**
29/09/2018	71.0	**80.0**	12.0	**42.0**	31.0	**117.3**	39.0	**85.3**
31/10/2018	70.0	**81.0**	11.0	**43.0**	30.0	**118.3**	38.0	**86.3**
30/11/2018	71.0	**80.0**	10.0	**44.0**	31.0	**117.3**	37.0	**87.3**
21/12/2018	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	36.0	**88.3**
31/01/2019	73.0	**78.0**	9.0	**45.0**	30.0	**118.3**	38.0	**86.3**
28/02/2019	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	37.0	**87.3**
29/03/2019	71.0	**80.0**	10.0	**44.0**	30.0	**118.3**	37.0	**87.3**
30/04/2019	72.0	**79.0**	9.0	**45.0**	30.0	**118.3**	38.0	**86.3**
31/05/2019	73.0	**78.0**	11.0	**43.0**	31.0	**117.3**	38.0	**86.3**
29/06/2019	72.0	**79.0**	8.0	**46.0**	30.0	**118.3**	37.0	**87.3**
31/07/2019	73.0	**78.0**	10.0	**44.0**	31.0	**117.3**	38.0	**86.3**
31/08/2019	72.0	**79.0**	9.0	**45.0**	30.0	**118.3**	37.0	**87.3**
30/09/2019	72.0	**79.0**	9.0	**45.0**	31.0	**117.3**	37.0	**87.3**
31/10/2019	71.0	**80.0**	10.0	**44.0**	30.0	**118.3**	38.0	**86.3**
30/11/2019	72.0	**79.0**	11.0	**43.0**	32.0	**116.3**	37.0	**87.3**
23/12/2019	73.0	**78.0**	12.0	**42.0**	32.0	**116.3**	39.0	**85.3**
31/01/2020	72.0	**79.0**	8.0	**46.0**	31.0	**117.3**	38.0	**86.3**
28/02/2020	73.0	**78.0**	9.0	**45.0**	31.0	**117.3**	38.0	**86.3**
31/03/2020	72.0	**79.0**	10.0	**44.0**	31.0	**117.3**	39.0	**85.3**
30/04/2020	73.0	**78.0**	11.0	**43.0**	31.0	**117.3**	38.0	**86.3**
29/05/2020	74.0	**77.0**	12.0	**42.0**	31.0	**117.3**	39.0	**85.3**
30/06/2020	74.0	**77.0**	12.0	**42.0**	30.0	**118.3**	38.0	**86.3**
31/07/2020	76.0	**75.0**	13.0	**41.0**	31.0	**117.3**	40.0	**84.3**
01/09/2020	75.0	**76.0**	13.0	**41.0**	30.0	**118.3**	40.0	**84.3**
02/11/2020	74.0	**77.0**	12.0	**42.0**	29.0	**119.3**	39.0	**85.3**
30/11/2020	73.0	**78.0**	12.0	**42.0**	29.0	**119.3**	39.0	**85.3**
11/12/2020	72	**79.0**	4	**50.0**	29	**119.3**	36	**88.3**
21/12/2020	73	**78.0**	9	**45.0**	29	**119.3**	37	**87.3**
01/02/2021	73	**78.0**	10	**44.0**	29	**119.3**	36	**88.3**
25/02/2021	74	**77.0**	11	**43.0**	30	**118.3**	37	**87.3**
06/04/2021	75	**76.0**	12	**42.0**	30	**118.3**	38	**86.3**
30/04/2021	75	**76.0**	11	**43.0**	30	**118.3**	37	**87.3**
01/06/2021	76	**75.0**	12	**42.0**	30	**118.3**	36	**88.3**
30/06/2021	77	**74.0**	13	**41.0**	31	**117.3**	37	**87.3**
30/07/2021	78	**73.0**	14	**40.0**	31	**117.3**	36	**88.3**
31/08/2021	78	**73.0**	14	**40.0**	31	**117.3**	36	**88.3**
30/09/2021	77	**74.0**	13	**41.0**	32	**116.3**	36	**88.3**
29/10/2021	76	**75.0**	13	**41.0**	31	**117.3**	35	**89.3**
30/11/2021	75	**76.0**	12	**42.0**	30	**118.3**	35	**89.3**
22/12/2021	75	**76.0**	12	**42.0**	31	**117.3**	35	**89.3**
31/01/2022	75	**76.0**	11	**43.0**	31	**117.3**	35	**89.3**
28/02/2022	75	**76.0**	12	**42.0**	30	**118.3**	35	**89.3**
31/03/2022	74	**77.0**	11	**43.0**	31	**117.3**	34	**90.3**
29/04/2022	74	**77.0**	10	**44.0**	31	**117.3**	35	**89.3**
31/05/2022	74	**77.0**	11	**43.0**	31	**117.3**	34	**90.3**
30/06/2022	73	**78.0**	11	**43.0**	32	**116.3**	33	**91.3**
29/07/2022	75	**76.0**	12	**42.0**	33	**115.3**	36	**88.3**
31/08/2022	75	**76.0**	13	**41.0**			36	**88.3**
30/09/2022	75	**76.0**	14	**40.0**			38	**86.3**
09/11/2022	76	**75.0**	16	**38.0**	35	**113.3**	41	**83.3**
30/06/2023	76	**75.0**	16	**38.0**			42	**82.3**
28/07/2023	76	**75.0**	16	**38.0**			42	**82.3**
30/08/2023	75	**76.0**	16	**38.0**			40	**84.3**
27/09/2023	74	**77.0**	14	**40.0**			38	**86.3**
27/10/2023	76	**75.0**	14	**40.0**			38	**86.3**
30/11/2023	76	**75.0**	13	**41.0**			35	**89.3**
21/12/2023	75	**76.0**	13	**41.0**			35	**89.3**
30/01/2024	76	**75.0**	11	**43.0**			34	**90.3**
29/02/2024	68	**83.0**	6	**48.0**	28	**120.3**	29	**95.3**

