CAULMERT LIMITED

Engineering, Environmental & Planning

Consultancy Services

Cassington Quarry

Hanson Quarry Products Europe Limited

Hydrogeological Risk Assessment

Prepared by:

Caulmert Limited

14 Farrington Way (Unit 3), Eastwood Link Business Park, Eastwood, Nottingham, NG16 3BF

Tel: 01773 749132

Fax: 01773 746280

Email: sarahvenning@caulmert.com

Web: www.caulmert.com

Doc ref: 4656-CAU-XX-XX-RP-V-0306.A0.C1

Issue date: October 2021

APPROVAL RECORD

Site: Cassington Quarry

Client: Hanson Quarry Products Europe Limited

Project Title: Bespoke Environmental Permit Application

Document Title: Hydrogeological Risk Assessment

Document Ref: 4656-CAU-XX-XX-RP-V-0306.A0.C1

Report Status: **Draft for Client Review**

Project Manager: Andy Stocks

Caulmert Limited: 14 Farrington Way (Unit 3), Eastwood Link Business Park, Nottingham, NG16 3BF

Tel: 01773 749132

Author	Alice Daly	**Date**	11/06/2021
Reviewer	Sarah Venning	**Date**	22/07/2021
Approved	Sarah Venning	**Date**	22/07/2021

DISCLAIMER

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1.0 INTRODUCTION

1.1 Report Context

1.1.1 Caulmert Ltd (Caulmert) was appointed by Hanson Quarry Products Europe Limited (the 'Operator') to prepare a hydrogeological risk assessment (HRA) as part of the bespoke environmental permit application for the former 'plant area' (hereafter referred to as 'the site') at Cassington Quarry in Yarnton, Oxfordshire.

1.2 Site Details

1.2.1 The site comprises the 'plant area' within the wider area of restored sand and gravel workings of Cassington Quarry and is approximately 7.12 hectares (ha) in size. The site is situated approximately 670m southwest of Yarnton village and 1.5km northeast of Cassington village. The site is 480m north of the A40 highway and the outskirts of Oxford are located approximately 2.2km southeast of the site.

1.2.2 The site is located at postcode OX29 4FL and National Grid Reference SP 47437 11274. Access to the site is from an unnamed road which comes off the eastbound A40 carriageway to the west of the site. This road serves the former quarry workings, the application plant site and three other waste management sites before heading back to rejoin the westbound A40 carriageway. The site location is indicated below in Figure 1:

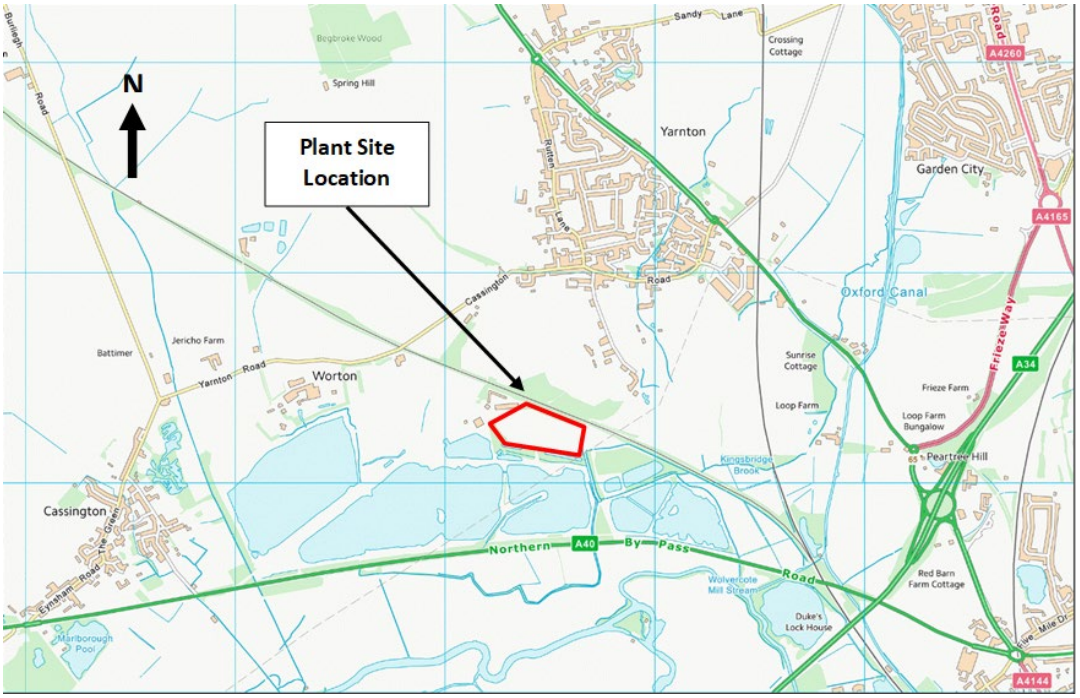


Figure 1 – Site Location (approximate boundary only)

1.2.3 The restoration of the wider quarry complex comprises grassland and water bodies, many of which are immediately to the south of the site, and the proposed end-use of the area once restoration is complete is a combination of agriculture and recreational use.

