Carew Quarry

Hydrogeological Impact Appraisal

A & C Aggregates Limited

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Table of Contents

Tables in Text

Figures in Text

Appendices

Acronyms and Abbreviations

NGR	National Grid Reference
HIA	Hydrogeological Impact Appraisal
EIA	Environmental Impact Assessment
EA	Environment Agency
SAC	Special Area of Conservations
ES	Environmental Statement
BGS	British Geological Society
SPZ	Source Protection Zone
CAMS	Catchment Abstraction Management Strategy
NRW	Natural Resources Wales
EA	Environment Agency
WFS	Water Feature Survey
mbsl	metres below survey level

1.0 Introduction

1.1 Context

SLR Consulting (SLR) has been commissioned by A & C Aggregates Limited to prepare a Hydrogeological Impact Appraisal (HIA) to accompany an application for a transfer licence to dewater a limestone aggregate quarry at Carew Quarry, Carew Cheriton, (the Site). The Site is centred on National Grid Reference (NGR) SN 04830 04277.

At present the quarry void is flooded and operations are limited to the higher benches. The Site's development scheme is based upon the exploitation of a total remaining reserve of ~3.7m tonnes of limestone, at an extraction rate of ~150 000 tonnes per annum. The life of mine is expected to be 25 years, which will be extracted progressively in a series of 3 phases. The restoration strategy of the site is to cease dewatering once mining has been completed and let the mine void full to form a lake.

1.2 Objectives and Methodology

The objectives of this HIA are to develop a conceptual model and to assess the potential impact on hydrogeological and hydrological receptors of the proposed dewatering of the Site. This appraisal has been completed considering the guidance provided within the Environment Agency (EA) Science Report SC040020/SR1[1] and is structured as follows:

- Section 2.0 geology and levels and a result — A baseline assessment of the site. This includes a summary of the site hydrogeology including information on ground conditions, groundwater flows and the location of potential receptors which could be affected as of the working of the site. Finally, a conceptual model of the current hydrogeological regime is provided.
- Section 3.0 will have — An assessment of the potential impact that the proposed development upon the identified receptors and regional hydrogeology.
- Section 4.0 — A conclusion of the overall impact that the site could have upon the local hydrogeology and any identified receptors.

1.3 Sources of Information

The following sources of information have been consulted to characterise the geology, hydrogeology, and hydrology of the area within and surrounding the application site:

- a site visit/walk-over survey, carried out by a hydrogeologist from SLR in April 2023.
- SLR, Carew Quarry ROMP review. Environmental Statement volume 1, December 2012
- National Soils Resource Institute Website for details on soils (https://www.landis.org.uk/soilscapes/);
- British Geological Survey (BGS) online maps (http://mapapps2.bgs.ac.uk/geoindex/home.html) for details of bedrock and superficial geology, also nearby borehole logs;
- Natural Wales resources- online database mapping (https://datamap.gov.wales/)
- Details of unlicensed groundwater abstractions obtained from the Pembroke council

[1] Environment Agency (April 2007) Hydrogeological Impact Appraisal for Dewatering Abstractions, ref: SC040020/SR1

- DEFRA Magic Map Website (https://magic.defra.gov.uk) for details on aquifer classification, source protection zones, groundwater vulnerability and groundwater and surface water dependent designated ecological sites;

2.0 Baseline Conditions

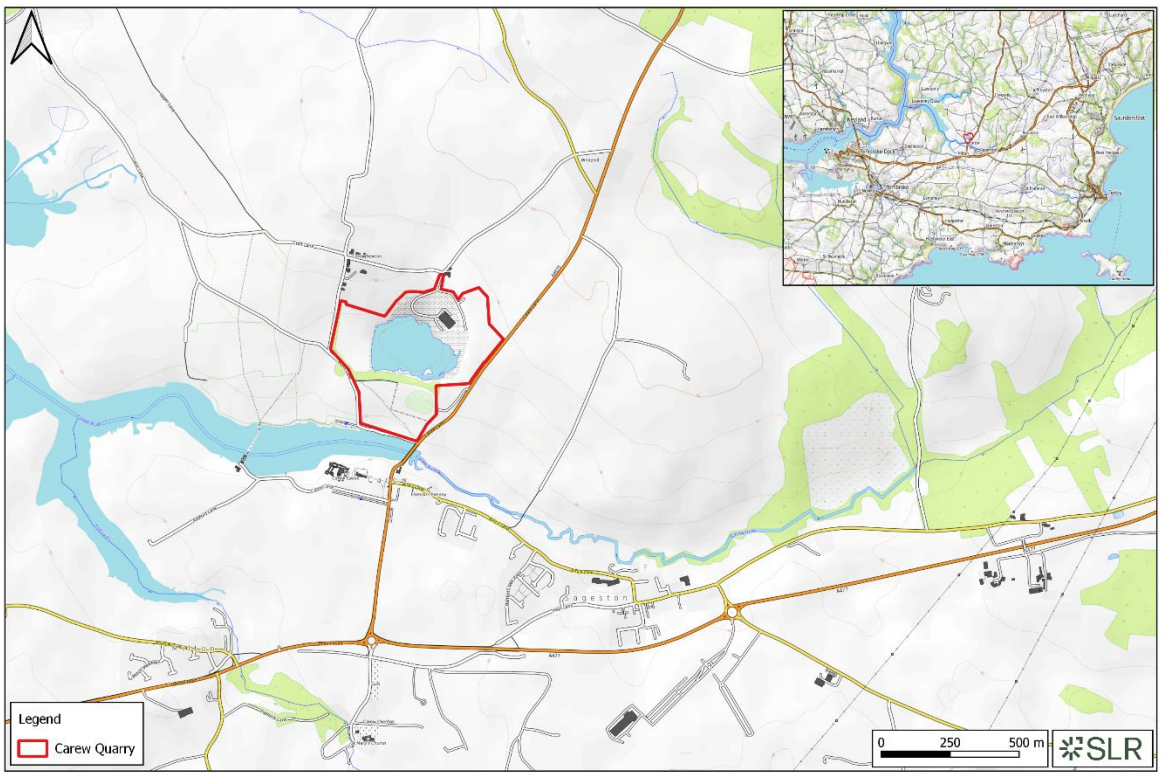
The geological and hydrogeological regime of the application site and the surrounding area is considered in this section in order to develop the sites conceptual model.

2.1 Location and Topography

The location of the Site is shown on Figure 1. The Site is located c. 8.5 km northeast of the town of Pembroke and c. 1.3 km north from the village of Carew Cheriton. The topography near to the Site varies between 20 – 30 mAOD, rising to 57 mAOD at Whitehill, c. 1 km to the northeast. The quarry has been developed within a gentle ridgeline, with the site boundaries defined to retain the outer edges of the ridgeline. As a result, the quarry is contained within a topographic low and visual hidden within the landscape.

The area of the Site c. 9.48 ha and comprises of a flooded quarry void with submerged quarry faces and benches, areas of historic quarry tips, redundant internal quarry haul roads, and mine equipment and an storage warehouse.

Figure 1: Site location and regional topography



2.2 Hydrology

The Site is located within the surface catchment of the tidal Carew River and Mill Pond (Carew Castle Moat), c. 0.25 km south of the site. The Mill Pond has undergone engineered adaptation for hydroelectricity. The Mill Pond captures seawater by sluices, on the upstream side, as well as freshwater flowing in from the Carew River. The mixing of both contributing waters creates a brackish lake of c. 7 ha (mean high water springs mark). The brackish environment has formed a habitat for the Tentacled Lagoon Worm *Alkmaria romijni* within its bottom sediments, as such the Mill Pond is a designated Special Area of Conservations (SAC).

The drainage within the surface water catchment is controlled by the local topography and the underlying geology (Section 2.4). The low permeability of the Bishopston Mudstone Formation, north of the quarry and to the south of Whitehill, has slow infiltration rates and leads to the runoff of the majority of rainfall, draining towards the Carew River.

Drainage on the eastern side of the road between Whitehill and the quarry is controlled by field drainage that outflows into a boundary ditch, which flows to the east of the quarry and discharges on the western side of the A4075 Carew Lane. SLRs Environmental Statement (ES) volume 1 (2012) reports that the prior quarry operators noted that the original flow was directed to a sink, located between Hillgate and the quarry car park on its north-eastern margin (NGR SN 0495 0440). Due to concerns of flooding the prior quarry operators plugged the inflow ditch with clay, to divert water away from the quarry towards Carew Lane. (Figure 1).

To the northeast of the Site, a small stream flows at Russan's Well, a small pond located in an area of poorly drained land with clay soils, c. 0.5 km to the north of the quarry (NGR SN 0508 0480). The outflow flows along a field boundary to the south-south-west into an overgrown area to the north of Brooklyn, which is classified as "sinks" (NGR SN 0480 0450). This location coincides with the mapped boundary between the Bishopston Mudstone Group and the Pembrokeshire Limestone Series (Appendix A, Figure 8) and is a sink hole or swalllet.

2.3 Geology and hydrogeology

2.3.1 Soils

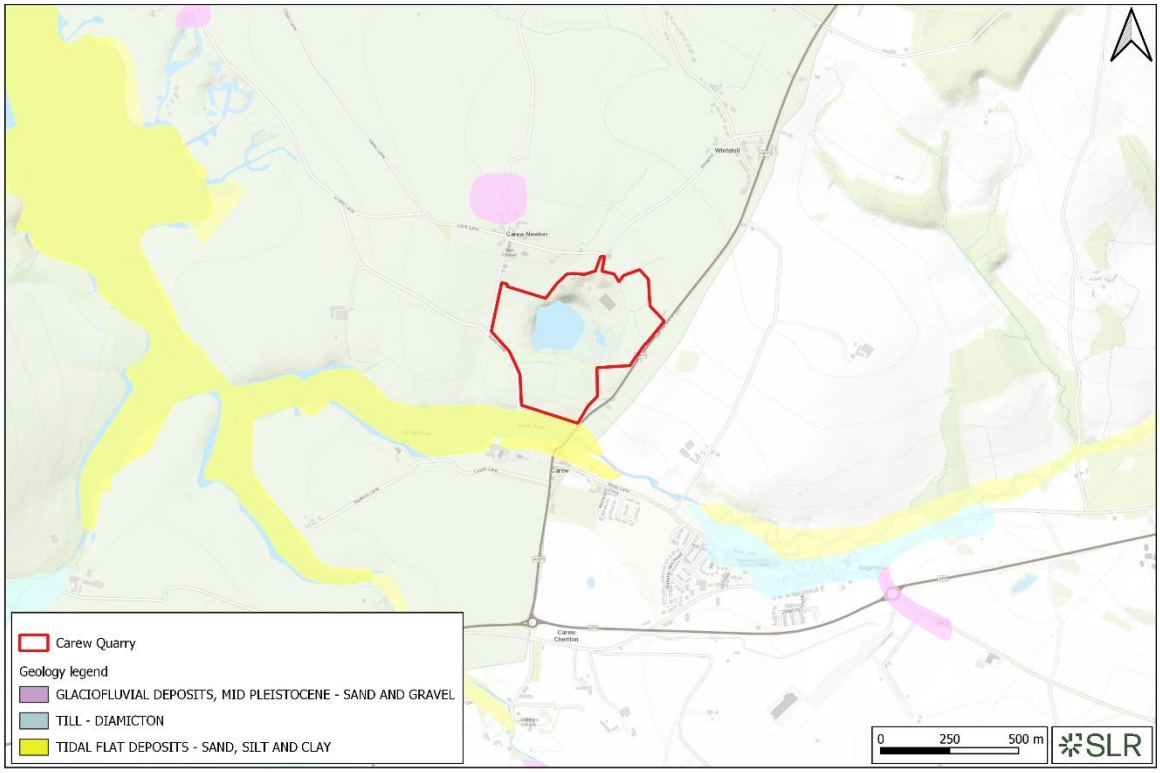
The Cranfield Soilscapes online soil map viewer[2] indicates that the Site is underlain by 'Freely draining slightly acid but base-rich soils', associated with Pembroke Limestone Group. c. 0.2 km north of the quarry the underlying soils comprise of 'Freely draining slightly acid loamy soils', associated with Bishopston Mudstone Formation.

2.3.2 Superficial

The 1:50,000 scale mapping by the BGS indicates that superficial deposits are absent at the Site. The nearest superficial deposits are associated with Mill Pond and comprise tidal flat deposits, sediment material made up of sand, silt, and clay (Figure 2).

[2] Cranfield Soil and Agrifood Institute Soilscapes Online Soil Map Viewer (Accessed on 22/02/21) http://www.landis.org.uk/soilscapes/

Figure 2: BGS 1:50k Superficial geology



2.3.3 Bedrock

The 1:50,000 scale mapping by the BGS indicates the Site is underlain by Pembroke Limestone Group (Carboniferous). The Limestone formation is overlain by the Bishopston Mudstone Formation, which outcrops to the north-east on the topographic high. The Limestone is underlain by the Black Rock Group and Gully Oolite towards the south-west of the Site (Figure 3). The Formations / Groups are mapped as having a dip angle of 40 degrees towards the north-east.

A regional fault structure is mapped, the Ritec Fault, and is located c. 2 km south (Milton Valley) of the Site. On a regional scale the fault divides the southern limestone strata from the northern strata. The BGS 1:50,000 hydrogeological scanned map cross section (Figure 4) indicates the Site is on the north-eastern limb of a north-westerly trending faulted anticline structure. The fault is likely to have enhanced fracturing in the limestone, this is evident from pumping test conducted in the Milton Valley (Section 2.4.2). The extent of the fractured zone produced by faulting is unknown in the local area.