Min	**68.0**	**70.0**	**1.2**	**34.5**	**18.0**	**111.3**	**24.5**	**73.9**
Max	**81.0**	**83.0**	**19.5**	**52.8**	**37.0**	**130.3**	**50.4**	**99.8**
Mean	**74.0**	**77.0**	**11.1**	**42.9**	**29.3**	**118.9**	**40.8**	**83.5**
Range	**13.0**	**13.0**	**18.3**	**18.3**	**19.0**	**19.0**	**25.9**	**25.9**

APPENDIX 3047/HIA/A2

Updated Working & Restoration Phase 2



Phase 4 Extraction - Est. 0.9 years duration

1. Progressive Restoration of Southern Faces
Topsoil (3,473m3) subsoil(8,102m3), Overburden (63,191m3) will be stripped and directly placed in to restoration. In addition quarry waste (7,687m3) will also be used to restore the southern faces.
Following mineral extraction the final phase of restoration will commence.

2. Recovery of Overburden from Landraising Areas
During this final restoration phase the Western and Dinorben landraising areas will be stripped of topsoil and subsoil and temporarily stored, whilst overburden is recovered for use within the restoration.The topsoil and subsoil will be replaced to original ground levels. Topsoil wi alsol be recovered from the North West Bund and used in the restoration.

3. Final Phase of Restoration- Western and Southern Faces
Overburden (185,000m3) and topsoil (2,720m3) will be recovered from Dinorben,Western and part of the North West bund areas and placed in restoration.
Woodland and grassland will subsequently be established.

Legend

- Application Boundary
- Existing Contours at 1m Intervals
- Proposed Restoration Contours at 5m Intervals
- Existing Woodland
- Woodland Planted in 1998
- Proposed Woodland
- Natural Regeneration of grass and scrub species
- Grassland Establishment
- Ongoing Restoration
- Layout of Quarry Benches
- Limit of Extraction
- Water Body
- Phase 4 Soils Strip and Extraction
- Soil Storage /Landraising Areas to be stripped and placed into restoration
- Processing Plant Area