1.3 Proposed Development

1.3.1 The proposed development comprises the importation of approximately 279,000 tonnes (155,00 m^3) of inert restoration material to infill the void created by the sand extraction in accordance with the implemented planning permission MW.0111/19. It seeks to utilise imported inert waste materials rather than using 'virgin' soils for the restoration as detailed in the waste recovery plan. The proposed development would use the imported materials to create grassland, with perimeter tree and shrub planting, and areas of open water in the south eastern section of the site. The revised restoration scheme is shown on drawing C4/HAN/05/4.

1.3.2 The open water complex in the south eastern part of the site would include lake shallows, reed beds and blocks of tree and shrub planting, creating a greater variance in increased habitats for local wildlife. Should it be required, selected restoration materials will be used to form the northern slope of the wetland ponds. Where possible this will comprise site derived materials or selected (cohesive) soils. It is assumed that this material will be placed dry.

2.0 CONCEPTUAL MODEL

2.1 Source Term

2.1.1 Permitted materials that will be accepted at the site will be strictly inert which is defined as "one which does not undergo any physical, chemical or biological transformations; It does not dissolve, burn or otherwise physically or chemically react. Biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. It's total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and in particular, do not endanger the quality of any surface water or groundwater".

2.1.2 Following strict waste acceptance criteria (screening of waste materials on site and rejection of non-complying materials), a leachate will not be generated within the site due to the inert nature of the materials accepted.

2.2 Pathway

2.2.1 The pathways of the site have previously been characterised from a number of sources, including:

- British Geological Survey (BGS) mapping; and,
- 'Cassington Quarry, Section 73 Application, Hydrological Assessment', (September 2019) document ref. HN/CASS/HA/001/19.

2.3 Geology

Regional Geology

2.3.1 The area encompassing the site is underlain by Jurassic Oxford Clay. Published borehole logs to the east and west of the site indicate a thickness of 10-18m of clay in the locality. The Kellaways Formation (silts and sands) underlies the Oxford Clay.

2.3.2 Within the wider areas around the site the Oxford Clay strata is overlain by River Terrace Sand and Gravel Deposits of the Thames Valley Formation and/or alluvium. These comprise extensive shallow and laterally continuous deposits, tracing both the present day and historic routes of the principal drainage channels through the area.

Local Geology

2.3.3 BGS mapping indicates that on the northern edge of the plant site is overlain by an isolated deposit of the Thames Valley Formation, known as the Summertown-radley Sand and Gravel Member. On the south and north eastern edges of the site the Oxford Clay is overlain by alluvium.

2.3.4 A detailed trial pitting exercise (referenced from document ref. HN/CASS/HA/001/19.) undertaken across the Site shows the sand and gravel deposits extend across the full area, increasing from a

depth of approximately 3m on the southern boundary, reducing to 1.2m on the northern boundary. Any sand and gravel deposits at the site will be extracted prior to the infilling of inert material.

2.3.5 Sand and gravel deposits within the wider Cassington Quarry have largely been removed, with the worked areas restored to a series of larger open waterbodies. During extraction, these were lined with basal clays/overburden along the southern flank to prevent draw-down effects which could negatively impact on the SSSI's to the south. Therefore, this limits the groundwater movement across these boundaries via limited interaction between groundwater in the residual sands and gravels and the open water areas.

2.3.6 Isolated areas of sand and gravel deposits are recorded on the higher ground areas to the south and northwest of Yarnton respectively. Areas of former sand and gravel deposition to the west and east of the Site have also both been worked and restored in accordance with the approved restoration plan.

Hydrogeology

2.3.7 The Oxford Clay is classified as unproductive strata[1]. (formerly non-aquifer) under the EA classification scheme[2]. Indicating a low permeability and negligible potential for water supply or river base flow.

2.3.8 The superficial sand and gravel deposits (underlying and encompassing the Plant Area) are designated by the EA as a 'Secondary A Aquifer' (formerly referred to as 'minor aquifers'). These are defined as permeable layers capable of supporting local abstraction and in some cases providing a component of baseflow to local watercourses.

2.3.9 The Site is not located within any EA defined Source Protection Zones (SPZs).

2.3.10 The groundwater environment is considered to be sensitive due to the presence of the Pixey and Yarnton Meads Site of Special Scientific Interest (SSSI) which is located approximately 450m south of the plant site. There are several lined lakes and drainage channels between the site and the SSSI which would indicate that there are no direct groundwater pathway between the site (inert restoration materials) and SSSI.

2.3.11 A Hydrological Risk Assessment (HRA) was undertaken (document ref. HN/CASS/HA/001/19) in support of the planning application to assess the impact on the local water environment as well as the SSSI. It was noted in this assessment that the amended restoration design for the plant site

[1] DEFRA: Magic Maps – Landscape - Aquifer designation map (bedrock)
[2] Environment Agency webpages Aquifer definitions

includes specific measures to ensure the protection of the water environment and the results of assessment indicate there are no hydrologically based reasons why the amended design should not be permitted.