Figure 3: BGS 1:50,000 Bedrock geology

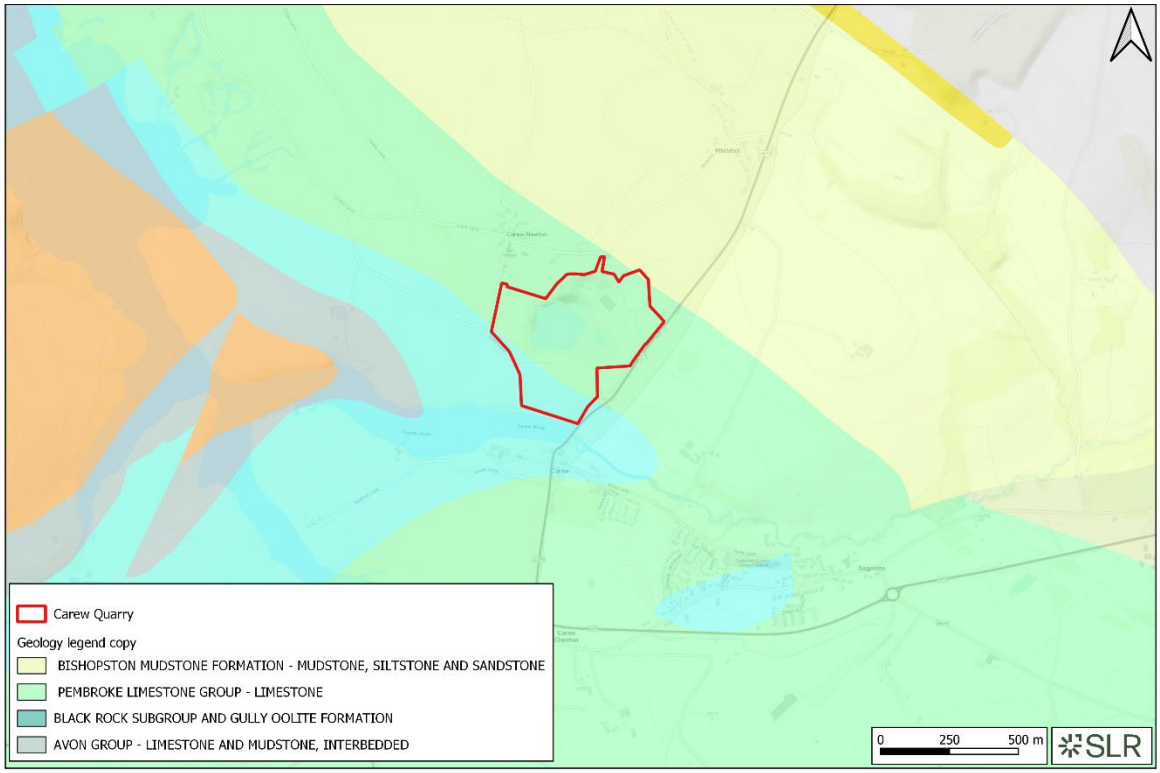
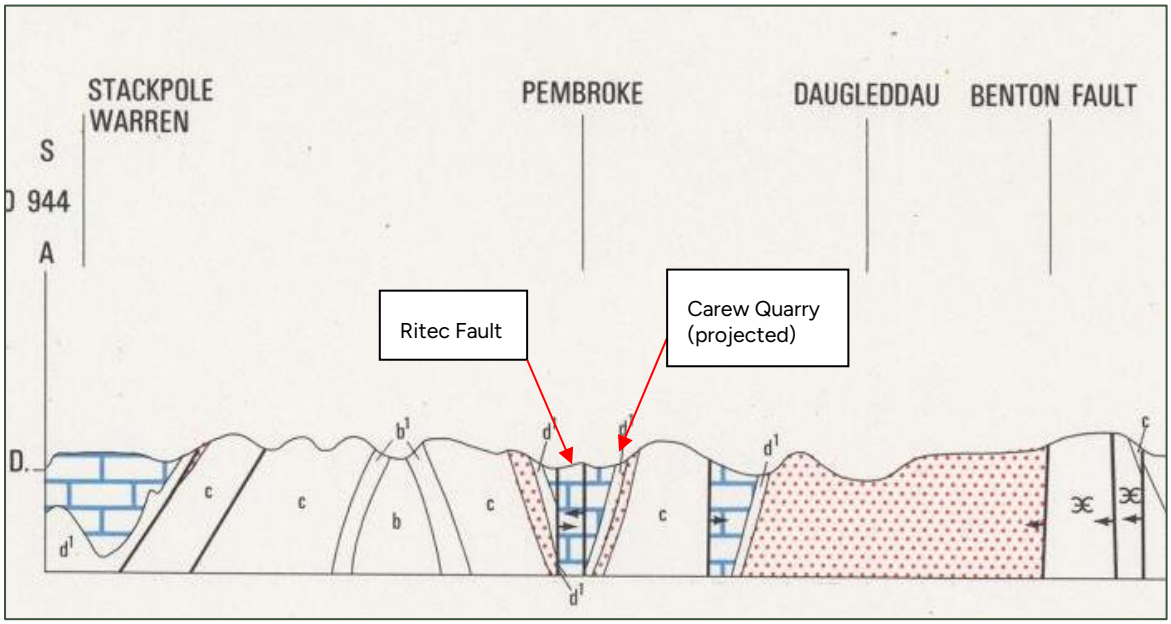


Figure 4: BGS 1:50,000 geological cross section.



Notes: Cross section is c. 6km to west of the Site orientated N -S. Limestones shown as blue bricks legend and non-aquifers as unshaded. red stippled strata are Devonian Sandstones.

2.4 Hydrogeology

2.4.1 Aquifer Classifications and Groundwater Vulnerability

The DEFRA online mapping service[3] classifies the Pembroke Limestone Group, Black Rock Group and Gully Oolite Formation as Principal Aquifer, described as:

> *"Layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and transmission. They may support water supply and/or river base flow on a strategic scale."*

Groundwater vulnerability at the Site is classified by the NRW[4] online mapping as High. The Site is not located within a Source Protection Zone (SPZ) or Drinking Water Protected or Safeguard Zone. The nearest SPZ is located 1 km south of the Quarry and is associated with the Milton spring source.

2.4.2 Aquifer Characteristics

The Carboniferous Limestone of the Pembroke Group is characterised as a karst aquifer as solution features have been identified, such as conduits, swallow holes and dry valleys. The aquifer is unconfined in the region underlying the Site. The major aquifer manual[5] reports that several pumping tests were carried out in a valley in Milton, c. 1.3 km south-west of the Site. Very high transmissivity values of 5,900 m^2/d and storativity of 0.01 was obtained. It is reported that a value of 4,000 m^2/d was more representative of the region, as the pumping test was conducted within the damage zone of the Ritec fault zone.

The underlying aquifer is classified as a fractured aquifer, where groundwater flow is mainly through fractures networks and faults providing preferential flow paths. The pumping test indicated that storage is controlled by the fracture network with very little matrix storativity. Observation well response data indicated a symmetrical cone of depression and indications that transmissivity varied with pumping rate suggesting that permeability decrease with depth. This is typical of karst aquifer where an epikarst weathered zone is present with the presence of an enhanced porosity and permeability relative to the deeper sections of the bedrock. The enhanced shallow porosity and permeability facilitates considerable lateral flow in the upper reaches of the karst system driving groundwater flow towards karst features (sinkholes) or fractures and fissures.

2.4.3 Groundwater Levels and Flow

No groundwater monitoring data is available for the Site. A review of the NRW and BGS online database was conducted, no groundwater data was available for the site or within a 2 km search radius of the site. As the quarry is not actively being pumped at present or likely to be impacted by small scale private abstraction, the static groundwater level can be assumed to be the elevation of the pit lake water level (surveyed pit lake water level, 13/04/23- 5.5 m AOD).

Based on the aquifer characteristics and geological structures present in the region, groundwater is predicted to flow through the aquifer system in three ways. The three-flow mechanisms include the epikarst, solution enlarged conduits and sink holes, and smaller fracture and joints linked to the main conduits. The shallow groundwater flow is assumed to follow topography and groundwater flow will be driven by the regional hydraulic gradient, such that the flow is predominantly from northeast towards the southeast (towards the Mill Pond). Deep groundwater flow is likely to be controlled by

[3] Magic Map Application (defra.gov.uk) accessed on 10/05/2023

[4] Natural Resource Wales (naturalresources.wales) accessed on the 10/05/2023

[5] The physical properties of major aquifers in England and Wales, BGS, 1997

the regional fault structure within the region and flow mechanics are controlled by fracture networks and solution-enhanced features generated during faulting.

2.4.4 Recharge

Runoff from the Bishopston Mudstone Fm to the northeast, accounts for the majority of recharge to the bedrock aquifer (allogenic recharge), via streams and sinks surrounding the quarry. Diffuse recharge rates across the direct (autogenic) recharge area, where the aquifer is unconfined in nature will be controlled by the soil and geological properties with greatly enhanced recharge occurring in areas where bedrock crops out. Point recharge occurs through swallow holes, depressions and losing section of streams.

2.4.5 Groundwater resource availability

As of the 1st January 2018 the Water Resources (Transitional Provisions) Regulations 2017 the pumped dewatering of mines, quarries and engineering works now require a licence to lawfully abstract water (except in an emergency).

The Site is located in the Cleddau & Pembrokeshire Coastal Rivers CAMS (Catchment Abstraction Management Strategy) area. The CAMS, which was last updated in May 2014, states that unconfined groundwater in the catchment is subject to the same availability criteria as the surface water availability, which is that water is available for licensing even when flows river are Q95 low flows. The application is for a transfer licence so there will be no loss of water resources, although the transfer could have an effect on the distribution of resources.

Notwithstanding the above this report provides an assessment on whether the proposed abstraction will have a negative impact upon water interests which rely on base flow from the groundwater aquifer.

2.5 Groundwater Quality

2.5.1 Superficial Deposits

No superficial water bearing deposits recorded within 2 km of the Site.

2.5.2 Bedrock Aquifer

There is no groundwater quality data for the aquifer directly underlying the Site.

2.5.3 Regional water quality – Natural Resources Wales and BGS groundwater review

The NRW and BGS conducted a review of the carboniferous limestone aquifer in Wales. Water quality in the limestone is classified as having a Ca-HCO_2 hydro-facies, slightly alkaline with an average pH of 7.6 and alkalinity ($CaCO_3$) ranges upwards of 230 mg/l. Groundwater samples with lower ranges are typical of immature waters that have not attained Ca saturation. In low lying coastal regions, distinct tidal influences and mixing zones can be observed by elevated concentrations of Ca and Na in the fracture networks at groundwater monitoring points.

2.6 Water Interests

2.6.1 Historical Water feature Survey

A Water Feature Survey (WFS) was undertaken by Parsons Brinckerhoff in November 2012 for Thomas Scourfield & Sons as part of support evidence for the review of the Mineral Planning Permission of the Quarry. The WFS identified water features such as well, springs, ponds, streams, and karst features.

The WFS survey included a review of the Environment Agency (EA) and consulted with Department of Pembrokeshire County Council for both registered water supplies and private users, within a 2 km search radius of the quarry site. One surface water abstraction license was registered (22/61/6/0090). The site is 1 km to the southeast and water is taken from the Carew River, for providing through for a fish farm.

No licensed groundwater abstractions were identified in the 2 km search radius, as the Carew area is classified by the EA as a groundwater exempt area. One unlicensed supply is recorded was recorded by Pembroke Council. The supply is utilised by a caravan site located 1.6 km west-north-west of the Site. Water features identified during the survey are included (Appendix A, Figure 8).

2.7 Review of Water Feature Survey

2.7.1 Site walkover survey

A site walkover survey and water quality investigation was undertaken in April 2023 to confirm the historical water features survey, this included:

- A water features survey.
- Salinity profiling of the quarry pit.

The survey confirmed the water features identified in the 2012 survey. No new wate features were identified during the site walkover.

2.7.2 Licensed and Private Water Supplies

A review of the NRW online licenced water abstraction database[6] indicated that there are no active groundwater or surface water abstractions within 2 km radius of the site. The surface water abstraction licence (22/61/6/0090), is no longer in place

A freedom of information request was sent to Pembroke Council to enquire about unlicensed supplies within a 2 km search radius. The council confirm that Tything Barn Private (unlicensed) water supply (NGR 034 052, 1.6 km to the west-north-west of the quarry) is activate and registered on their system.

2.7.3 Salinity Profiling

SLR conducted a conductivity profile of the flooded quarry void at six locations (

[6] https://datamap.gov.wales/layers/geonode:nrw_water_resource_permits

Table 2-1 and Figure 5). The survey data indicated that the pit lake is stratified in to three layers, with two distinct salinity transitional boundaries found at a depth of 10 metres below measured survey level (mbsl) and 20 mbsl.

The conductivity profile data indicated the following (Figure 6):

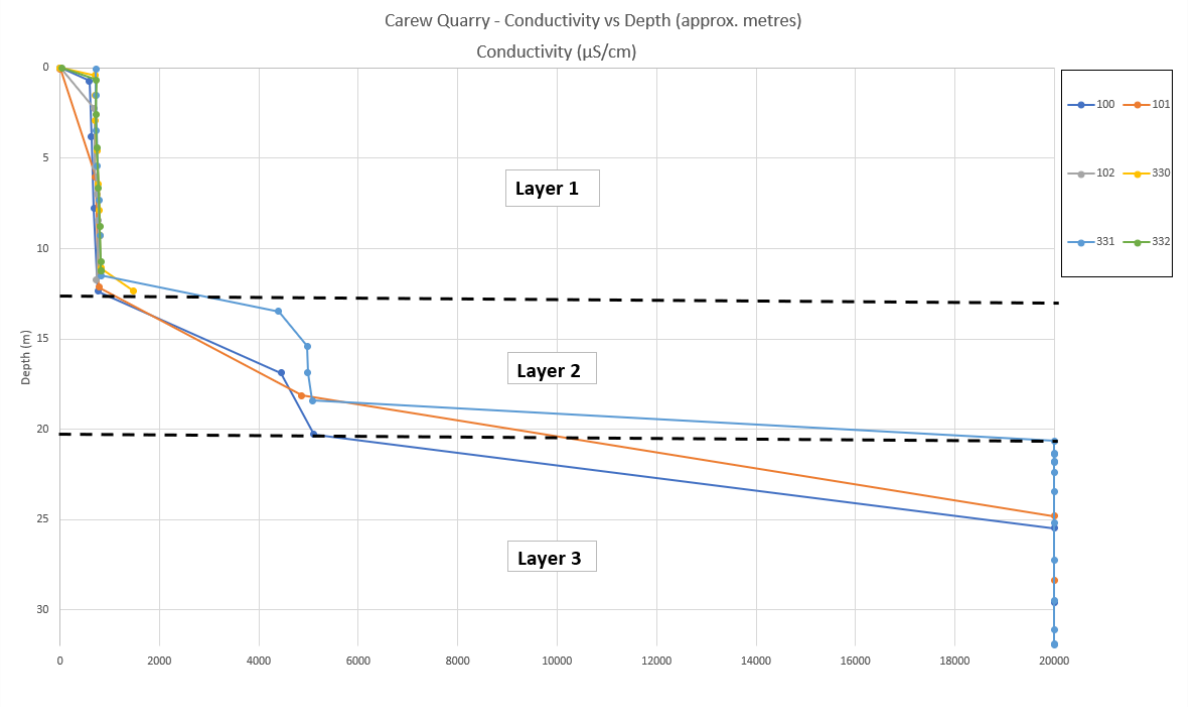
- Layer 1 - Conductivity range of 35 -830 µS/cm from a depth of 0 to 12 mbsl
- Layer 2 - Conductivity range of 830 -5110 µS/cm from a depth of 12 to 21 mbsl
- Layer 3 – Conductivity range 5110 - >20 000 µS/cm (above sensor detection limit), from depth of 21 to 31.91 mbsl.