Hanson

Hanson Aggregates

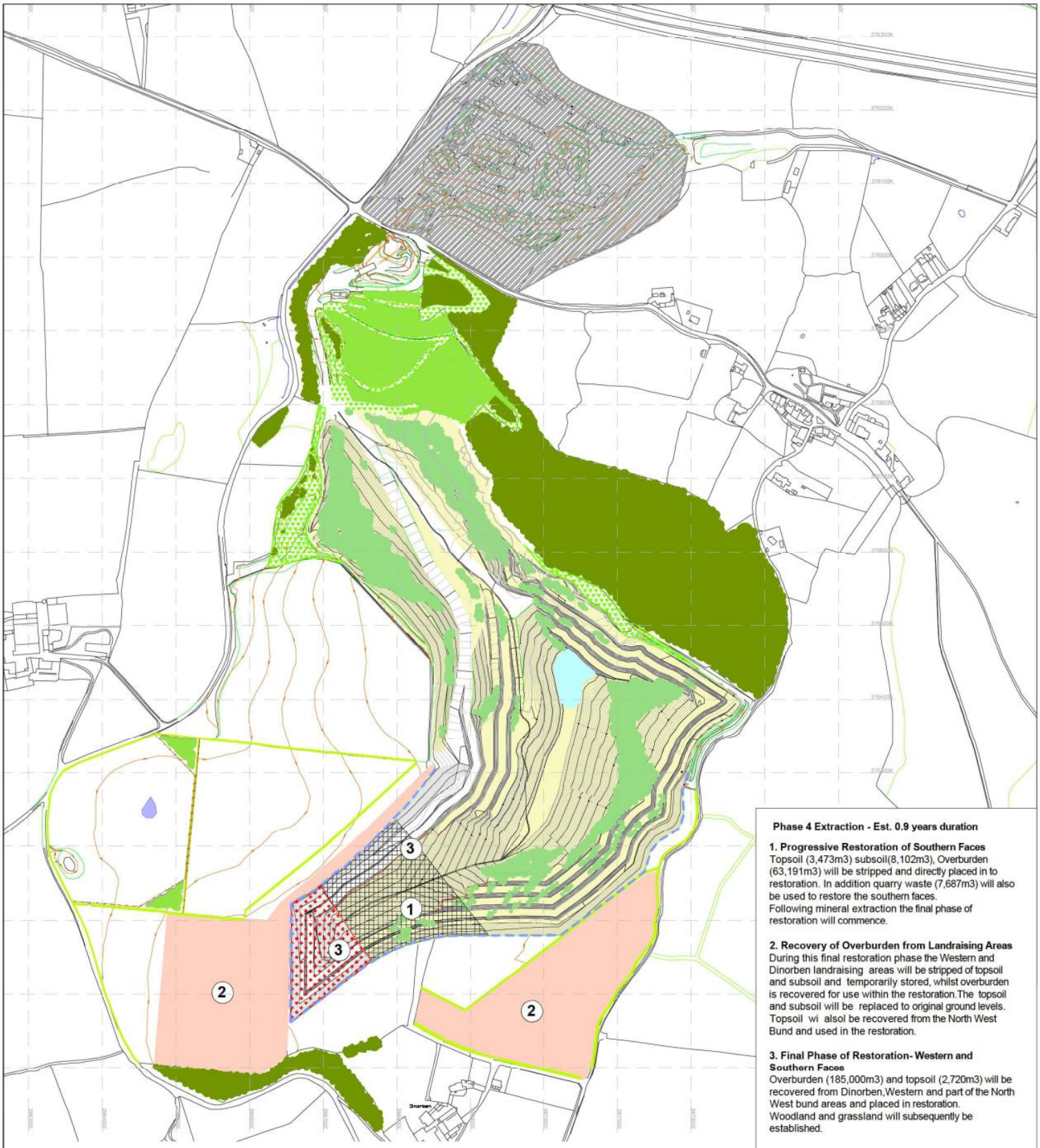
Site: Abergele Quarry

Title: Phase 4 – 200m Stand off from Dinorben Farm

Scale	Date	Drawing No.
1:5000@A3	Feb 06	A121/77
Drawn by GW	Checked by TDB	

APPENDIX 3047/HIA/A3

Updated Working & Restoration Phase 4



Phase 4 Extraction - Est. 0.9 years duration

1. Progressive Restoration of Southern Faces
Topsoil (3,473m3) subsoil(8,102m3), Overburden (63,191m3) will be stripped and directly placed in to restoration. In addition quarry waste (7,687m3) will also be used to restore the southern faces.
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Woodland and grassland will subsequently be established.