Hydrology

2.3.12 The Site is located within the Gloucestershire and the Vale Catchment of the Thames River Basin District. The principal watercourse with regard to the surface water drainage systems in proximity to the site is the Kingsbridge Brook located to the east.

2.3.13 A total of nine water features are recorded on OS mapping data within 500m of the site. The majority are located within the wider quarry complex and related to the former extraction operations undertaken within the wider quarry complex (restored areas to open water and former silt processing areas).

2.3.14 The two ponds located along the southern flank (referred to as the 'Long Ponds') are natural features excavated into the sand and gravel aquifer. The water levels within the ponds are expected to be maintained by a combination of groundwater and runoff input from the adjacent lands. Water accumulating within these ponds flows via a culvert into the wider drainage system to the east.

2.3.15 A single pond is identified outside the wider quarry complex falling within the 500m search radius. This is an isolated feature located some 350m to the northeast of the Site. This is situated on the edge of the sand and gravel deposit as shown by BGS mapping data and to the east of an area of former infill. Based on the local topography, anticipated extent/thickness of the sand and gravel deposit, the presence of the railway/associated foundations and drainage that separates the two areas, the pond is not expected to be hydraulically linked to the Site.

Groundwater Flow

2.3.16 A number of piezometers are currently installed within the wider quarry complex which measure the groundwater levels within the sand and gravel aquifer. Available data from 2000-present within boreholes surrounding the site are presented in Table 1 below and a groundwater hydrograph is presented in appendix 1.

Table 1. Groundwater levels 2000-2021

Groundwater Level (mAOD)					
Location		Min	Avg	Max	Count
west	WR65	59.98	60.58	61.44	153
west	WR66	56.44	58.08	59.94	198
south west	WR15	55.41	57.95	58.84	209
south west	WR 2	55.71	58.45	61.38	280
south	WR13	57.77	58.59	61.85	316

south	WR19	57.92	58.33	59.50	318
north	YN2A	57.78	58.53	59.27	163
east	YN6	57.86	58.38	59.61	253
east	YN5	57.40	58.52	59.88	281
east	BR10	57.76	58.30	62.54	313
south east	WR18C	57.66	58.05	59.02	222
south east	WR18B	57.84	58.17	59.12	213

2.3.17 Borehole WR65 to the west of the site show consistently higher groundwater levels, with all locations showing a strong seasonal trend. Borehole WR15 is located closest to the site indicating groundwater levels in this area are approximately 58.25 mAOD. Groundwater flow appears to be in a generally easterly direction across the region which is consistent with the levels presented on figure 7 from the hydrological risk assessment (document ref. HN/CASS/HA/001/19).

2.3.18 The unproductive strata of the Oxford Clay will not support groundwater flow and therefore forms the base of the hydrogeological system present at the site.

2.3.19 At the site, there will be localised groundwater flow within the remaining sands and gravels surrounding the site. The local groundwater flow direction is likely to be highly dependent upon the water levels within adjacent ponds and drainage ditches and therefore is very localised towards these water bodies. It is noted that areas of previous infill and restoration within the wider quarry complex to the south were lined with overburden material to impede any interaction between the groundwater and surface water.

Groundwater Quality

2.3.20 The proposed restoration material will be strictly inert. By definition, the total leachability and pollutant content of the wastes, and the ecotoxicity of the leachate produced, must be insignificant and in particular not endanger the quality of surface water or groundwater. Waste acceptance procedures and appropriate controls will be implemented to ensure there is no unacceptable risk to the local water environment.

2.3.21 In addition, due to the negligible flow within the Oxford Clay and the plant site being surrounded by areas of former infill and lined waterbodies, there is expected to be minimal lateral movement of groundwater.

2.3.22 The plant site is situated within a void produced by the excavation of sand and gravels and the infill of restoration materials will operate as a recovery activity. Consequently, this activity does

not fall within the requirements of the Landfill Directive and therefore no engineering is proposed due to the nature of the wastes to be accepted.

2.3.23 The placement of inert waste materials as part of the proposed restoration activities does not pose a potential pollution risk to the groundwater environment, as these materials will not be a source of contamination. Therefore, additional controls to protect groundwater from possible pollution from the waste materials is not required.

2.4 Receptor

2.4.1 Potential receptors from the plant site are considered below.

Groundwater

2.4.2 The superficial sand and gravel deposits surrounding the plant area are designated by the EA as a 'Secondary A aquifer'. The underlying solid strata of the Oxford Clay is regard as unproductive with low permeability and negligible potential for water supply or river base flow. Due to the inert nature of the wastes accepted, a leachate will not be generated that will give rise to pollution within the site and will not impact on potential groundwater receptors.