Table 2-1: Conductivity survey location and max depth survey

Location ID	X (Easting)	Y (Northing)	Max Depth surveyed
100	204727.174	204212.706	29.60
101	204727.918	204203.594	28.39
102	204768.995	204278.795	11.73
330	204732.473	204213.042	12.33
331	204746.524	204239.991	31.92
332	204846.488	204205.13	11.23

Figure 5: Conductivity Survey location.

Figure 6: Carew Quarry - Conductivity vs Depth (approx. metres)



The survey indicates that there is a layer of fresh water at surface from groundwater recharge from the catchment, a translational zone and then more saline water at depth from recharge from the tidal Mill Pond and River Carew. The electrical conductivity of seawater is c 50,000 us/cm. The transition from fresh to saline water occurs at a depth of c. 13m to 20m below the water level in the void or c. -7 to -14m AOD.

2.8 Conceptual understanding

The hydrogeological conceptual model is a description of how a hydrogeological system is believed to behave. The model describes the inflow and outflows from the system and has been split into three categories: regional setting, Stage 1 Dewatering (exiting pre-drainage) and Stage 2 Dewatering (operational). The categories can be summarised as follows:

Regional setting and Stage 1 Dewatering (exiting pre-drainage)

- Superficial deposits are absent from the Site. Topsoil is likely to be derived from both weathered limestone and Bishopston Mudstone Fm and is classified a freely draining.
- The aquifer is unconfined in the area underlying the Site.
- Pembroke Limestone and Black Rock Group and Gully Oolite are likely to have similar and moderate permeability and are in hydraulic continuity.
- Recharge via the shallow epikarst system, sink holes, surface water runoff from the surrounding highlands and direct rainfall.
- The regional groundwater flow direction is generally from the northeast to southwest across the groundwater discharging to the River Carew and Mill Pond.

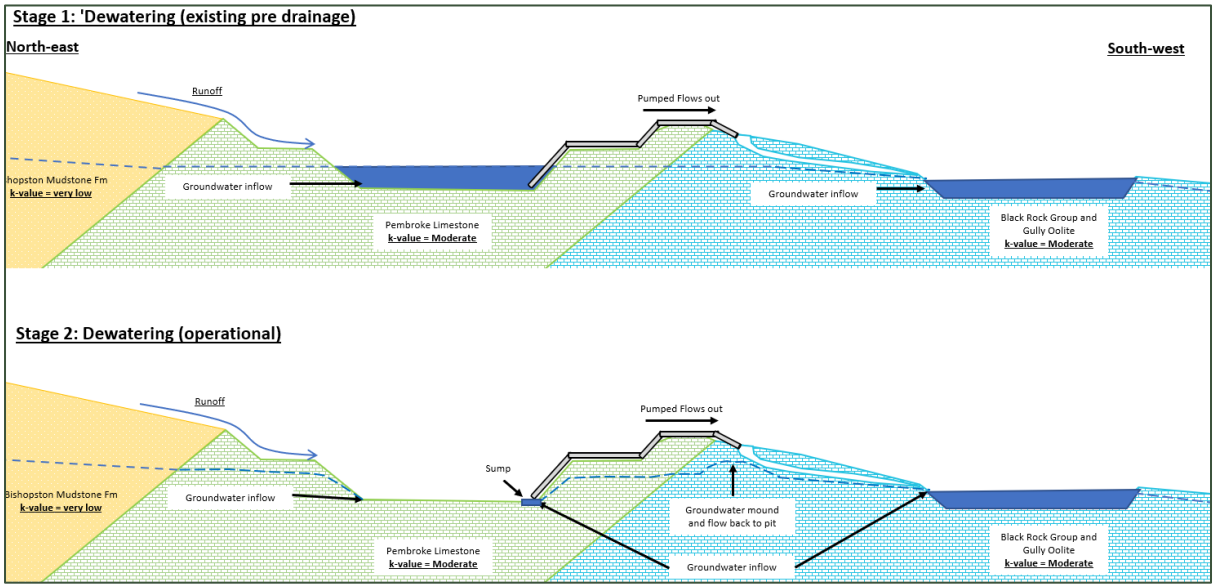
Stage 2 Dewatering (operational):

- Groundwater flow within the zone of influence of the quarry can be conceptualised as radial flow through an unconfined fractured rock aquifer that acts like an equivalent porous medium at the large scale.
- System outflows during prevailing conditions include groundwater discharge to Mill Pond and the River Carew Estuary. During operation the quarry will dewater the quarry pit lake and

discharge the groundwater into a swallow hole c. 70 m to the south of the quarry under an existing discharge consent. The swallow hole is connected to a subterranean fracture network which discharges to the Mill Pond.

- The direct discharge of groundwater to the aquifer will produce a localised area of recharge and form a groundwater mound. The formation of the groundwater mound is likely to have a minor impact on the hydraulic gradient towards the mine pit and Mill Pond.

Figure 7: Conceptual site model – Stage 1 & 2



3.0 Hydrogeological Impact Appraisal

3.1 Total Discharge Requirements

Stage 1 of dewatering is required to drain the flooded void to the lowest flooded bench in the quarry void. The water is a combination of both groundwater and surface water runoff and has been assessed as fresh groundwater with a relatively low electrical conductivity as the site. Stage 1 dewatering will comprise of discharging the excess water in the quarry pit to a soakage area located c. 70 m south of the quarry pit. This soakage has been used previously to dewatering the quarry when it was operational.

The volume of water in the void has been calculated to be c. 941,201 m^3 (SLR, 2023) and has been estimated to take c. 95 days to dewater, based on the current maximum discharge rate permitted under the consent of 10,000 m^3/d.

Stage 2 dewatering will be to maintain dry conditions for the operational phase of mineral extraction. Operational dewatering water will involve only pumping incidental rainfall on the void and groundwater seepage within the quarry. Incidental groundwater seepage entering the quarry will drain across the quarry floor to a sump located in the north-east corner of the lowest bench.

The estimated operational discharge volumes are based on the pumping rates for the dewatering activities taken from SLR ROMP ES volume 1 (2012)[7]. Routine measurements of the quarry discharge between 1 May 2000 and 1 March 2004, indicate a range of daily pumped volume between 2,800 to 5,700 m^3/day, with a mean daily flow of 4,250 m^3/day.

3.2 Assessment Methodology

For dewatering abstractions, NRW advises that the Environment Agency's Hydrogeological impact appraisal for dewatering abstractions[8] should be followed, in order to provide an assessment of the effect the proposed abstraction and discharge may have on other water users and the environment. It is noted that the steps are intended to be flexible, and each step should be tailored to the specific situation based on data available. It is recognised that a conceptual model is an iterative process and, in turn, could be refined to align with a tiered or hierarchical approach to assessing potential for impacts from the abstraction. The assessment provided below constitutes a Tier 1 assessment.

3.2.1 Step 1: Regional water resource status

As discussed in Section 2.4.5, it is considered that there is sufficient water resource availability, especially given the non-consumptive nature of the proposed dewatering abstraction with the water returned back to the aquifer from where it had been abstracted.

3.2.2 Step 2: Conceptual model

The conceptual models for the site have been presented in Section 2.8. The main impact identified relating to the dewatering of Site appear to be:

- A total volume of 941,201 cubic meters of water in the void to be removed in the first instance and discharged into Mill Pond; and
- Potential impacts on groundwater levels due to continuous dewatering of the quarry pit for the mineral extraction operation.

3.2.3 Step 3: Water features susceptible to flow impacts

A detailed water interest survey has been undertaken within a 2km radius of the quarry. Based on the conceptual model and water feature surveys, it is considered that the only water features susceptible to flow impacts from the dewatering activities at the Site is the Mill Pond.

3.2.4 Step 4: Apportion the flow impacts

The abstraction of groundwater via dewatering of the current quarry void could affect the discharge from the groundwater system to the Mill Pond which is included in the Pembrokeshire Marine Special Area of Conservation (SAC).

3.2.5 Step 5: Mitigation of flow impacts

Flow impacts to surface water bodies from the dewatering of the groundwater within the quarry void are mitigated by the return of the non-consumptive usage to a swallow hole upgradient of Mill Pond. This swallow hole is connected to discharges to the Mill Pond and hence there will be no reduction in the water discharged to the Mill Pond.

[7] SLR (December 2012), Carew Quarry ROMP Review. Environmental Statement Volume 1.

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291080/scho0407bmae-e-e.pdf

3.2.6 Step 6: Significance of net flow impacts

In terms of flows to surface watercourse, it is likely that there will be no significant net flow impact on the Mill Pond or the River Carew.

3.2.7 Step 7: Search area for drawdown impacts

The search area for drawdown impacts was derived by the previous ROMP ES report[7] and set to 2 km. However, an assessment of likely radius of influence from dewatering (Step 9 below) indicates that the extent is unlikely to be more than 300m. Based on the conceptual model the mudstone strata to the north of the quarry is likely to restrict the drawdown in this direction due to the lower permeability value and drawdown to the south are likely to be restricted by the discharge of water to ground between the Site and the Mill Pond.

3.2.8 Step 8: Water features susceptible to drawdown impacts

There are no groundwater source protection zones within this search area, so it is assumed that there are no major groundwater abstractions. Local enquiries did not identify any licensed or unlicensed groundwater abstractors with hydraulic connectivity within 2km of the Site.

One spring issue was observed from the hillside to the north of the quarry (located on the Bishopston Mudstone Formation). However, the spring is at an elevation above the level of the water in the quarry void and in the limestone aquifer and will not therefore be affected by dewatering.

3.2.9 Step 9: Predict maximum drawdown impacts

The maximum extent of drawdown impacts is likely to arise from the Stage 2 of CSM operational dewatering as this involves the long term dewatering of the quarry void. Calculations have been undertaken to assess the radius of influence (drawdown cone extent) and further refine the confidence level.

A calculation of a first order estimate of the radius of influence associated with dewatering activities at the Site have been made using the Sichardt Formula and the analytical solution proposed by Dupuit-Thiem (Unconfined) presented in the Environment Agency published Tier 1 Groundwater Analytical Equation Tool (EA, 2007).

The calculations of the radius of influence resulting from the proposed dewatering of the site assumes the pit has been drained (Figure 7 – Stage 2). Dewatering will occur to the base of the excavation; therefore drawdown has been set as 35 m. Average pumping rate for the dewatering activities have been taken from SLR ROMP ES volume 1 (2012)[7] and set as 4,500 m^3/day. Although there are no site-specific aquifer parameters available for the site, a range of hydraulic conductivity (k-values) has been taken from literature values. The literature value is for k-values of a limestone in the upper 20 m of the aquifer. A summary of input parameters are presented in Table 3-1.

Table 3-1: Parameter values used in drawdown calculations

Parameter	Value	Note
Analytical solution	Thiem-Dupuit (steady state)	
Hydraulic conductivity	8.5x10-06 m/s	Literature value
	0.734 m/d	
H	35 m	Groundwater head above base of quarry pit (based on bathymetry data)
hw	0 m	Groundwater head base of aquifer at quarry sump pump

Parameter	Value	Note
Re	97.37 m	Equivalent Well radius, visual match on aerial photo.
Q	4,500 m^3/day	SLR ROMP ES volume 1

The initial radius of influence calculated using the Sichardt equations, indicated a radius of influence of approximately 306 m from the quarry face. To further refine the expected radius of influence, the Thiem-Dupuit Equation was used for steady state unconfined conditions and estimated the radius of influence at the estimated quarry floor level of -29.5 mOD, some 185m from the quarry face.

3.2.10 Step 10: Mitigation of drawdown impacts

Drawdown impacts to the south of the quarry, towards the Mill Pond will be mitigated by the discharge of water back into the aquifer. Impacts to the north of the site will be limited by the geological strata (see Step 7) There are no water interests in other directions that could be significantly affected by drawdown impacts.

3.2.11 Step 11: Significance of drawdown impacts

Not significant.

3.2.12 Step 12: Water quality impacts

After settlement in the quarry sump water is pumped from the main quarry and discharged back into the aquifer to the south of the quarry, ultimately discharging to the Mill Pond as is the current location for groundwater discharge without pumping. The discharge water quality from the quarry is therefore likely to be broadly similar and no significant impact is predicted.

An assessment of the impact of the discharge from the quarry was made in 2004 to accompany the application to increase the discharge consent to 10,000m^3/day. This concluded that there would be no significant adverse impact on the water quality of the Mill Pond as a result of the discharge. A copy of the assessment is provided in Appendix B. and the consent in Appendix C.

3.2.13 Step 13: Redesign mitigation measures

Not applicable

3.2.14 Step 14: Monitoring and reporting plan

The following monitoring and reporting should be put in place during both the initial dewatering of the quarry void and dewatering during operational phase:

- Water levels and pumping rates should be measured for the duration of the dewatering operations
- Water quality monitoring of the discharge (suspended solids, pH and electrical conductivity).

4.0 Conclusions and recommendations

The purpose of this HIA is to assess the potential risk to hydrological or hydrogeological receptors and to provide details of appropriate mitigation measures of the proposed pumped dewatering of Carew quarry. Historical and recent water features surveys indicated that there are no significant water features within a 2 km radius of the site except for the Mill Pond approximately 200m to the south. The estimated drawdown radius form operational dewatering is likely to range between 250 – 330 m only, however, the drawdown cone is only likely to extend laterally to the west and east of the site due to the low permeability mudstone to the north and direct the direct discharge of pumped water back into the aquifer to the south under an existing environmental permit (Ref. BP0236901/V001).

The assessment has demonstrated that the impact on water interests is unlikely to be significant.

It is recommended that the water quality of the discharge is monitored (suspended solids, pH and electrical conductivity). The monitoring point should be located at the pump outlet prior to the consented discharge point. Dewatering of the quarry pit is unlikely to significantly affect water quality.