Legend

- Application Boundary
- Existing Contours at 1m Intervals
- Proposed Restoration Contours at 5m Intervals
- Existing Woodland
- Woodland Planted in 1998
- Proposed Woodland
- Natural Regeneration of grass and scrub species
- Grassland Establishment
- Ongoing Restoration
- Layout of Quarry Benches
- Limit of Extraction
- Water Body
- Phase 4 Soils Strip and Extraction
- Soil Storage /Landraising Areas to be stripped and placed into restoration
- Processing Plant Area

Hanson

Hanson Aggregates

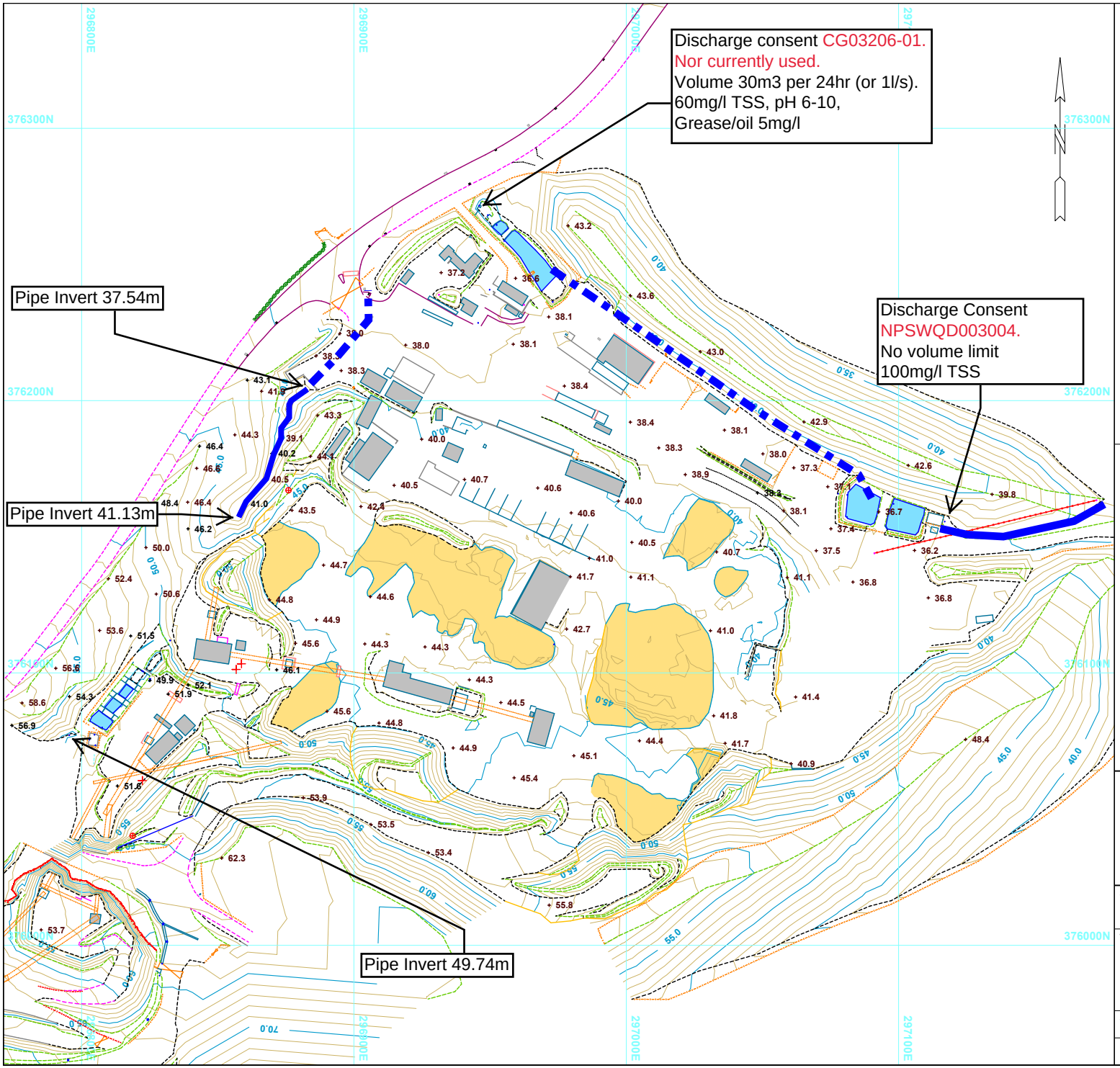
Site: Abergele Quarry

Title: Phase 4 – 200m Stand off from Dinorben Farm

Scale	1:5000@A3	Date	Feb 06	Drawing No.
Drawn by	GW	Checked by	TDB	A121/77

APPENDIX 3047/HIA/A4

Water management



LEGEND

- Building
- Kerb
- Fence
- Gate
- Hedge
- Stock
- Road
- Rail
- Track
- Wall
- Manhole
- Edge of Veg
- Tree (Con)
- Ditch Invert
- Borehole
- Pipe Invert
- Building
- Water
- Top of Batter
- Bottom of Batter
- Conveyor
- Royalty Boundary
- OS General Feature
- Top of Face
- Overhead Cable (Electric)
- Overhead Cable (Tele)
- Waters Edge
- Edge of Concrete
- Water Pipe
- Lamp Post
- Tree (Dec)
- Telegraph Post
- Electricity Pylon
- Piezometer
- Stock

Hanson HEIDELBERGCEMENT Group

Site: **Abergele Quarry**

Title: **Water Management Plan**
Proposed Upgrades

Scale	Date	Drawing no
1:2000	AUG 2020	A121/
Drawn by: SH	Revised	

APPENDIX 3047/HIA/A5

Groundwater inflow calculations

Calc sheet by:	DI
Version number:	1
Date:	24/05/2021

hafrenwater

Hydraulic parameters

	min	most likely	max
Hydraulic conductivity, K (m/day)	0.1	0.5	5

Dupiut-Forcheimer formula for inflows

Initial saturated thickness, h_0 (m)	27	
Seepage face, h_s (m)		
Drawdown, Δh (m)	27	
Saturated thickness, h_w (m)	0	