Surface Water

2.4.3 The Site is within the River Thames valley, and associated with the flood plain of the River Thames. The primary receptor is considered to be the Kingsbridge Brook to the east of the plant site prior to this converging with the River Thames at some distance from the site. The long ponds adjacent to the southern site boundary are considered to be predominantly groundwater fed either via flow within residual sand and gravel corridors or via incident rainfall / runoff from the adjacent areas. There is the potential for a component of flow to be derived from groundwater movement within the placed restoration materials.

2.4.4 Other surface water features surrounding the plant site are located mainly within the wider site boundary and former extraction operations and one isolated feature located some 350m to the northeast of the Site.

2.4.5 By definition the inert wastes will not be capable of generating a leachate with the potential to cause pollution and therefore it is considered there will be no impact on the surrounding surface water features.

2.4.6 Previous areas of infill and restoration within the wider quarry complex to the south of the site have been lined with overburden and therefore impeding any interaction between groundwater and surface water associated with the SSSI. Therefore, the SSSI is not considered to be at risk of any significant contamination.

3.0 HYDROGEOLOGICAL RISK ASSESSMENT

3.1 The Nature of the Hydrogeological Risk Assessment

3.1.1 Section 22 of the Environmental permitting Regulations (which transposed the requirements of the Groundwater Directive) do not apply to the site since the materials to be imported are strictly inert. The site is located in a moderate sensitivity setting with respect to the groundwater and surface water due to the presence of the SSSI to the south. However, the SSSI is not considered to be at a risk of significant contamination and therefore, in line with the Environment Agency's technical guidance (Table 1), the assessment comprises a risk screening approach. This is based on the following key points:

- The regional groundwater flow direction is to the east, indicating the SSSI is cross gradient of the site.
- There is no vertical pathway due to the presence of the Oxford Clay beneath the site
- Any localised groundwater flow within the residual sand and gravels surrounding the site is likely to be highly dependent upon the water levels within adjacent ponds and drainage ditches and therefore is very localised towards these water bodies.
- Previous areas of infill and restoration within the wider quarry complex to the south have been lined with overburden, therefore impeding interaction between groundwater and surface water associated with the SSSI.
- There will be no source term as restoration materials will be strictly inert and therefore by definition will not pose a potential pollution risk to the groundwater environment

Table 1. Environment Agency Risk Assessment Scenarios for Low Permeability Strata

Landfill setting	Inert landfill classification	Non-hazardous landfill classification	Hazardous landfill classification
No surface water or other receptors (for example, springs or abstractions)	RS	GQRA	GQRA/DQRA
Surface water, springs, abstractions, etc. present or significant uncertainty	RS/GQRA	GQRA/DQRA	DQRA

Landfill setting	Inert landfill classification	Non-hazardous landfill classification	Hazardous landfill classification
Below the water table	RS/GQRA	GQRA/DQRA	DQRA

Definition of terms:

- RS: risk screening
- GQRA: generic quantitative risk assessment
- DQRA: detailed quantitative risk assessment

3.2 Risk Screening

3.2.1 This risk screening reviews the potential sources present, the pathways and receptors with respect to the importation of restoration materials under a recovery operation. The absence of a source, pathway or receptor would indicate no discernible pollutant linkages present and that there is negligible risk from this assessed activity. Therefore, each component is considered individually below.

Source

3.2.2 The materials to be imported at the site will be strictly inert. Therefore, by definition, the source material will not be capable of generating a leachate that will cause pollution and so it is considered that the material does not constitute a potential source of contamination. Strict waste procedures will be in place to ensure only permitted inert materials are accepted at the site.

Pathway

3.2.3 There are no significant pathways present at the site. The site is located on the unproductive strata of the Oxford Clay and therefore there is no vertical pathway. Localised groundwater flow will occur in the remaining sands and gravels and alluvium deposits surrounding the site. The localised groundwater flow direction will likely to be highly dependent upon the water levels within

adjacent ponds and drainage ditches and therefore will be very localised towards these water bodies.