Appendix A Hydrology and hydrogeology – ES Chapter

Water Feature Survey

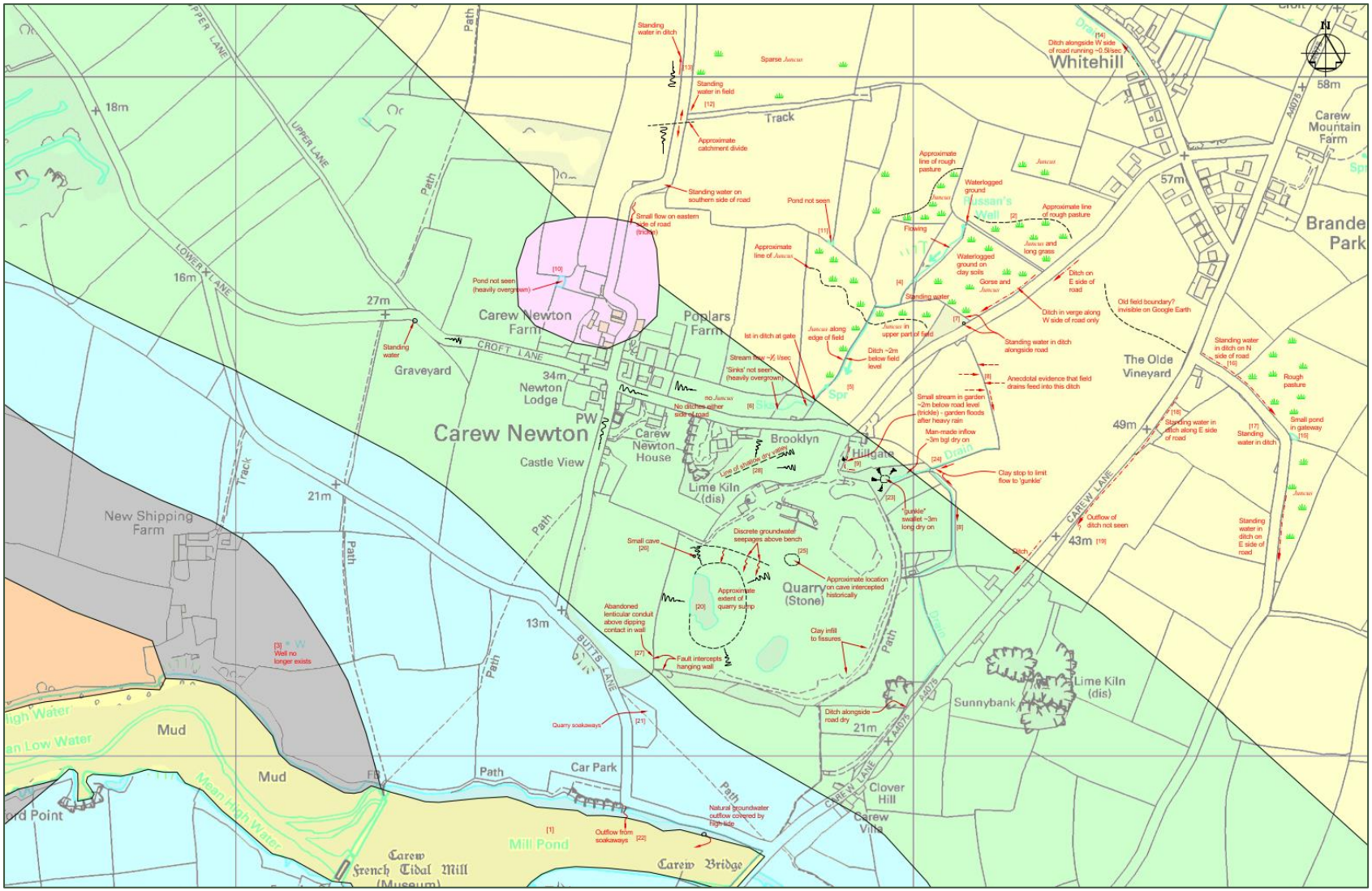
Thomas Scourfield & Sons

November 2012

A.1 Identified water features – 16/10/2012

Feature ID	Feature type	Grid reference.	Noted comments
1 – Mill Pond	Pond		South of the quarry
2 – Russan's well	Well	NGR 0508 0480	500m to the north of the quarry
3	Well	NRG 0406 0416	No longer exists, last observed flow was in 1998
4	Pond	NRG 0500 0470	
5	Spring		Spring marked on OS publications
6	Sink		Marked on OS publications
7	Drain - ditch		
8	Drain - ditch		
9 – Hill gate	Stream		
10	Pond		Dry during survey
11	Pond		Dry during survey
12	Water dived		
13	Drain		
14	Drain		0.5 L/s measured flow
15 – olde Vineyard	Pond		
16	Ditch		Fed by feature [15]
17	Ditch		
18	Drain		
19	Soakaway		
20 – Quarry base	Quarry pit lake		
21	Soakaway		
22 – Mill Pond discharge	outflow		
23 - Gunkle	Sink		This feature is a swallet or sink hole and appears to take the local drainage from Hillgate, the garden of which regularly floods during periods of rainfall
24 -Quarry	Quarry		
25	Sink/cave		
26	Sink/cave		
27	Sink/cave		
28	Sink/depression		

Figure 8: Water Feature Survey – Showing observation for the 16/10/2012 survey



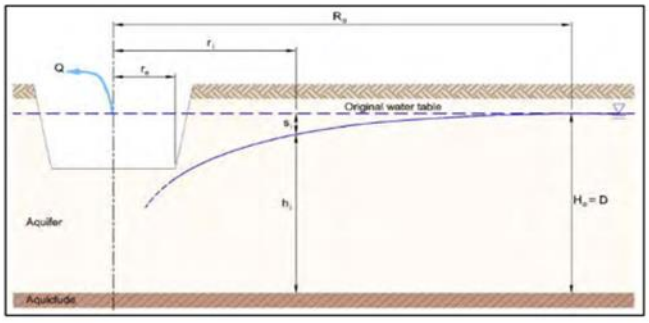
Appendix B Groundwater radius of influence impact calculations

B.1 Radius of influence (Sichardt)

Sichardt equations			
		Notes	Sichardt's Empirical Equation: $R_o = C(H - h_w)\sqrt{(k)}$
C	3000	Constant	Where:
H-hw	35	annual average	C is a constant (usually 3000)
k	8.50E-06	literature or in-situ	$H\text{-}h_w$ is drawdown at the excavation (m)
Ro	306.12	Excludes Re	k is permeability (m/s)
Ro	403.49	includes Re	

B.2 Radius of influence Dupuit-Thiem (Unconfined)

Drawdown impacts			
k-value	0.734	m/d	litrature or in-situ
H	35	m	Groundwater head above quarry floor outside zone of influence (annual average)
hw	0	m	Groundwater head above quarry floor at quarry face
re	97.37	m	Equivalent Well radius (I.e. borehole/mine diameter)
R	0	m/d	Recharge per day (annual average)



Thiem-Dupuit Equation:

$$Q = \frac{\pi k\left(H^2 - h_w^2\right)}{\ln\left[R_o / r_e\right]}$$

Assumptions:
- the aquifer is unconfined
- the aquifer has infinite areal extent
- the aquifer is homogeneous, and of uniform thickness
- there is only a small water table gradient
- groundwater flow is horizontal
- the pumping rate is constant
- the aquifer is fully penetrated
- the flow is in steady state
- the Dupuit assumptions are satisfied

For proposed bench

R0 (from quarry centre)	182.00	m
R0 (from quarry face)	85	m
Q gw inflow	4518.55	m3/d
Q gw inflow	52.30	l/s

Appendix C Assessment of the Effect of Varying the Discharge from Carew Quarry on the Water Quality in Carew Mill Pond (March 2004)

THOMAS SCOURFIELD & SONS

ASSESSMENT OF THE EFFECT OF VARYING THE DISCHARGE FROM CAREW QUARRY ON THE WATER QUALITY IN CAREW MILL POND

March 2004

Prepared by
Parsons Brinckerhoff Ltd
Queen Victoria House
Redland Hill
Redland
Bristol
BS6 6US

Report Title	**:**	**Assessment of the Effect of Varying the Discharge from Carew Quarry on the Water Quality in Carew Mill Pond**
Report Status	**:**	**Issue No. 2**
Job No	**:**	**KDBENCF012/040**
Date	**:**	**March 2004**
Prepared by	**:**	**.....** **A C D Groves**
Checked by	**:**	**.....** **J Price**
Check Cat	**:**	**C**
Approved by	**:**	**.....** **A Limage**

CONTENTS

Assessment of the Effect of Varying the Discharge from Carew Quarry on the Water Quality in Carew Mill Pond

Background

Carew Quarry is currently licensed to discharge water collected in its sump at a maximum rate of 3600 m^3/day. Monitoring of the discharge has shown that this volume is insufficient to support the effective operation of the quarry, particularly in periods of wet weather, when quarry inflows increase dramatically. The quarry owners, Thomas Scourfield & Sons therefore intend to apply to the Environment Agency Wales (EA) to increase the allowable discharge.

The sump water is discharged to a series of soakaways, from where it infiltrates into the host rock as groundwater. A proportion of this returns to the quarry (and the sump), whilst the remainder enters the Mill Pond to the south. The Mill Pond is the impounded section of the Carew River estuary, which is designated as a candidate Special Area for Conservation (cSAC).

The Countryside Commission for Wales (CCW) and the EA have confirmed that because of the cSAC status of the Mill Pond and the hydraulic connection between it and the quarry soakaways, the application to vary the existing discharge consent should be accompanied by an 'appropriate assessment' under the Habitats Regulations 1994. This report provides this assessment. It has been prepared by Parsons Brinckerhoff (PB) on behalf of the quarry owner and follows the methodology agreed with the EA at the meeting with CCW on 16 January 2003.

The report examines the potential for the proposed discharge consent variation to affect the salinity of the Mill Pond, which supports the Tentacled Lagoon Worm *Alkmaria romijni* within its bottom sediments. *Alkmaria romijni* is understood to be able to tolerate salinity between 5 - 20 mS/cm.

Hydrology of the Mill Pond

The Mill Pond is formed by impoundment of the Carew River, about 650m downstream (west) of the tidal limit. Flap valves (sluices) are located on the upstream side of the dam at three locations, allowing entrapment and containment of seawater on high tides, as well as freshwater flowing down the Carew River. The sluices allow the Pond to be emptied, if required. The area impounded between the dam and the Mean High Water Springs (MHWS) mark, is about 7 ha.

It is assumed that when originally constructed the tidal flaps operated efficiently. In time, however, these became worn and for many years significant leakage occurred through the tide dam, between high and low water. As recently as 2001, the leakage was such that the floor of the Mill Pond was exposed on most tides. More recently, however, Pembrokeshire National Park has undertaken refurbishment of the dam and sluices, such that the Mill Pond is now regularly full. It is understood that the refurbishment was completed in 2002.

Prior to the refurbishment of the tide dam, PB Kennedy & Donkin (now PB) confirmed that there were three main variables influencing the quantity and quality of water within the Mill Pond [(1)]:

- The flow regime of the Carew River;
- Discharge from Carew Quarry; and
- The state of the tide.

These are illustrated on the schematic of the Mill Pond hydrology, which is presented as Figure 1.

Quarry Discharge

The quarry discharge has been measured since May 2000, when an in-line flowmeter was installed on the pump rising main. Records have typically been taken at a weekly or fortnightly frequency and the data obtained are summarised in Table 1.

In the period between 1 May 2000 and 1 March 2004, a total of 5.943 Mm^3 of water was discharged through the rising main, corresponding to a mean daily flow of 4,245 m^3. A marked seasonal variation is apparent in the data, however, with average flows in wetter (generally winter) periods significantly exceeding those in drier weather. The maximum recorded mean daily discharge was 5,723 m^3 (between 13-20 February 2001), with a minimum of 2,792 m^3, between 11 June and 2 July in the same year.

The variation is caused because the quarry acts as the focus for drainage within a catchment significantly greater than the quarry footprint, which reacts rapidly to incident rainfall on the Carboniferous Limestone strata.

Discharge Quality

The water within the sump at Carew Quarry has been routinely monitored since February 1998 and is summarised on Figure 2. This shows the conductivity of the sump water to have varied between 0.5 mS/cm and about 3.5-4 mS/cm, with a mean value of 1.83 mS/cm. (The value of 6.1 mS/cm in early 2000 does not have a correspondingly elevated chloride value and appears to be spurious). It has been assumed that this data is an accurate representation of both the conditions during the monitoring period as well as the future conditions predicted under any revised consent.

Carew River Flows and Quality

The flow data for the Carew River Carew were provided by the Environment Agency Wales and a copy of their correspondence of 24 January 2003 is included in Appendix A. This indicates computed flows entering the Mill Pond as follows:

- Annual Mean Flow (ADF) 0.364 m^3/s (31,450 m^3/day)
- Annual 95 percentile low flow 0.027 m^3/s (2333 m^3/day)

For the purposes of this assessment, it has been assumed that the runoff within the Carew River has a conductivity of 250 µS/cm (0.25 mS/sm).

Estimated Volume of Mill Pond

The surface area of the Mill Pond upstream of the Tide Dam to the Mean High Water Springs (MHWS) mark, shown on published Ordnance Survey maps is 7.1 ha. For the purposes of this assessment it has been assumed that the *mean* depth of water impounded in this area is 1m. The impounded volume is therefore of the order of 71,000 m^3.

Mass Balance of Mill Pond

The assessment uses a simple mass balance approach to the hydrology of the Mill Pond, which can be summarised as follows:

$$V_P.C_P = V_T.C_T + V_Q.C_Q + V_S.C_S \quad (1)$$

Where, V, C refer to Volume and Conductivity respectively; and
subscripts $_{P,Q,T}$ refer to the Mill Pond, Quarry and Tidal Inflows respectively.

This equation is summarised on Figure 1.

It follows that:

$$C_P = [V_T.C_T + V_Q.C_Q + V_S.C_S] / V_P \quad (2)$$

In solving this equation to assess the effect of varying the quarry discharge (V_Q) into the Mill Pond, it is assumed that the volume of the Mill Pond (V_P) remains constant at 71,000 m^3, with the rest of the Mill Pond water comprising tidal inflow (V_T) and flows from the Carew River (V_S). It follows that,

$$V_T = 71{,}000 - V_Q - V_S \quad (3)$$

It is further assumed that with the refurbishment of the tide dam, leakage from the Mill Pond is negligible over a tidal cycle.

The equations have been solved for three different values of quarry discharge:

- 3600 m^3, the current consented volume;
- 4,245 m^3, the mean daily volume actually discharged between 1 May 2000 and 1 March 2004; and
- 10,000 m^3. This approximates to the maximum volume that could be discharged from the existing quarry with the existing infrastructure, which is limited by available electricity to power pumps (currently discharge is limited to about 7 hours per day).

The mass balance assumes full mixing within the Mill Pond. In assessing the historic situation, it has been assumed that mixing occurred over one tidal cycle (approximately 12 hours), reflecting the fact that leakage through the tide dam was significant and the bottom muds were often exposed at low water.