Radius of working area choice	Rectangular	← select result from box 1
Radius of working area, r_w (m)	144.8	

	min	most likely	max
Groundwater inflow, Q (m^3/day)	486.2	1343.3	6902.0
Groundwater inflow, Q (L/s)	5.63	15.55	79.88

Box 1: CIRIA formula for effective radius of working area

Length (m)	340	
Width (m)	115	
	Circular	Rectangular
Effective radius (m)	111.6	144.8

Box 2: Sichardt formula for radius of influence

Sichardt factor, Cs	3000	(3000 for radial flow, 1500-2000 for linear flow)
Drawdown (m)	27	

	min	most likely	max
Radius of influence, R_0 (m)	87.1	194.9	616.2

Total ingress (groundwater + rainfall)

Groundwater inflow choice	most likely	← select result from Theim calcs
Groundwater inflow (m3/day)	1343.3	
Runoff catchment (m2)	305000	

	min	most likely	max
Fraction of rainfall forming runoff	60%	80%	100%

Fraction of rainfall choice	max ← select proportion from table above

	Avg. rainfall per month (mm)	Runoff rate (m3/day)	Runoff rate (L/s)	Runoff + GW inflow (m3/day)	Runoff + GW inflow (L/s)
January	59.00	580.5	6.72	1923.8	22.27
February	50.00	544.6	6.30	1887.9	21.85
March	44.00	432.9	5.01	1776.2	20.56
April	42.00	427.0	4.94	1770.3	20.49
May	42.00	413.2	4.78	1756.5	20.33
June	46.00	467.7	5.41	1811.0	20.96
July	48.00	472.3	5.47	1815.6	21.01
August	60.00	590.3	6.83	1933.6	22.38
September	57.00	579.5	6.71	1922.8	22.25
October	69.00	678.9	7.86	2022.2	23.40
November	78.00	793.0	9.18	2136.3	24.73
December	81.00	796.9	9.22	2140.2	24.77
Annual average		564.7	6.5	1908.0	22.1
Annual maximum		796.9	9.2	2140.2	24.8

EXPLANATION OF CELL COLOURS

Yellow	Data entry
Green	Formulae
Blue	Select from list

EXPLANATION OF DUPUIT-FORCHEIMER FORMULA

Dupiut-Forcheimer is valid for unconfined flow (i.e. variable saturated thickness) CIRIA 2000: Eq 6.7.