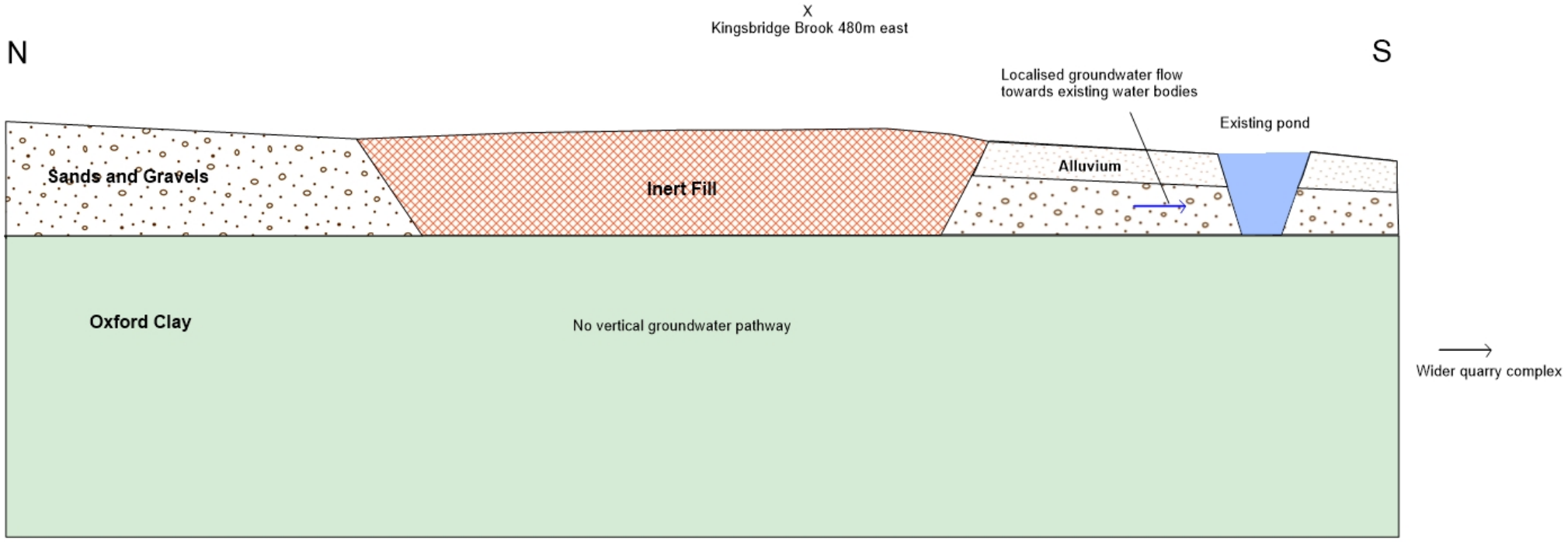
Receptor

3.2.4 The primary receptor is considered to be the Kingsbridge Brook to the east of the site. Groundwater flow from the site will be captured by the local drainage network which eventually discharges to the Kingsbridge Brook.

3.2.5 The SSSI to the south is dependent on water levels. During the operation and restoration of the wider quarry complex (located between the site and the SSSI) mitigation measures were implemented to minimise the risk to the SSSI from changes in water levels. This lining of the quarry voids with clay will also prevent the migration groundwater from the site. Therefore, it is considered that the theoretical pathway between the site and the SSSI has been broken via the clay barriers (preventing migration) and drainage channels (intercepting migration), in this direction. Therefore, the SSSI are not considered to be at risk of any significant contamination. A schematic conceptual model sketch of the plant site is presented below.

Conclusion

3.2.6 Risk screening has concluded that there is no source of contamination based on the inert nature of the restoration materials to be accepted at the site. The absence of any significant groundwater pathways also indicates there is no discernible pollutant linkages and therefore there is considered to be negligible risk on any potential receptors from the assessed recovery activity.



SCHEMATIC CONCEPTUAL MODEL

4.0 CONCLUSIONS

4.1.1 This report has reviewed the risks to the groundwater and surface water environment associated with the importation of inert materials to restore the void at the plant area (Site) at Cassington Quarry.