In assessing the current and future scenarios, the effect of varying the allowable quarry discharge upwards has assumed that mixing occurs over two tidal cycles, allowing relatively *more* freshwater inflows and dilution from the Carew River.

In each case, equation (2) has been solved for both mean and low flow conditions in the Carew River. The input parameters for each situation analysed are summarised in Table 2.

Results

The results of the mass balance model are summarised in Table 2. These show that:

- in the historic situation, increased discharges from the quarry were likely to have been marginally beneficial in improving the quality of impounded water in the Mill Pond;
- in the current situation, servicing of the tide dam should likewise have caused improvements in the quality of the impounded water, principally by allowing more freshwater flows from the Carew River to dilute saline inflows; and
- increasing the quarry discharge should lead to further improvements in the quality of the impounded water, which should not be harmful to the habitat of the Tentacled Lagoon Worm *Alkmaria romijni*.

Comment on Validity of Results

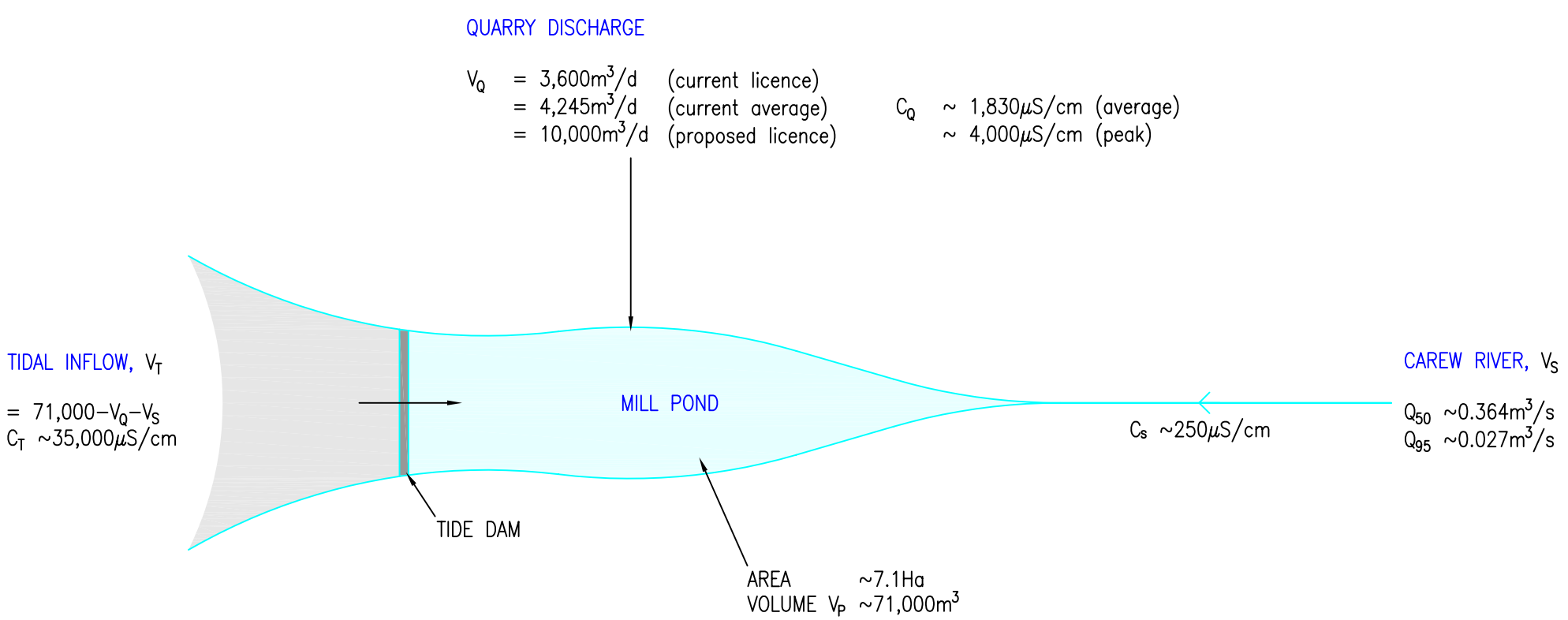
It is emphasised that the detailed hydrology of the Mill Pond is complex and the results presented in Table 2 are only 'valid' for the assumptions that have been made to simplify the natural situation. Whilst these are considered to be reasonable for the purpose of this report, it is emphasised that the hydrology of the Mill Pond is variable, in terms of both the volume and quality of the impounded water. In literal terms, the resultant quality of water in the Mill Pond, summarised in Table 2 for the current and future situations, actually represents the best estimate *following 24 hours of impoundment at Mean High Water Springs* for the purposes of comparison. At all other states of the tide, river inflow and durations of impoundment, variations in water quality from those shown in Table 2 can be expected. Such variations should not have a material effect on the overall conclusion of this assessment, provided below.

Conclusion

The mass balance approach undertaken in this assessment indicates that increasing the allowable discharge volume from Carew Quarry to 10,000 m^3 will be beneficial to the habitat of the Tentacled Lagoon Worm *Alkmaria romijni*.

(1) Carew Quarry, Carew Cheriton, Pembrokeshire. Review of Hydrological Information and Preliminary Assessment. PB Kennedy & Donkin Limited, July 2000.

FIGURES



MASS BALANCE

$$V_P.C_P = V_T.C_T + V_Q.C_Q + V_S.C_S$$

Where V,C = Volume, Conductivity
P = Pond
T = Tide
Q = Quarry Discharge
S = Surface Water

PB PARSONS BRINCKERHOFF

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- CLIENT/PROJECT
THOMAS SCOURFIELD & SONS
CAREW QUARRY
APPROPRIATE ASSESSMENT
OF MILL POND
- TITLE
SCHEMATIC SHOWING
HYDROLOGY OF MILL POND

- DATE 05/03/04
- SCALE Not to Scale
- CAD REF \BEN\CF\012\Z\1\BENCF012-F01.DWG

DRAWN BY BRG
PRODUCED BY ACDG
CHECKED ACDG
APPROVED

- DRAWING NUMBER
FIGURE 1

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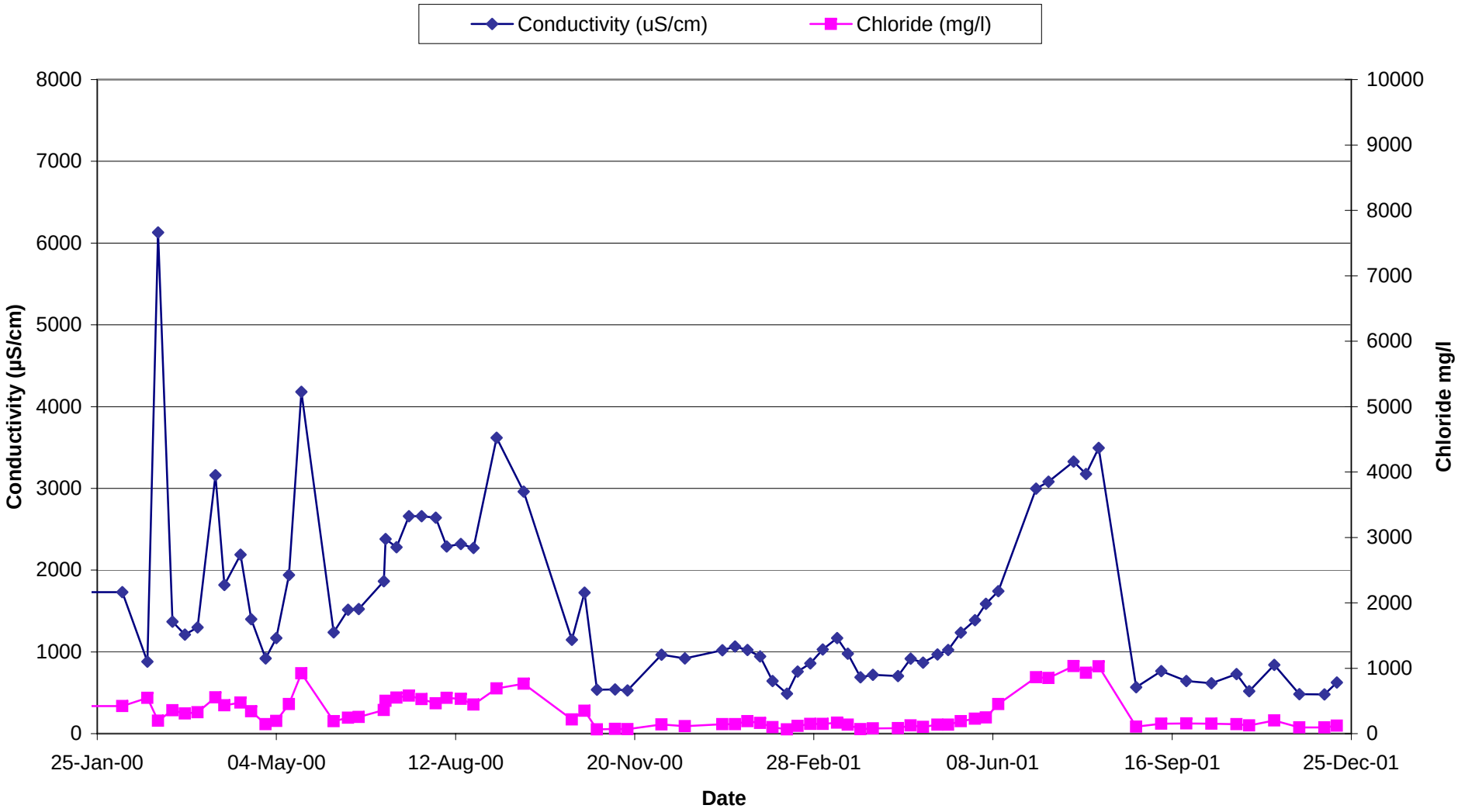


Figure 2: Sump Water Quality, 2000 - 2001

TABLES

Date	Meter Reading cu. m. (x10)	Accreted Vol. cu. m.	Time Interval (Days)	Mean Daily Vol. cu. m.
01-May-00				
12-Jun-00	12941	129410	42	3081
08-Jan-01	98562	856210	210	4077
15-Jan-01	102373	38110	7	5444
22-Jan-01	105684	33110	7	4730
29-Jan-01	109151	34670	7	4953
05-Feb-01	112721	35700	7	5100
13-Feb-01	116852	41310	8	5164
20-Feb-01	120858	40060	7	5723
26-Feb-01	123804	29460	6	4910
05-Mar-01	127795	39910	7	5701
12-Mar-01	130933	31380	7	4483
19-Mar-01	134483	35500	7	5071
26-Mar-01	138161	36780	7	5254
02-Apr-01	141764	36030	7	5147
17-Apr-01	150332	85680	15	5712
23-Apr-01	153384	30520	6	5087
30-Apr-01	156897	35130	7	5019
08-May-01	160955	40580	8	5073
14-May-01	164029	30740	6	5123
21-May-01	167491	34620	7	4946
29-May-01	170895	34040	8	4255
04-Jun-01	173165	22700	6	3783
11-Jun-01	175418	22530	7	3219
02-Jul-01	181282	58640	21	2792
09-Jul-01	183643	23610	7	3373
23-Jul-01	189539	58960	14	4211
30-Jul-01	191744	22050	7	3150
06-Aug-01	195385	36410	7	5201
13-Aug-01	198964	35790	7	5113
20-Aug-01	202432	34680	7	4954
28-Aug-01	206486	40540	8	5068
29-Oct-01	231930	254440	62	4104
12-Nov-01	238783	68530	14	4895
26-Nov-01	243139	43560	14	3111
10-Dec-01	250782	76430	14	5459
17-Dec-01	254306	35240	7	5034
07-Jan-02	262278	79720	21	3796
21-Jan-02	267740	54620	14	3901
19-Mar-02	297364	296240	57	5197
Pumping Statistics for Jan 2001- Mar 2002			Max	5723
			Mean	4667
			Min	2792

Table 1: Summary of Discharge Volumes, May 2000 - March 2004

Date	Meter Reading cu. m. (x10)	Accreted Vol. cu. m.	Time Interval (Days)	Mean Daily Vol. cu. m.
02-Dec-02	398916	1015520	258	3936
06-Jan-03	417964	190480	35	5442
13-Jan-03	421739	37750	7	5393
20-Jan-03	425483	37440	7	5349
27-Jan-03	429061	35780	7	5111
03-Feb-03	432639	35780	7	5111
10-Feb-03	436217	35780	7	5111
17-Feb-03	439233	30160	7	4309
24-Feb-03	443022	37890	7	5413
03-Mar-03	445749	27270	7	3896
10-Mar-03	449064	33150	7	4736
17-Mar-03	452138	30740	7	4391
31-Mar-03	457921	57830	14	4131
07-Apr-03	460458	25370	7	3624
14-Apr-03	462560	21020	7	3003
28-Apr-03	468465	59050	14	4218
05-May-03	471911	34460	7	4923
12-May-03	474300	23890	7	3413
29-May-03	481650	73500	17	4324
04-Jun-03	483439	17890	6	2982
09/06/2003	485670	22310	5	4462
23-Jun-03	491126	54560	14	3897
17-Jul-03	498841	77150	24	3215
21-Jul-03	500593	17520	4	4380
28-Jul-03	503503	29100	7	4157
11-Aug-03	509716	62130	14	4438
18-Aug-03	512230	25140	7	3591
08-Sep-03	520536	83060	21	3955
15-Sep-03	523030	24940	7	3563
22-Sep-03	525782	27520	7	3931
13-Oct-03	533302	75200	21	3581
20-Oct-03	535872	25700	7	3671
27-Oct-03	538529	26570	7	3796
03-Nov-03	541366	28370	7	4053
10-Nov-03	544018	26520	7	3789
24-Nov-03	549854	58360	14	4169
01-Dec-03	552870	30160	7	4309
15-Dec-03	558599	57290	14	4092
05-Jan-04	568396	97970	21	4665
19-Jan-04	575218	68220	14	4873
26-Jan-04	578484	32660	7	4666
09-Feb-04	585122	66380	14	4741
16-Feb-04	588031	29090	7	4156
23-Feb-04	591231	32000	7	4571
01-Mar-04	594300	30690	7	4384
Pumpage Statistics for 2003 - February 2004			Max	5442
			Mean	4272
			Min	2982

Table 1 (cont'd): Summary of Discharge Volumes, May 2000 - March 2004

	HISTORIC SITUATION				CURRENT		FUTURE	
	MEAN	**LOW FLOW**	**MEAN**	**LOW FLOW**	**MEAN**	**LOW FLOW**	**MEAN**	**LOW FLOW**
Quarry Discharge V_Q (m^3/day)	3600	3600	4245	4245	4245	4245	10,000	10,000
Discharge Quality C_Q (mS/cm)	1.83	4	1.83	4	1.83	4	1.83	4
River Inflow, V_s (m^3)	15,725	1166.5	15,725	1166.5	31,450	2,333	31,450	2,333
River Quality, C_s (mS/cm)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Tidal Inflow, V_T (m^3)	51,675	66,533.5	51,675	66,533.5	35,305	64,422	29,550	58,667
Tidal Quality, C_T (mS/cm)	35	35	35	35	35	35	35	35
Mill Pond Quality, C_P (mS/cm)	25.62	32.86	25.32	32.58	17.62	32.0	14.94	29.49
Calculations	p.3	p.3	p.4	p.4	p.5	p.5	p.6	p.6
Assumptions	Mixing Over 1 Tidal Cycle = 12 hrs				Mixing Over 2 Tidal Cycles = 24 hrs			

Table 2: Summary of Mass Balance Calculations

APPENDICES

APPENDIX A

EA CORRESPONDENCE, 24 JANUARY 2003

RECEIVED 27 JAN 2003

ASIANTAETH YR AMGYLCHEDD CYMRU
ENVIRONMENT AGENCY WALES

Ein cyf/Our ref. SW/WQRT/TJW

Dyddiad/Date: 24 January 2003

Mr. Alistair Groves
Parsons Brinckerhoff
Queen Victoria House
Redland Hill
Redland
Bristol BS6 6US

Dear Mr. Groves

RE: DISCHARGE CONSENT VARIATION APPLICATION – BP0236901

Further to my letter of 17th January, I write, as promised, to confirm the effect of your proposals on the discharge limit for Total Suspended Solids (TSS).