This is called the Theim-Dupiut equation by the Environment Agency 2007: box 3.2.

$$Q = \pi k\left[\left(h_o^2 - h_w^2\right)/\ln\left(r_o / r_w\right)\right]$$

Where
Q = groundwater ingress rate (m3/d)
k = hydraulic conductivity (m/d)
h0 = sat'd thickness before drawdown (m)
hs = height of seepage face in workings (m)
hw = sat'd aquifer thickness after drawdown + hs (m)
rw = radius of working area (m)
r0 = rw + radius of influence (m)

Effective radius of the working area estimate is based on CIRIA 2000: equation 6.5

EXPLANATION OF SICHARDT FORMULA

Cited as equation 6.8 in CIRIA 2000, and equation 3.4 by Cashman and Preene 2001.

$$r = Ch\sqrt{k}$$

Where
r = radius of influence (m)
C = constant
h = drawdown (m)
k = hydraulic conductivity (m/s)
rw = radius of working area (m)

REFERENCES

Cashman and Preene, 2001. Groundwater Lowering in Construction: A Practical Guide. Spon Press. (Superseded by Cashman and Preene, 2020. Groundwater Lowering in Construction: A Practical Guide to Dewatering (3rd edition). CRC Press)

CIRIA, 2000. Groundwater control - design and practice. Report C515 (Superseded by CIRIA, 2007. Groundwater control - design and practice (second edition). Report C750.)

Environment Agency, 2007. Hydrogeological impact appraisal for dewatering abstractions. Science Report SC040020/SR1

APPENDIX 3047/HIA/A6

Storm water, total water ingress and water storage requirements

	Quarry Void Catchment
Runoff Coefficient	1.00
Area Ha	24

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\,CiA$$

Where:

C	co-efficient of run-off (dimensionless)
i	rainfall intensity (mm/hr)
A	catchment area (Ha)

Climate change (% rainfall increase)	10	%

Estimate of Discharge	60.0	l/s

Groundwater Inflow Rate (-ve for Outflow)	15.6	l/s

	Rainfall *2	Rainfall intensity	Rainfall Runoff from Quarry Floor *3	Groundwater Inflow	Release to Watercourse *3	Net Runoff	Required storage (discharging at 60 l/s)
Duration	**10 year event**						
hours	mm	mm/hr	l/s	l/s	l/s	l/s	m^3
0.25	13.8	55.3	4060	16	-60	4016	3614
0.5	18.3	36.5	2682	16	-60	2637	4747
1	23.1	23.1	1693	16	-60	1649	5936
2	29.2	14.6	1072	16	-60	1028	7401
4	36.5	9.1	669	16	-60	625	8996
6	41.3	6.9	505	16	-60	460	9940
8	44.8	5.6	411	16	-60	367	10569
12	50.2	4.2	307	16	-60	263	11340
16	54.2	3.4	248	16	-60	204	11755
20	57.4	2.9	211	16	-60	166	11961
24	60.0	2.5	184	16	-60	139	12027
28	62.3	2.2	163	16	-60	119	11977
32	64.2	2.0	147	16	-60	103	11855
36	66.0	1.8	135	16	-60	90	11684
40	67.6	1.7	124	16	-60	80	11470
44	69.1	1.6	115	16	-60	71	11221
48	70.5	1.5	108	16	-60	63	10947

hafrenwater
environmental water management

Barkers Chambers
Barker Street
Shrewsbury, Shropshire SY1 1SB
UK
Tel: 01743 355770
www.hafrenwater.com

Client: **Hanson UK**

Title:	1 in 10-year plus cc runoff rates and retention volumes for quarry void		
Project:	Abergele		
Calc Sheet:	A1.1	Date:	Jun-21

	Quarry Void Catchment
Runoff Coefficient	1.00
Area Ha	24

The Rational Method to give peak flow Q_p is in the form:

$$Q_p = 2.78\ CiA$$

Where:

C	co-efficient of run-off (dimensionless)
i	rainfall intensity (mm/hr)
A	catchment area (Ha)