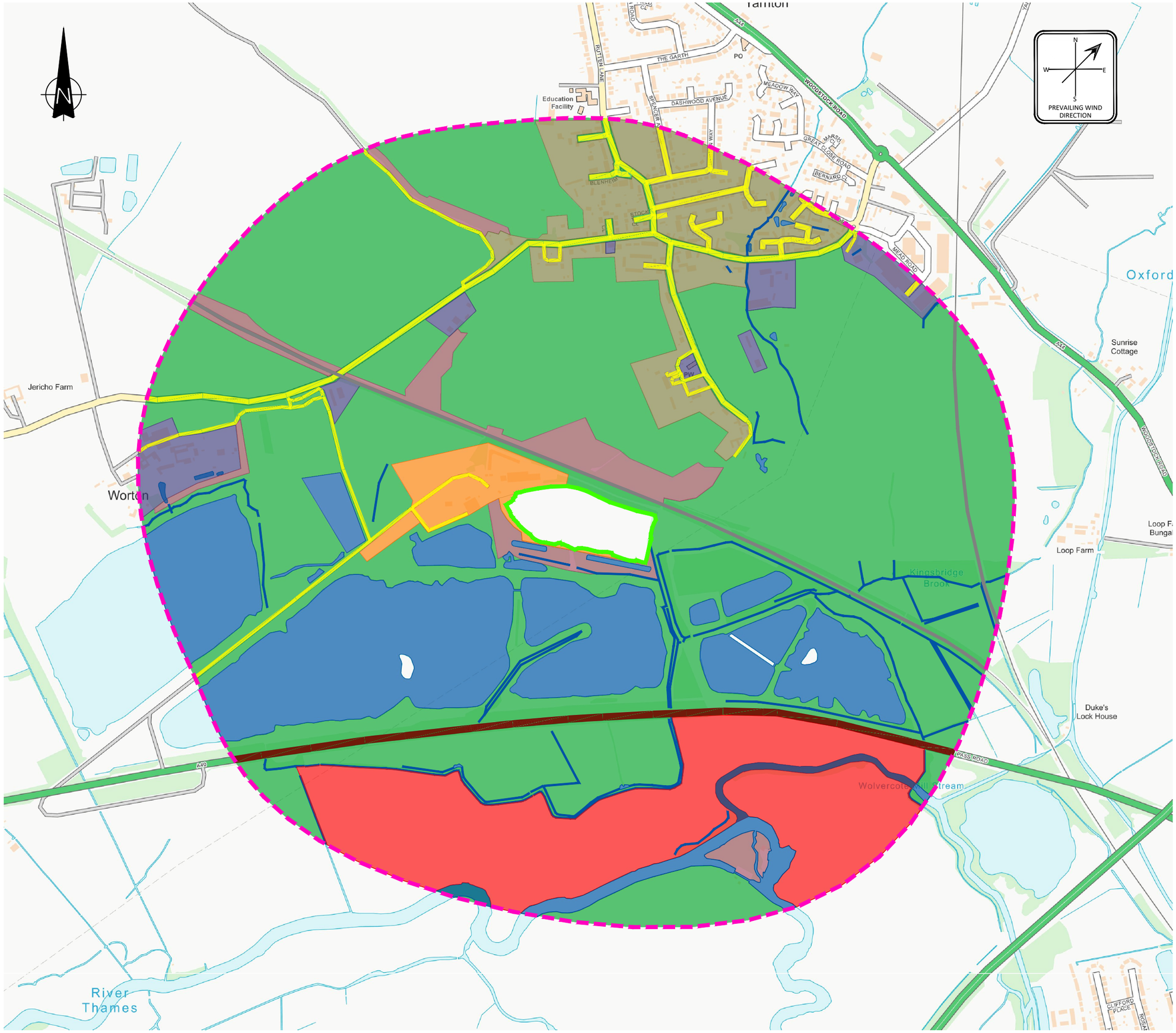
4.1.2 The nature of the materials to be imported will be strictly inert. By definition this source material will not be capable of generating a leachate with the potential to cause pollution and therefore it is considered that material does not constitute a potential source of contamination.

4.1.3 The geological setting of the site is such that there is no discernible groundwater pathways beneath the restoration materials however there remain the potential of water constrained within the restoration soils to discharge to the ponds to the south of the site. The Oxford Clay is classed as unproductive strata and therefore forms the base to the hydrogeological regime at the site. Localised groundwater flow is present within the residual sands and gravels deposits between previously worked areas. The overall flow is towards the 'long ponds' on the southern flank of the plant site. These in turn discharge via the surface water drainage network to the Kingsbridge Brook to the east of the site.

4.1.4 Risk Screening has concluded that the inert waste materials do not represent a significant source of contamination and as a consequence the overall risk to the groundwater and surface water environment is considered to be low.

4.1.5 The report has indicated that whilst the Pixey and Yarnton Meads Site of Special Scientific Interest (SSSI) is sensitive to groundwater levels, there are no direct pathways between the site and the SSSI. Furthermore, without a source term, the risks posed to the SSSI from the development are considered to be negligible. 6

DRAWINGS



LEGEND

- PERMIT BOUNDARY
- 1000m OFFSET
- SURFACE WATER
- WOODLAND
- COMMERCIAL
- INDUSTRIAL
- RESIDENTIAL
- MAJOR ROAD
- MINOR ROAD
- RAIL
- AGRICULTURAL
- EDUCATIONAL
- SSSI AND SAC DESIGNATION

REV					
P03	PERMIT BOUNDARY UPDATED	EJD	KB	KB	04.06.21
P02	PERMIT BOUNDARY UPDATED	EJD	KB	KB	23.04.21
P01	ISSUED FOR INFORMATION	EJD	SB	SB	20.04.21
REV	MODIFICATIONS	BY	RE	AP	DATE

PURPOSE OF ISSUE: FOR INFORMATION

STATUS: S2

CLIENT: Hanson HEIDELBERGCEMENT Group

PROJECT: CASSINGTON QUARRY

TITLE: SENSITIVE RECEPTORS PLAN

DESIGNED BY	DRAWN BY	REVIEWED BY	AUTHORISED BY
EJD	EJD	SB	SB

DATE	SCALE @ A3	JOB REF:	REVISION
12.04.2021	1:10000	4656	P03

DRAWING NUMBER: 4656-CAU-XX-XX-DR-V-1801

Caulmert engineering environmental planning

WWW.CAULMERT.COM

Registered Office: InTec, Parc Menai, Bangor, Gwynedd, LL57 4FG Company Registered No: 06716319

Key:

- Cross Sections
- Fencing and Gates
- Proposed Restoration Contours
- ExistingConsent Area
- Existing Tree and Shrub Vegetation
- Areas to be Restored to Agricultural Grassland
- Existing Water Bodies
- Proposed New Pond Complex
- Proposed Tree and Shrub Planting
- Lake Shallows/ Reed Bed
- Areas to be Restored to Conservation Grassland