I have established that with regard to this parameter, strict application of the Agency's 'no deterioration' policy need not be applied in this instance, as the consent limit thus derived would be deemed unreasonably onerous. Instead, the consent variation application, once complete, will be determined to include a general sector discharge standard, which I confirm for TSS to be 50mg/l.

Please feel free to contact me should you wish to discuss any of the above.

Yours sincerely,

Trevor J. West
Water Quality Regulatory Officer

cc. Rod Thomas (Environment Officer - EAW)

Asiantaeth yr Amgylchedd Cymru
Glan Tawe, 154 Ffordd San. Helen, Abertawe, SA1 4DF Ffon 01792 645300, Ffacs 01792 648652

Environment Agency Wales
Glan Tawe, 154 St. Helens Road, Swansea, SA1 4DF Tel 01792 645300, Fax 01792 648652

RECEIVED 24 JAN 2003

WATER RESOURCES REF :	CONSENT REF :
Gen03_03	none

Location Reference : SN04800380

Summary:
River Carew where it passes under main road above the Carew Mill Pond

Flow Estimates/Calculations	Value	Comment
Annual MF (*ADF)	0.364 m^3/s	Natural Flow Estimate using Low Flows 2000
Annual 95%(ile) Flow	0.027 m^3/s	

Additional Comments	Catchment area measured by Low Flows 2000 is 18.68km^2. Confidence Intervals For Low Flows 2000: MF + 10%, Q95 + 65%

Signed (WR staff) : TAD	Date : 21/01/2003

Replied & thanks
23/1/03.

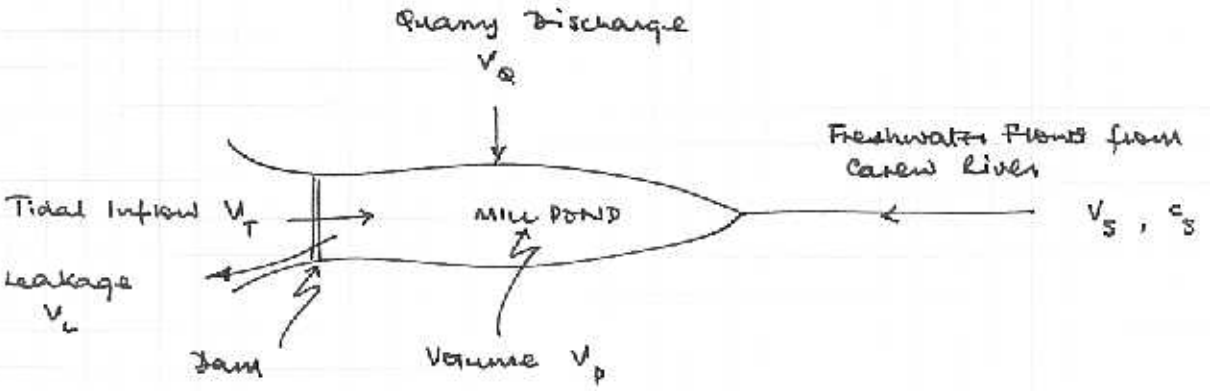
APPENDIX B

CALCULATION SHEETS

PB 100 YEARS

CALCULATION SHEET

Contract Title	CAREW QUARRY		Job No KD BENCF012.040.
Subject	Appropriate Assessment of Mill Pond.		Drawing No.
Calc. by	ACBG7	Date 5.3.2004.	Dept. Ref.
Checked by	JP	Date 8/3/04	Calc. Sheet 1. of 7



Area of Mill Pond upstream of tide dam on published OS plans = 71,000 m² (7.1 ha) to MHWS

Assume mean water level in Mill Pond = 1m (probably conservative)

∴ Volume of Mill Pond, V_p = 71,000

Assume ∴ $V_T + V_Q + V_S$ = $71,000 - V_L$

Assume leakage is negligible over one tidal cycle

∴ V_T = $71,000 - V_Q - V_S$ (1) V_S ? ✓

Assuming full mixing in Mill Pond

$$V_p \cdot C_p = V_T \cdot C_T + V_Q \cdot C_Q + V_S \cdot C_S$$

where C is concentration (eg of $[Cl^-]$ or salinity or conductivity)

∴ Resultant concentration within the Mill Pond

$$C_p = \frac{V_T \cdot C_T + V_Q \cdot C_Q + V_S \cdot C_S}{V_p} \quad (2)$$

where,

C_T = quality of tidal inflow
C_Q = quality of quarry discharge
C_S = quality of surface flows

PB 100 YEARS

CALCULATION SHEET

Contract Title	CAREW QUARRY	Job No.	KD BENBL012.040
Subject	Appropriate Assessment of Mill Pond	Drawing No.	
Calc. by	AC[illegible]	Date	5.3.04
Checked by	[signature]	Date	8/3/04
Dept. Ref.		Calc. Sheet	2 of 7

Q_{50} (mean daily flow) of Carew River ~ 0.364 m^3/sec (31,450 m^3/d)

Q_{95} (5% low flow) ~ 0.027 m^3/sec (2,333 m^3/day)

(Data provided by EA Wales @ NGR SN 0480 0380 using Low Flows 2000)

Assume C_S low throughout year, reflecting surface flows

~ 250 µS/cm (probably conservative)

Assume C_T ~ 35,000 µS/cm, reflecting seawater

C_Q taken from quarry sump quality (2000-2001)

~ 1,830 µS/cm (mean)
~ 4,000 µS/cm (peak)

(see figure)

Solve equations (1), (2) for the following situations:

(i) V_Q = 3600 m^3/day (existing consent)

(ii) V_Q = 4245 m^3/day (current mean discharge 2000-2005)

(iii) V_Q ~ 10,000 m^3/day (proposed revised consent)

Solve each for:

(a) V_S = 31,450 m^3/day (mean river flows)
for C_S = 0.25 mS/cm ;
C_Q = 1.83 mS/cm (mean discharge quality)

(b) V_S = 2,333 m^3/day (low flows)
C_S = 0.25 mS/cm
C_Q = 4 mS/cm (assuming quarry discharge quality passes @ low flow).

CALCULATION SHEET

Contract Title: CAREW QUARRY			Job No: KDBENCF012 · 040
Subject: Appropriate Assessment of Mill Pond			Drawing No.
Calc. by: ACBQ	Date: 5.3.04		Dept. Ref.
Checked by:	Date: 8/3/04		Calc. Sheet: 3 of 7

Historic Situation:

Leakage occurred thro' tide dam ∴ some for (2) over 1 no. tidal cycle (assume 12 hours).

Consented discharge $V_Q = 3600\ m^3/d$; $C_Q = 1.83$ mS/cm (av.)

Mean river flows $V_{QS} = (31,450/2)\ m^3/d$; $C_S = 0.25$

$\therefore$ $V_T = 71,000 - 3600 - 15725 = 51,675$; $C_T = 35$

$\therefore$ with full mixing $C_p = \dfrac{(51,675 \cdot 35) + (3600 \cdot 1.83) + (15725 \cdot 0.25)}{71,000}$

$= \underline{25.62\ mS/cm.}$

Under low flow conditions:

$V_S = (2,333/2)\ m^3/d$; $C_S = 0.25$

$V_T = 71,000 - 1166.5 - 3600 = 66,233.5$

$C_Q = 4$ mS/cm

$\therefore$ $C_p = \dfrac{(66,233.5 \cdot 35) + (3600 \cdot 4) + (1166.5 \cdot 0.25)}{71,000}$

$= \underline{32.86\ mS/cm}$

In other words, the quality of water within the mill Pond falls in summer (dry) conditions because of the small proportion of 'sweetening flow' from the Carew River and leakage through the tide dams

PB 100 YEARS

CALCULATION SHEET

Contract Title	CAREW QUARRY		Job No. KD BENCF012.040
Subject	Appropriate Assessment of Mill Pond		Drawing No.
Calc. by	ACBBY	Date 5.3.04	Dept. Ref.
Checked by	JP	Date 8/3/04	Calc. Sheet 4 of 7

Under mean conditions with the actual discharge, assuming mixing over one tidal cycle:

ie $V_Q = 4245$; $C_Q = 1.83$
$V_S = 15725$; $C_S = 0.25$

$V_T = 71,000 - 4245 - 15725 = 51,030$; $C_T = 35$

$$\therefore C_p = \frac{(51,030 \cdot 35) + (4245 \cdot 1.83) + (15725 \cdot 0.25)}{71,000}$$

$$= \underline{25.32 \text{ mS/cm}}$$

At low flows

$V_Q = 4245$; $C_Q = 4$
$V_S = 1166.5$; $C_S = 0.25$

$V_T = 71,000 - 4245 - 1166.5 = 65,588.5$; $C_T = 35$

$$\therefore C_p = \frac{(65,588.5 \cdot 35) + (4245 \cdot 4) + (1166.5 \cdot 0.25)}{71,000}$$

$$= \underline{32.58 \text{ mS/cm}}$$

In other words, the historic quality of water within the Mill Pond was marginally better with the increased inflows from the quarry.

PB 100 YEARS

CALCULATION SHEET

Contract Title	CAREW QUARRY		Job No. KDBENCP012 · 040 .
Subject	Appropriate Assessment of Mill Pond		Drawing No.
Calc. by	AC[illegible]	Date 5.3.04	Dept. Ref.
Checked by		Date 8/3/04	Calc. Sheet 5. of 7

Current Situation

Tide dam now refurbished ∴ assume mixing over 2 no. tidal cycles

ie V_Q = 4245 ; C_Q = 1.83
V_S = 31,450 ; C_S = 0.25

V_T = 71,000 − 4245 − 31,450 = 35,305 ; C_T = 35

$$\therefore C_p = \frac{(35{,}305 \cdot 35) + (4245 \cdot 1.83) + (31{,}450 \cdot 0.25)}{71{,}000}$$

= 17.62 mS/cm (cf first soln on p.4) ✓

At low flows:

V_Q = 4245 ; C_Q = 4
V_S = 2333 ; V_S = 0.25

V_T = 71,000 − 4245 − 2333 = 64,422 ; C_T = 35

$$\therefore C_p = \frac{(64{,}422 \cdot 35) + (4245 \cdot 4) + (2333 \cdot 0.25)}{71{,}000}$$

= 32 mS/cm * (cf 2nd soln on p.4). ✓

These results show / illustrate that refurbishment of the tide dam led to marginally better quality within the Mill Pond by allow more freshwater inflows.

NOTE: * 2nd solution at low flows reflects the quality that would result at Q_{95} in the Carew River if the tide dam was opened every 24 hours. In reality, this does not happen regularly and Mill Pond is progressively diluted by continued quarry discharge & river flow.

Eg after 5 days, with full mixing C_p → ≈ 20 mS/cm.

PB 100 YEARS

CALCULATION SHEET

Contract Title	CAREW QUARRY		Job No. KDBENCP012.040.
Subject	Appropriate Assessment of Mill Pond		Drawing No.
Calc. by	ACH	Date 5.3.04	Dept. Ref.
Checked by	JP	Date 8/3/04	Calc. Sheet 6 of 7

Future Situation

Assuming mixing over 1 tidal cycle, for comparison with results on p.6.

ie V_Q = 10,000 ; C_Q = 1.83

V_S = 31,450 ; C_S = 0.25

V_T = 71,000 − 10,000 − 31,450 = 29,550 ; C_T = 35

$$\therefore C_p = \frac{(29,550 \cdot 35) + (10,000 \cdot 1.83) + (31,450 \cdot 0.25)}{71,000}$$

= 14.94 mS/cm ✓ (cf soln #1 on p5)

At low flows:

V_Q = 10,000 ; C_Q = 4

V_S = 2,333 ; C_S = 0.25

V_T = 71,000 − 10,000 − 2,333 = 58,667

$$\therefore C_p = \frac{(58,667 \cdot 35) + (10,000 \cdot 4) + (2,333 \cdot 0.25)}{71,000}$$

= 29.749 mS/cm * ✓ (cf soln #2 on p.5)

In other words, increased quarry discharge is beneficial to the quality of water in the Mill Pond when compared with the current situation.