Climate change (% rainfall increase)	10	%

Estimate of Discharge	60.0	l/s

Groundwater Inflow Rate (-ve for Outflow)	15.6	l/s

Duration	Rainfall *2	Rainfall intensity	Rainfall Runoff from Quarry Floor *3	Groundwater Inflow	Release to Watercourse *3	Net Runoff	Required storage (discharging at 60 l/s)
	2 year event						
hours	mm	mm/hr	l/s	l/s	l/s	l/s	m^3
0.25	7.2	28.8	2114	16	-60	2069	1862
0.5	9.4	18.9	1384	16	-60	1340	2412
1	11.9	11.9	876	16	-60	831	2992
2	16.4	8.2	600	16	-60	556	4000
4	21.6	5.4	396	16	-60	352	5067
6	25.0	4.2	305	16	-60	261	5632
8	27.5	3.4	252	16	-60	207	5972
12	31.2	2.6	191	16	-60	146	6310
16	33.9	2.1	156	16	-60	111	6402
20	36.2	1.8	133	16	-60	88	6351
24	38.0	1.6	116	16	-60	72	6210
28	39.7	1.4	104	16	-60	60	6006
32	41.2	1.3	94	16	-60	50	5762
36	42.6	1.2	87	16	-60	42	5484
40	43.8	1.1	80	16	-60	36	5182
44	45.0	1.0	75	16	-60	31	4859
48	46.2	1.0	71	16	-60	26	4518

*2 Obtained from FEH CD-ROM v3

*3 Climate change factored into rainfall intensity at this stage

hafrenwater
environmental water management

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Tel: 01743 355770
www.hafrenwater.com

Client: **Hanson UK**

Title:	1 in 2-year plus cc runoff rates and retention volumes for quarry void		
Project:	Abergele		
Calc Sheet:	A1.2	Date:	Jun-21

APPENDIX 3047/HIA/A7

Risk assessment methodology

Method of assessment

The method of assessment of hydrological and aquatic effects has involved:

- Characterisation of the baseline environment
- Determination of the sensitivity of key catchments and watercourses
- Evaluation of the significance of predicted effects taking account of the magnitude of effects (before and after mitigation)
- Evaluation of the sensitivity of the baseline environment affected

A rigorous and consistent approach to the assessment has been adopted using matrices to help classify sensitivity of the resource and determine the scale and significance of effects.

Baseline sensitivity

The characterisation of the baseline water environment has involved the review of data and identification of sensitivities. The characterisation of catchment sensitivities has been guided by the matrix presented in *Table 3047/HIA/A7.1* which lists indicative criteria.

The criteria for sensitivity are based approximately on hierarchy of factors relating to the quality of the aquatic environment. The criteria have been used to guide the analysis of the sensitivity of the baseline hydrological, hydrogeological and water quality environment.

Table 3047/HIA/A7.1: Catchment sensitivity classification

Sensitivity/ importance	Description	Example criteria
Very High	Nationally, or internationally significant attributes of high importance	▪ Surface water and its ecology at the site protected under UK National Site Network ▪ Principal aquifer providing a nationally important resource, or supporting a site protected under wildlife legislation ▪ SPZ I ▪ Flood risk receptor classified as essential infrastructure or highly vulnerable development in the NPPF
High	Regionally significant attributes of high importance	▪ Surface water downstream of the site protected by national designation ▪ Principal aquifer providing a regionally important resource or supporting a nationally important water dependent protected site ▪ Flood risk receptor classified as more vulnerable development in the NPPF

Table 3047/HIA/A7.1: Catchment sensitivity classification		
Sensitivity/ importance	**Description**	**Example criteria**
Medium	Locally significant attribute of moderate importance	▪ In close proximity to surface water and its ecology protected by a local designation ▪ Secondary aquifer providing locally important resource, with limited connection to surface water ▪ Flood risk receptor classified as less vulnerable development in the NPPF
Low	Low quality and rarity on a local scale	▪ Waterbody with no significant habitat ▪ Secondary aquifer, with no local water abstraction ▪ Flood risk receptor classified as water compatible
Not sensitive		▪ No aquatic habitats or watercourses present ▪ Unproductive strata

Impact prediction and evaluation

The prediction and assessment of effects on hydrology, hydrogeology and other aquatic resources has been undertaken using a series of tables to document the various potential impacts from aspects of the proposed project. Impacts have been predicted for the proposed development based on the guideline criteria for impact magnitudes set out in *Table 3047/HIA/A7.2*.