Anglo-Saxon Burial Ground

Path

Dismantled

Drain

Drain

(DRY SILT

PIPE INVERTS 1–58.2 2–58.2 3–58.2

PIPE W 58.25

WL 58. (17/4/

BH

58.73

59.15

64.0 63.0 62.0 61.0 60.0 59.0 59.0

rev:	date:	details:
C	04/06/19	(SD)Addition of Fence line and pond
B	22/05/19	(SD)Addition of Cross Sections
A	13/05/19	(SD)Addition of Proposed Trees

corylus Planning & Environmental Ltd.
The Old Dairy
Yanworth
Cheltenham
Gloucestershire
GL54 3LQ
tel: 01285 721072

client: Hanson

project: Cassington Quarry

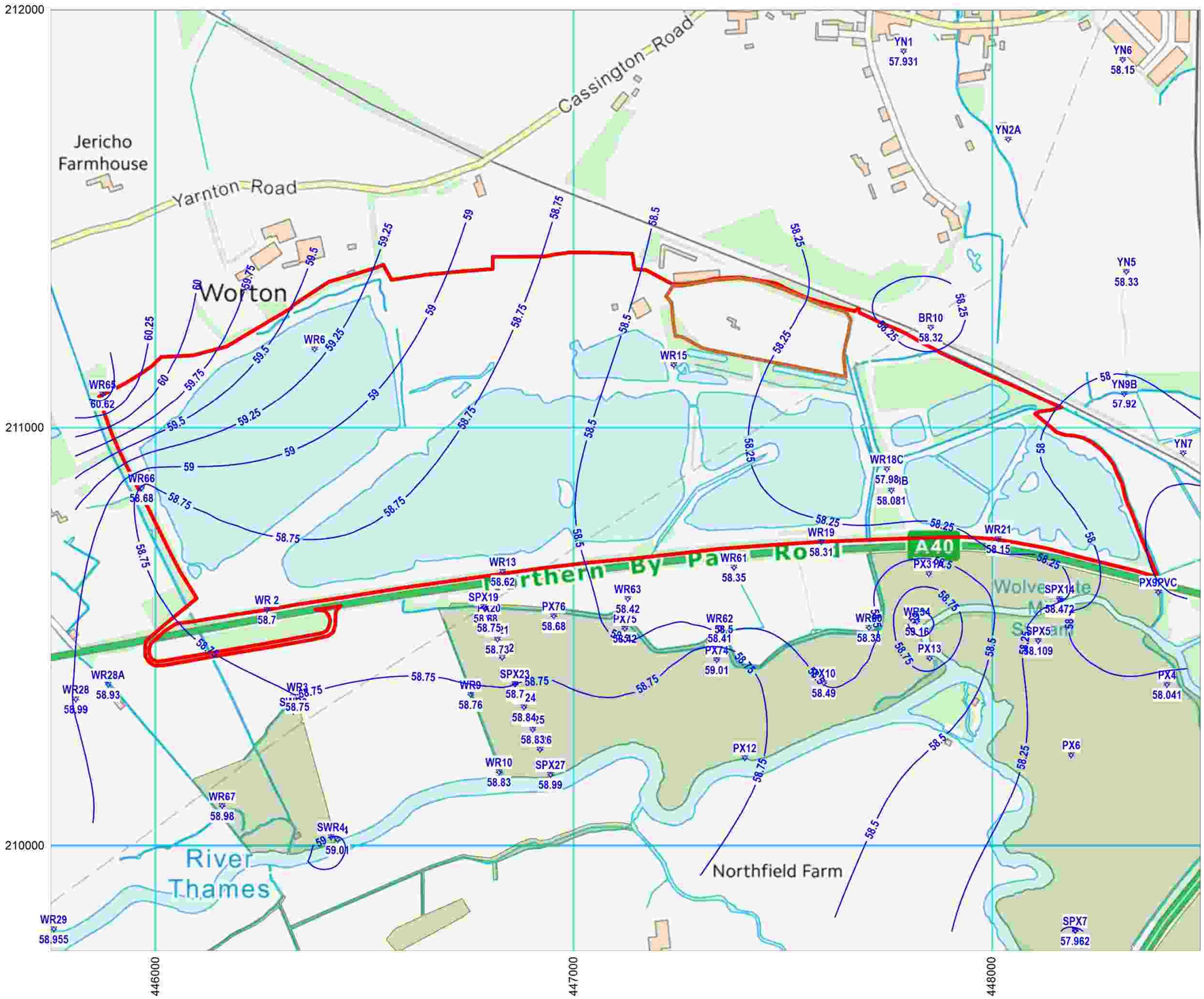
title: Revised Restoration Scheme For Former Plant Site

scale:	date:	drawn by :	checked by:	size:
1:2000	13/05/19	SD	AW	A3

Project ref :	dwg no:	rev:
C4/HAN/05	C4/HAN/05/4	C

0 m 40 m 80 m 120 m 160 m 200 m

Scale Bar 1: 2000



Key

- Site Boundary
- Plant Area
- Protected Site
- Groundwater monitoring point and ID
- Groundwater contour (maOD)