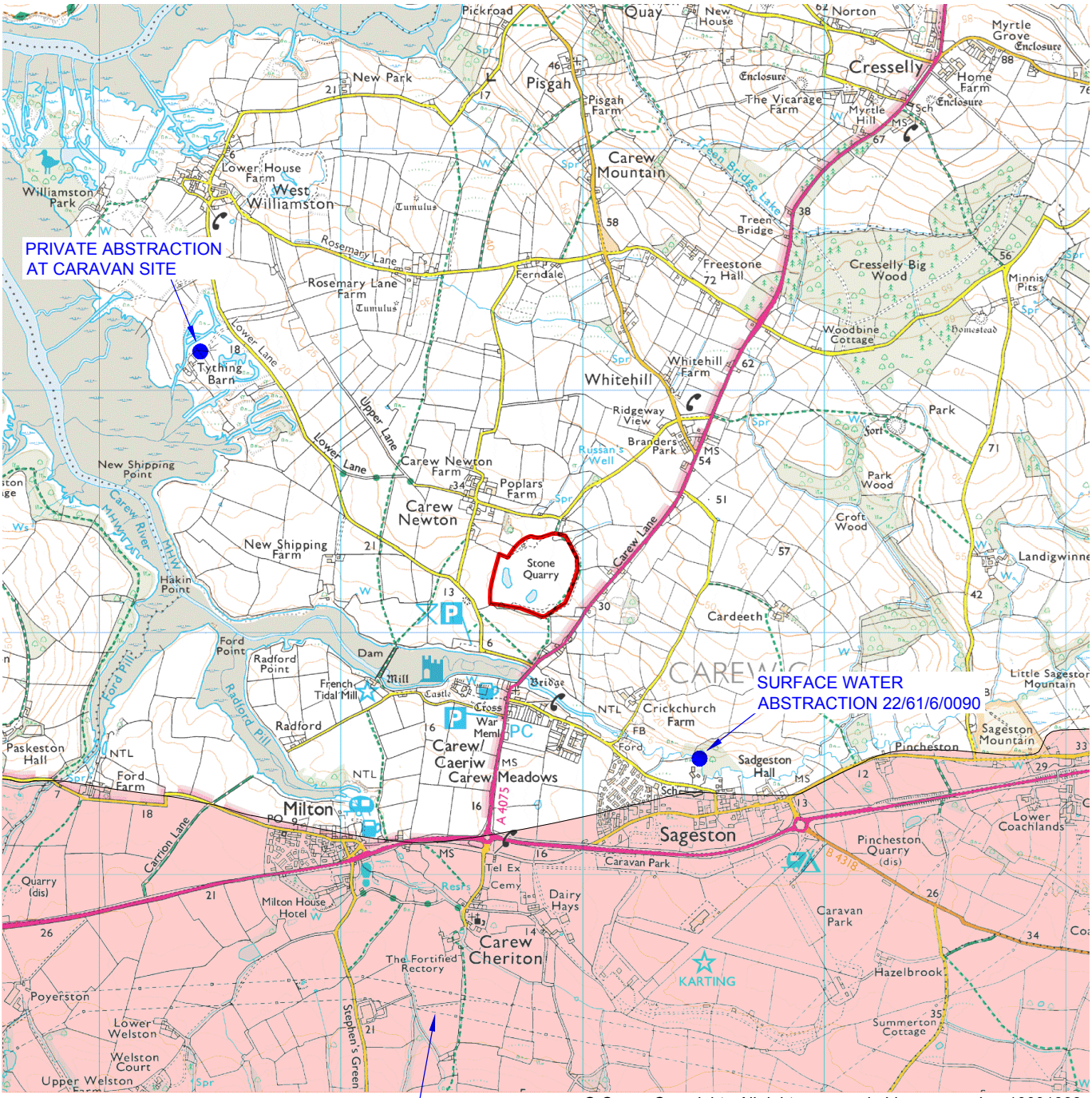
* Again this result shows av. quality in Mill Pond at Q_{95} after the tide dam has been shut for 24 hrs.

After 5 days with full mixing $C_p \rightarrow$ 7.5 mS/cm.

CALCULATION SHEET

Contract Title	CAREW QUARRY	Job No.	KD8ENCF012. 040.
Subject	Appropriate Assessment	Drawing No.	
Calc. by	ACJDG7	Date	5-3-04
Dept. Ref.			
Checked by	JP	Date	8/3/04
Calc. Sheet	7. of 7		

	HISTORIC SITUATION				CURRENT		FUTURE.	
	MEAN	LOW FLOW	MEAN	LOW FLOW	MEAN	LOW FLOW	MEAN	LOW FLOW
QUARRY DISCHARGE (m^3/day)	3600	3600	4245	4245	4245	4245	10,000	10,000
DISCHARGE QUALITY (mS/cm)	1.83	4	1.83	4	1.83	4	1.83	4
RIVER INFLOW (m^3)	15,725	1166.5	15,725	1166.5	31,450	2,333	31,450	2,333
RIVER QUALITY (mS/cm)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TIDAL INFLOW (m^3)	5t 51,675	66,233.5	51,675	66,233.5	35,305	64,422	29,550	58,667
TIDAL QUALITY (mS/cm)	35	35	35	35	35	35	35	35
MILL POND QUALITY (mS/cm)	25.62	32.86	25.32	32.58	17.62	32.0	14.94	29.49
CALCULATIONS	p.3	p.3	p.4	p.4	p.5	p.5	p.6	p.6
ASSUMPTIONS.	MIXING OVER 1 TIDAL CYCLE = 12 HRS				MIXING OVER 2 TIDAL CYCLES = 24 HRS			



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PARSONS BRINCKERHOFF
Queen Victoria House
Redland Hill, Redland
Bristol BS6 6US
Tel: 44-(0)117-933-9300
Fax: 44-(0)117-933-9253

Client/Project:
THOMAS SCOURFIELD AND SONS

Title:
HYDROGEOLOGICAL ASSESSMENT

Drawn: BRG		Checked: ACDG	
Designed: ACDG		Approved:	
Date: 13/11/2012	Scale: 1:25,000	A4	Sheet:
Project Number: 3512339A		Drawing Number: FIGURE 7.1	Revision:

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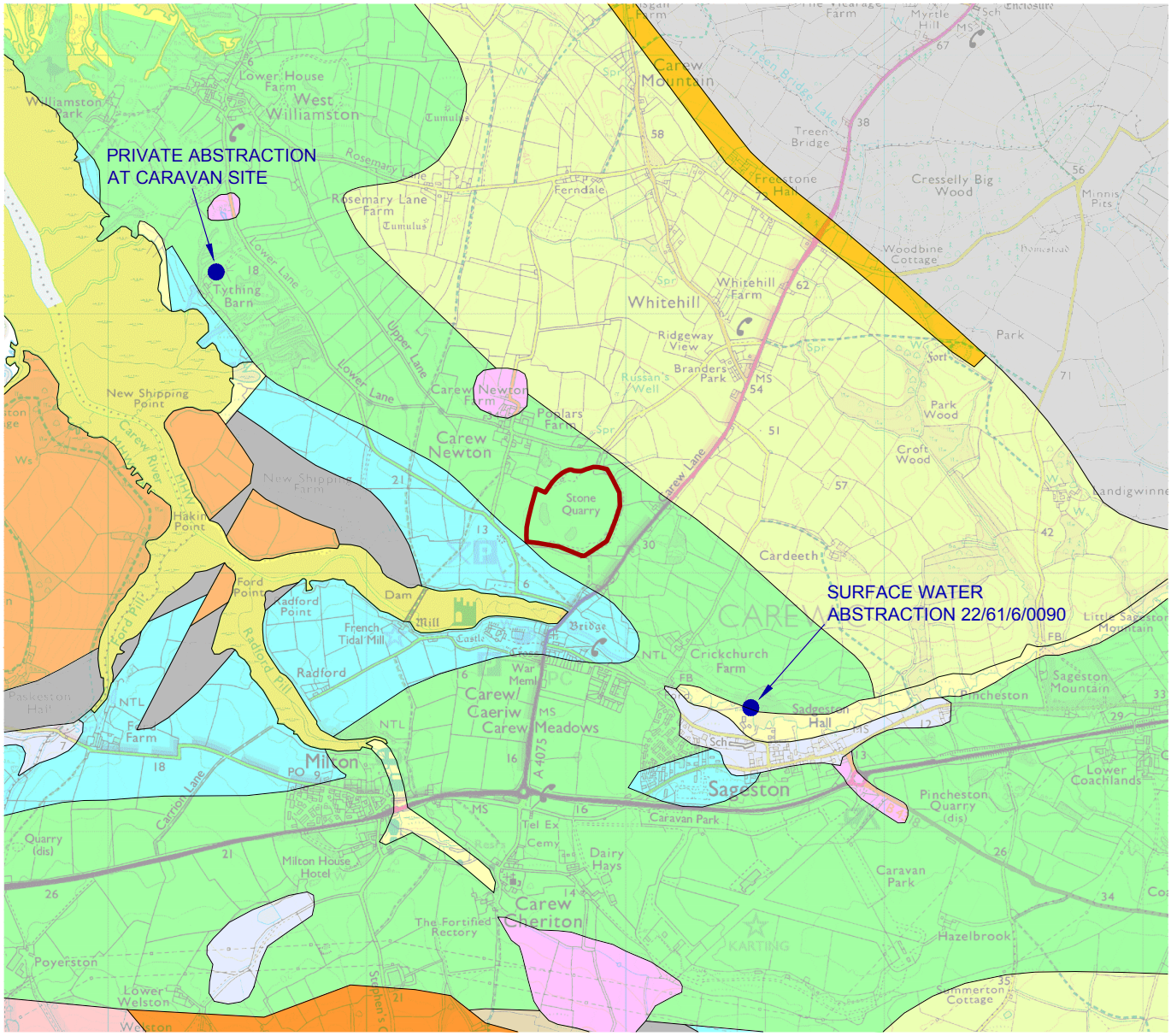
Login: Giles, Ben



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EXTENT OF SURVEY

SITE LOCATION

Superficial Deposits

- Alluvium
- Tidal flat deposits
- Glacial fluvial deposits
- Till, mid pleistocene

Bedrock Geology

- South Wales Lower Coal Measures Formation
- Telpyn Point Sandstone Formation
- Bishopston Mudstone Formation
- Avon Group
- Black Rock Subgroup and Gully Oolite Formation (undifferentiated)
- Pembroke Limestone Group
- Skrinkle Sandstone Formation
- Ridgeway Conglomerate
- Cosheston Group
- Milford Haven Group

PARSONS BRINCKERHOFF
Queen Victoria House
Redland Hill, Redland
Bristol BS6 6US
Tel: 44-(0)117-933-9300
Fax: 44-(0)117-933-9253

Client/Project:
THOMAS SCOURFIELD AND SONS

Title:
SITE GEOLOGY

Drawn: JSdS		Checked: ACDG	
Designed: JSdS		Approved:	
Date: 13/11/2012	Scale: 1:25,000	A4	Sheet:
Project Number: 3512339A		Drawing Number: FIGURE 7.2	Revision:

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Login: Giles, Ben

creating a better place

Environment Agency

Thomas Scourfield & Sons
The Director
Carew Quarry
Carew Cheriton
Tenby
SA70 8SR

Our ref: BP0236901/V001

Date: 26/11/2011

Dear Sir or Madam

Notice of variation to change conditions of environmental permit for a groundwater activity

Permit reference: BP0236901/V001
Operator: Thomas Scourfield & Sons
Facility: Carew Quarry

When the Environmental Permitting Regulations 2010 were enacted in April 2010, your existing discharge consent automatically became an environmental permit.

The Regulations state that we must review all consents for discharges to groundwater in existence at the time the Regulations came in, to make sure we have the right conditions in place to protect the environment.

I enclose a notice to show the changes we've made to your permit following our review. We refer to these changes as a variation. Please keep the notice in a safe place with your other permit records.

We haven't changed the volume to be discharged, the discharge location and method of discharge. The only change you need to be aware of is a new requirement under the Environmental Permitting Regulations 2010 for you to manage and operate the activities according to a written management system. This is referred to under condition 1.1 of the permit; General management. A copy of a management system template can be found on our internet site at http://www.environment-agency.gov.uk/business/topics/pollution/113738.aspx

Your Environment Management System (EMS) must be proportionate to the size of your activities:

- If your permit covers just your household, then you should keep records of emergency contact numbers and records of maintenance including invoices for de-sludging and repairs. You must keep these records for 6 years and pass them on to the new owner if you move house.
- If your permit covers multiple properties you should use the management system template, found via the link above, as the basis for the EMS. The EMS should be used to demonstrate good practice in running the facility and include emergency contact numbers and maintenance.
- For discharges of trade effluent or sewage effluent with a volume above 20 cubic metres per day the link above outlines what the EMS should include.

If you have any questions about the above variation please email

wqpermittingwales@environment-agency.gov.uk or phone 02920 466474.

The following options explain what you need to do if you need to make further changes to your permit.

Changing or giving up a permit

If you need to change your permit, pass it to someone else (transfer), or give it up (surrender) please phone us for advice about what to do or look at our website: http://www.environment-agency.gov.uk/business/topics/permitting/32318.aspx

If the permit has been passed to you to use but you're not named on it you need to let us know.

If you have any questions regarding transferring or surrendering your permit please email psc-waterquality@environment-agency.gov.uk or phone 01142 898 335.

Right of appeal

If you're not happy with any condition that we've included in this variation you may appeal to the Welsh Ministers.

You must appeal within two months from the date of the notice. The Planning Inspectorate website has more information on how to appeal, or you can contact them at:

The Planning Inspectorate, Crown Buildings, Cathays Park, Cardiff, CF10 3NQ. Phone 029 2082 3866 / 389, Fax: 029 2082 5150

Email: wales@pins.gsi.gov.uk

You must send written notice of the appeal and the documents listed below to the Welsh Ministers to the Planning Inspectorate address and a copy to us.

The documents required for an appeal are:

- a statement of the grounds of appeal
- a copy of any relevant application
- a copy of any relevant environmental permit
- a copy of any relevant correspondence between you and us
- a copy of any decision notice which is the subject matter of the appeal
- a statement indicating whether you wish the appeal to be in the form of a hearing or dealt with by way of written representations.

Please send the copies for the Environment Agency to:

Victoria Balmer, Appeals Coordinator, Environment Agency. National Permitting Service, Knutsford Road, Latchford, Warrington, WA4 1HG.

Phone: 01925 542456 Email: Victoria.balmer@environment-agency.gov.uk

You may withdraw an appeal by writing to the Welsh Ministers and sending a copy to us.

Yours faithfully

National Permitting Service

Appendix D Emvironmental Permit Reference BP0236901/ V001

Notice of variation and consolidation with introductory note

Environmental Permitting (England & Wales) Regulations 2010

Thomas Scourfield & Sons

Carew Quarry
Carew
Cheriton
Tenby
Pembrokeshire
SA68 0TP

Variation application number

BP0236901/V001

Permit number

BP0236901

Carew Quarry
Permit number BP0236901

Introductory note

This introductory note does not form a part of the notice.

The following notice gives notice of the variation of an environmental permit.

Following a review of the existing permit this variation notice changes the conditions to ensure compliance with the Environmental Permitting (England and Wales) Regulations 2010 ('the Regulations'). There are no changes to the groundwater activity.