Table 3047/HIA/A7.2: Magnitude of Impact		
Impact magnitude	**Description**	**Guideline criteria**
Major	Total loss of, or alteration to, key features of the baseline attribute	Loss or extensive change to a designated Groundwater dependent ecosystem (GWDE) Total loss of a potable water supply
Moderate	Partial loss of, or alteration to, key features of the baseline attribute	Reduction in river flow Reduction in flow to GWDE
Low	Some measurable change in attributes, quality or vulnerability	Minor effects on an aquifer or GWDE
Negligible	Very slight change from baseline conditions, but of insufficient magnitude to affect the use or integrity	No measurable impact upon surface water receptors, an aquifer or groundwater receptors

Using these criteria a series of generic impacts have been predicted for the proposed

development. Residual effects have been predicted taking into account site-specific mitigation.

The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource. A matrix of significance was developed to provide a consistent framework for evaluation and is presented in *Table 3047/HIA/A7.3*. Guideline criteria for the various categories of effect are included in *Table 3047/HIA/A7.4*.

Table 3047/HIA/A7.3: Significance matrix

Magnitude	Sensitivity				
	Very High	High	Medium	Low	Not sensitive
High	Major	Major	Major	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Minor/ Negligible
Low	Moderate	Moderate	Minor	Minor/ Negligible	Negligible
Negligible	Minor	Minor/ Negligible	Negligible	Negligible	Negligible

Table 3047/HIA/A7.4: Significance of effects categories

Significance	Definition	Guideline criteria
Negligible	No detectable change to the environment	No effects on drainage patterns, surface and groundwater quality or aquatic habitat
Minor	A small but detectable change to the environment	Localised changes in drainage patterns or groundwater flows, or changes resulting in minor and reversible effects on surface and groundwater quality or aquatic habitats
Moderate	A larger, but non-fundamental change to the environment	Changes in water quality or quantity affecting part of a catchment or groundwaters of moderate vulnerability, or changes resulting in loss of conservation value to aquatic habitats or designated areas
Major	A fundamental change to the environment	Changes in water quality or quantity affecting widespread catchments or groundwater reserves of strategic significance, or changes resulting in substantial loss of conservation value to aquatic habitats and designations

In the above classification, fundamental changes are those which are permanent, detrimental and would result in widespread change to the baseline environment.

The matrices used to guide the assessment have been applied with a degree of flexibility since the evaluation of effects would always be subject to particular location-specific characteristics which need to be taken into account. For this reason, the

evaluation of impact significance, in particular, would not always correlate exactly with the cells in the relevant matrix where professional judgement and knowledge of local conditions may result in a slightly different interpretation of the impact concerned. Cumulative effects have been taken into account through prediction and evaluation of effects at a catchment-wide level.

APPENDIX 3047/TL/A4

Letter of Authority

Heidelberg Materials

Heidelberg Materials UK
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Arena Court
Crown Lane
Maidenhead
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SL6 4JJ

Phone 01628 774100
www.heidelbergmaterilas.com

Environment Agency
Permitting Support Centre
Quadrant 2
99 Parkway Avenue
Parkway Business Park
Sheffield
S9 4WF

27 November 2023

Dear Sirs

Hanson Quarry Products Europe Limited - Company No. 300002
Hanson Packed Products Limited - Company No. 26306
Castle Cement Limited - Company No. 2182762
Civil and Marine Limited - Company No. 2301423
Midland Quarry Products Limited - Company No. 3173418

I confirm that the persons listed below are relevant persons for the purposes of completing Environment Agency permit applications, including water and waste permits and carbon related permits, and compliance matters (e.g. ETS and ESOs) on behalf of the above mentioned companies and that they have the authority to bind each of the above companies in relation to documents signed on their behalf.

The relevant persons are:

Emma Goode,	Senior Geologist (Central Region)
Adam Chapman,	Senior Geologist (Southern Region)
Roger Griffiths,	Geology Manager (South-Western Region)
David Holman,	National Landfill and Recycling Manager
David Ryan,	Geology Manager (Northern Region)
Matthew Uttley,	Geological Services Manager
Marcus Dorey,	Geology Manager (Central Region)
Matthew Newton,	Senior Energy & Water Manager
Iain Walpole,	Environmental Sustainability Manager

Please note this notification replaces any previous notifications of relevant persons by the above companies.

Yours faithfully

Wendy F Rogers

W F Rogers
Company Secretary of each of the above companies