Document ref. HN/CASS/HA/001/19

Hanson HEIDELBERGCEMENT Group

Hanson Aggregates Europe Limited

Cassington Quarry, Yarnton, Oxfordshire

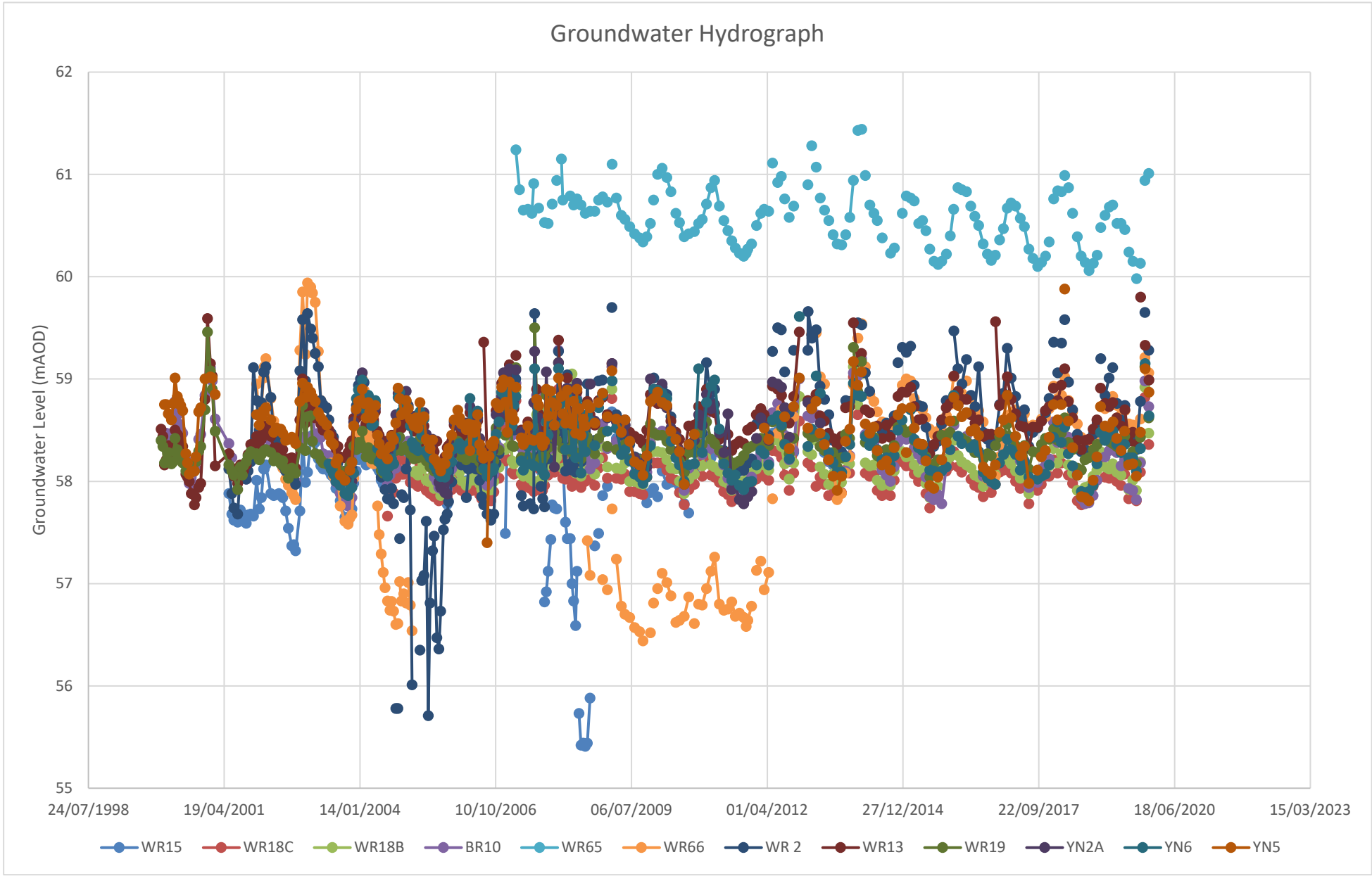
Hydrological Assessment

Final Report

Figure 7: Groundwater contour plot (Sand and gravel aquifer : May 19)

Drawn By: PB	Scale: 1:10,000
Date: Sep 19	Format: A3L

Appendix 1


Groundwater Hydrograph
Groundwater Level (mAOD)
62
61
60
59
58
57
56
55
24/07/1998
19/04/2001
14/01/2004
10/10/2006
06/07/2009
01/04/2012
27/12/2014
22/09/2017
18/06/2020
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WR66
WR 2
WR13
WR19
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YN5