Site plans attached to the permits when they were originally granted are to be deleted in this review exercise. Regulation 14(4) of the Regulations requires environmental permits to include a map, plan or other description of the site of the regulated facility showing its geographical extent. However, regulation 70(a) disapplies this requirement to discharge consents and authorisations (such as this) which became environmental permits on 6 April 2010, upon the introduction of the Regulations. The original site plans do not show the boundary of the site.

The schedules specify the changes made to the original permit.

The status log of a permit sets out the permitting history, including any changes to the permit reference number. It is not backdated before 6 April 2010

Status log of the permit		
Description	**Date**	**Comments**
Regulator initiated variation determined BP0236901/V001	26/11/2011	EPR and GWDD update

End of introductory note

Notice of variation and consolidation

Environmental Permitting (England and Wales) Regulations 2010

The Environment Agency in exercise of its powers under regulation 20 of the Environmental Permitting (England and Wales) Regulations 2010 varies and consolidates

Permit number
BP0236901

issued to:
Thomas Scourfield & Sons ("the operator")

of

The Director
Carew Quarry
Carew Cheriton
Tenby
SA70 8SR

to operate a regulated facility at

Carew Quarry
Carew
Cheriton
Tenby
Pembrokeshire
SA68 0TP

to the extent set out in the schedules.

The notice shall take effect from 26/11/2011

Name	Date
Eleanor Smart	**26/11/2011**

Authorised on behalf of the Environment Agency

Schedule 1 – conditions to be deleted

All conditions and site plans are deleted and replaced with new template conditions.

Schedule 2 – conditions to be amended

None.

Schedule 3 – conditions to be added

Please see attached new conditions.

Permit [redacted]

The Environmental Permitting (England and Wales) Regulations 2010

Permit number
BP0236901

This is the consolidated permit referred to in the variation and consolidation notice for application BP0236901/V001 authorising,

Thomas Scourfield & Sons ("the operator")

of

The Director
Carew Quarry
Carew Cheriton
Tenby
SA70 8SR

to operate a groundwater activity at

Carew Quarry
Carew
Cheriton
Tenby
Pembrokeshire
SA68 0TP

to the extent authorised by and subject to the conditions of this permit.

Name	Date
Eleanor Smart	**26/11/2011**

Authorised on behalf of the Environment Agency

Conditions

1 Management

1.1 General management

1.1.1 The operator shall manage and operate the activities:

(a) in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances and those drawn to the attention of the operator as a result of complaints; and

(b) using sufficient competent persons and resources.

1.1.2 Records demonstrating compliance with condition 1.1.1 shall be maintained.

1.1.3 Any person having duties that are or may be affected by the matters set out in this permit shall have convenient access to a copy of it kept at or near the place where those duties are carried out.

2 Operations

2.1 Permitted activities

2.1.1 The operator is only authorised to carry out the activities specified in schedule 1 table S1.1 (the "activities").

2.2 The discharge

2.2.1 The discharge shall be made at the point listed in table S3.2 of this permit (discharge points).

3 Emissions and monitoring

3.1 Emissions to water, air or land

3.1.1 There shall be no point source emissions to water, air or land except from the sources and emission points listed in schedule 3 tables S3.1, S3.2 and S3.3.

3.1.2 The limits given in schedule 3 shall not be exceeded.

3.2 Emissions of substances not controlled by emission limits

3.2.1 Emissions of substances not controlled by emission limits (excluding odour) shall not cause pollution. The operator shall not be taken to have breached this condition if appropriate measures, including, but not limited to, those specified in any approved emissions management plan, have been taken to prevent or where that is not practicable, to minimise, those emissions.

3.2.2 The operator shall:

(a) if notified by the Environment Agency that the activities are giving rise to pollution, submit to the Environment Agency for approval within the period specified, an emissions management plan;

(b) implement the approved emissions management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

3.2.3 Appropriate measures shall be taken to prevent the input of hazardous substances to groundwater by avoiding the entry of those substances into groundwater and by avoiding any significant increase in their concentration in groundwater.

3.3 Monitoring

3.3.1 Permanent means of access shall be provided to enable sampling/monitoring to be carried out in relation to the emission points specified in schedule 3 tables S3.1, S3.2 and S3.3 unless otherwise agreed in writing by the Environment Agency.

4 Information

4.1 Records

4.1.1 All records required to be made by this permit shall:

(a) be legible;

(b) be made as soon as reasonably practicable;

(c) if amended, be amended in such a way that the original and any subsequent amendments remain legible, or are capable of retrieval; and

(d) be retained, unless otherwise agreed in writing by the Environment Agency, for at least 6 years from the date when the records were made.

4.1.2 The operator shall keep on site all records, plans and the management system required to be maintained by this permit, unless otherwise agreed in writing by the Environment Agency.

4.2 Reporting

4.2.1 The operator shall send all reports and notifications required by the permit to the Environment Agency using the contact details supplied in writing by the Environment Agency.

4.3 Notifications

4.3.1 The Environment Agency shall be notified without delay following the detection of:

(a) any malfunction, breakdown or failure of equipment or techniques, accident, or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution;

(b) the breach of a limit specified in the permit; or

(c) any significant adverse environmental effects.

(d) any emergency discharge that has occurred.

4.3.2 Any information provided under condition 4.3.1 shall be confirmed by sending the information listed in schedule 5 to this permit within the time period specified in that schedule.

4.3.3 Where the Environment Agency has requested in writing that it shall be notified when the operator is to undertake monitoring and/or spot sampling, the operator shall inform the Environment Agency when the relevant monitoring and/or spot sampling is to take place. The operator shall provide this information to the Environment Agency at least 14 days before the date the monitoring is to be undertaken.

4.3.4 The Environment Agency shall be notified within 14 days of the occurrence of the following matters, except where such disclosure is prohibited by Stock Exchange rules:

Where the operator is a registered company:

(a) any change in the operator's trading name, registered name or registered office address; and

(b) any steps taken with a view to the operator going into administration, entering into a company voluntary arrangement or being wound up.

Where the operator is a corporate body other than a registered company:

(a) any change in the operator's name or address; and

(b) any steps taken with a view to the dissolution of the operator.

4.3.5 Where the operator proposes to make a change in the nature or functioning, or an extension of the activities, which may have consequences for the environment and the change is not otherwise the subject of an application for approval under the Regulations or this permit:

(a) the Environment Agency shall be notified at least 14 days before making the change; and

(b) the notification shall contain a description of the proposed change in operation.

4.4 Interpretation

4.4.1 In this permit the expressions listed in schedule 6 shall have the meaning given in that schedule.

4.4.2 In this permit references to reports and notifications mean written reports and notifications, except where reference is made to notification being made "without delay", in which case it may be provided by telephone.

Schedule 1 – Operations

Table S1.1 Activities	
Description of activity	**Limits of specified activity**
Groundwater activity: discharge into land of trade effluent from trade effluent treatment	Via a soakaway system at NGR SN0459504048

Schedule 2 - Waste types, raw materials and fuels

Wastes are not accepted as part of the permitted activities and there are no restrictions on raw materials or fuels under this schedule.

Schedule 3 – Emissions and monitoring

Table S3.1 Point Source emissions to water (other than sewer) and land – emission limits and monitoring requirements

Emission point ref. & location	Parameter	Limit (incl. unit)	Reference Period	Monitoring frequency	Compliance statistic
Outflow from trade effluent treatment prior to discharge into land	Maximum daily flow	10000.0 m^3/day	Total daily volume	N/A	Maximum
Outflow from trade effluent treatment prior to discharge into land	Visible oil or grease	No significant trace present	Instantaneous (spot sample)	N/A	No significant trace
Outflow from trade effluent treatment prior to discharge into land	pH	6.0 pH Units	Instantaneous (spot sample)	N/A	Minimum Value
Outflow from trade effluent treatment prior to discharge into land	pH	9.0 pH Units	Instantaneous (spot sample)	N/A	Maximum Value
Outflow from trade effluent treatment prior to discharge into land	Solids, Suspended at 105 C	50.0 Milligrams Per Litre	Instantaneous (spot sample)	N/A	Maximum Value
Outflow from trade effluent treatment prior to discharge into land	Flow, instantaneous	115.0 Litres Per Second	Instantaneous (spot sample)	N/A	Maximum Value

Table S3.2 Discharge points

Effluent Name	Discharge Point	Discharge point NGR	Receiving Environment
trade effluent	Outlet 1	SN0459504048	Groundwater

Table S3.3 Monitoring points

Effluent and discharge point	Monitoring type	Monitoring point NGR	Monitoring point reference
trade effluent via Outlet 1	Effluent sample point	SN0459504048	N/A

Schedule 4 - Reporting

There is no reporting under this schedule.

Schedule 5 - Notification

These pages outline the information that the operator must provide.

Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

If any information is considered commercially confidential, it should be separated from non-confidential information, supplied on a separate sheet and accompanied by an application for commercial confidentiality under the provisions of the EP Regulations.

Part A

Permit Number	
Name of operator	
Location of Facility	
Time and date of the detection	

(a) Notification requirements for any malfunction, breakdown or failure of equipment or techniques, accident, or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution	
To be notified within 24 hours of detection	
Date and time of the event	
Reference or description of the location of the event	
Description of where any release into the environment took place	
Substances(s) potentially released	
Best estimate of the quantity or rate of release of substances	
Measures taken, or intended to be taken, to stop any emission	
Description of the failure or accident.	

(b) Notification requirements for the breach of a limit	
To be notified within 24 hours of detection unless otherwise specified below	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value and uncertainty	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Time periods for notification following detection of a breach of a limit	
Parameter	**Notification period**

(c) Notification requirements for the detection of any significant adverse environmental effect	
To be notified within 24 hours of detection	
Description of where the effect on the environment was detected	
Substances(s) detected	
Concentrations of substances detected	
Date of monitoring/sampling	

Part B - to be submitted as soon as practicable

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission	
The dates of any unauthorised emissions from the facility in the preceding 24 months.	

Name*	
Post	
Signature	
Date	

* authorised to sign on behalf of the operator

Schedule 6 - Interpretation

“accident” means an accident that may result in pollution.

“annually” means once every year.

“application” means the application for this permit, together with any additional information supplied by the operator as part of the application and any response to a notice served under Schedule 5 to the EP Regulations.

“emissions to land” includes emissions to groundwater.

“EP Regulations” means The Environmental Permitting (England and Wales) Regulations SI 2010 No.675 and words and expressions used in this permit which are also used in the Regulations have the same meanings as in those Regulations.

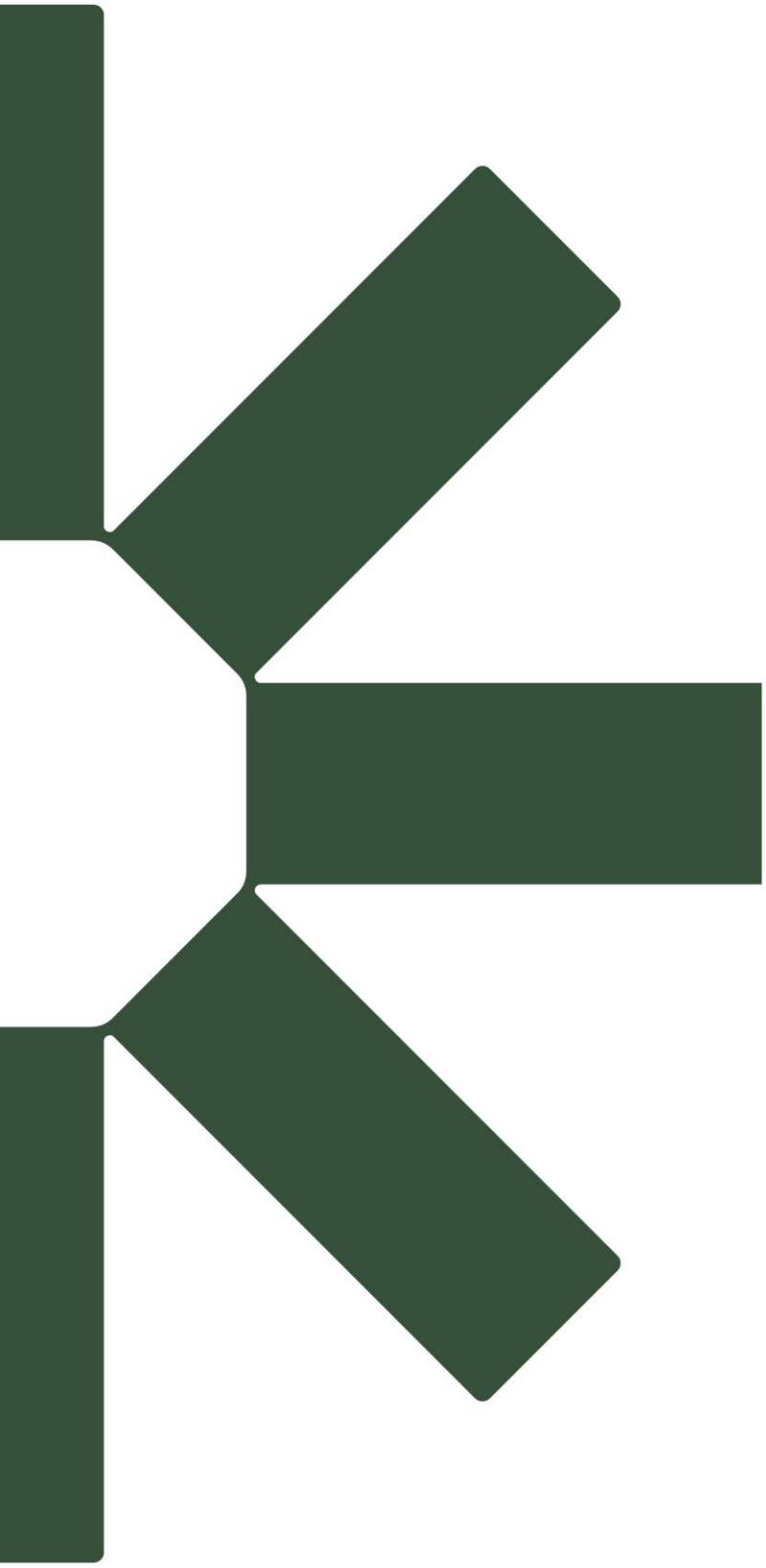
“emissions of substances not controlled by emission limits” means emissions of substances to air, water or land from the activities, either from the emission points specified in schedule 3 or from other localised or diffuse sources, which are not controlled by an emission limit.

“groundwater” means all water, which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

“quarter” means a calendar year quarter commencing on 1 January, 1 April, 1 July or 1 October.

“year” means calendar year ending 31 December.

END OF PERMIT



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