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Aggregate Industries UK Limited

Tatchells Quarry
Wareham, Dorset

Extension to Existing Mineral Workings
Baggs Land Extension

Hydrogeological & Hydrological Assessment

Version 1

14th June 2018

Report Prepared For:

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Company Registration Number: 4043373
Registered in England & Wales. Registered Office: 33, Wolverhampton Road, Cannock

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BCL CONSULTANT HYDROGEOLOGISTS LIMITED EXPERIENCE & QUALIFICATIONS

BCL is an independent consultancy specialising in all aspects of hydrogeology and hydrology as they relate to minerals extraction, water supply and environmental issues.

Peter Simpson (the author of this report) holds an honours degree (Environmental Science) conferred by The University of Birmingham, 2003 and a Master of Science Degree (Hydrogeology), also conferred by The University of Birmingham, in 2011.

Staff of BCL have provided specialist services and advice to the extractive industry since 1990. During this time experience has been gained from involvement in the study of hydrogeological and hydrological systems in connection with planning matters at over 220 quarries or associated secondary and tertiary operations throughout the United Kingdom, Republic of Ireland and mainland Europe.

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1 INTRODUCTION

1.1 Background

1.1.1 Aggregate Industries UK Limited (AI) presently undertake mineral extraction operations (fine sand) at Tatchells Quarry, Wareham, Dorset (the Site) under current planning permissions 6/98/0694, as issued by Dorset County Council (DCC) in 1998.

1.1.2 It is proposed that the existing mineral workings be extended to the south east over an area of some 2.5 hectares (ha) into an area known as Baggs land (the Proposed Development). This is intended to release 230,000 tonnes of fine sands with the associated extraction of 50,000 tonnes of clay flint overburden over a period of some 4 years.

1.1.3 A screening response was received from Dorset County Council (DCC) in February 2018 (PL\2273\17\SEO), confirming that the Proposed Development is not considered to require a full Environmental Impact Assessment (EIA).

1.1.4 BCL Consultant Hydrogeologists Limited (BCL) have thus been commissioned by AI to conduct a Hydrogeological and Hydrological Assessment (H&HA) to assess the potential impacts of the Proposed Development upon the local water environment.

1.2 Purpose of H&HA

1.2.1 The H&HA reported here presents:

i. Baseline characterisation of the local water environment;

ii. Impact analysis of the Proposed Development upon the water environment; and

iii. Formulation of mitigation measures designed to eliminate or limit identified impacts to a sustainable level.

1.3 Methodology & Outcomes of H&HA

1.3.1 Collection and interpretation of published data, in conjunction with a programme of data collection and field works, has facilitated the development of a conceptual model describing the nature of, and interactions between, the groundwater and surface water systems operating within and around the Site.

1.3.2 The conceptual model has been employed to assist identification of the likely impacts of the Site upon the water environment.

1.3.3 Where significant effects have been identified, alterations to the project design and / or specific mitigation measures have been adopted to eliminate, reduce or compensate for those effects.

1.4 H&HA Data Sources

1.4.1 Site specific data reviewed as part of the assessment includes the following:

i. Walk over survey of the Site (made by BCL, May 2018);

ii. Water Features Survey (made by BCL, May 2018);

iii. Interviews with Site staff (made by BCL, May 2018);

iv. Drilling logs for Site boreholes, provided by AI, 2018;

v. Groundwater level, groundwater qualkity and sub-surface gas monitoring data provided by AI / Viridor, 2018;

vi. David Jarvis Associates, 'Proposed Extension of Tatchels Quarry by way of Extraction of Baggs Land to the South of Carey Road, Request for Screening Opinion', December 2017.

vii. Development phasing and restoration plans, 2549-4-3-PR-0001 to 0006, AI, December 2017.

1.4.2 Published sources of information that have been referenced include:

i. Ordnance Survey (OS): 1:25,000 Explorer published mapping.

ii. OS: Panorama, Meridian, Vectormap and Streetview and Open-data products.

iii. British Geological Survey (BGS): Published 1:50,000 geological mapping, Sheets 328, Dorchester, and 329, Bournemouth, solid and drift.

iv. British Geological Survey (BGS): On-line Lexicon of Named Rock Units.

v. BGS: On-line Geo-Index Service.

vi. Environment Agency (EA) & BGS: 'The physical Properties of Major Aquifers in England and Wales', hydrogeology group, technical report WD/97/034, 1997.

vii. Environment Agency (EA) & BGS: 'The physical Properties of Minor Aquifers in England and Wales', hydrogeology group, technical report WD/00/04, 2000.

viii. EA: a) Public Register of Landfill Sites, b) Source Protection Zone mapping data, c) Flood Risk Zone mapping data, d) Aquifer Vulnerability and Aquifer Classification mapping data, e) Surface Water Levels, f) Surface Water Flows, g) Surface Water Quality, h) Groundwater Levels, i) Abstraction Licences, & j) Rainfall data k) 2m resolution LIDAR data.

ix. EA: R&D handbook, 'Estimation of Evaporation from Open Water', W6-043/HB.

x. EA: "Rainfall Runoff Management for Developments", R Kellagher, October 2013, joint DEFRA / EA Flood and Coastal Erosion Risk Management R&D Programme, Report SC030219.

xi. Centre for Ecology and Hydrology (CEH; formerly the Institute of Hydrology): "Flood Estimation Handbook (FEH) web service, 2018.

xii. Centre for Ecology and Hydrology (CEH; formerly the Institute of Hydrology): National River Flow Archive, 2018.

xiii. UK Sustainable Drainage & Guidance Tools, Greenfield Runoff Estimation for Sites, HR Wallingford, 2016.

xiv. Natural England (NE): Mapping data & associated citations for: Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA), Special Areas of Conservation (SAC) & National Natures Reserves (NNR).

xv. Purbeck District Council, Private Water Supply data (de-regulated abstractions).

xvi. Ministry of Agriculture Fisheries and Food (MAFF) Technical Bulletin 34, Climate and Drainage, 1976.

xvii. 'Hydrology in Practice', EM Shaw, Second Edition, 1988.

1.5 H&HA Report Structure

1.5.1 Baseline data concerning the topography, geology, hydrology and hydrogeology of the study area which are drawn together to inform a preliminary conceptual model of the extant hydrogeological and hydrological regimes, are presented at *section 2*.

1.5.2 An account of the Proposed Development is made in *section 3*.

1.5.3 Assessment of significant water-related impacts, together with an outline description of monitoring and / or mitigation measures proposed to ameliorate those impacts, is given at *section 4*.

1.5.4 A summary impact & mitigation schedule is presented at *section 5* with report summary and conclusions given at *section 6*.

2 THE BASELINE STUDY

2.1 Site Location & Study Area

2.1.1 The Site is approximately centred upon National Grid Reference (NGR) $^{3}90651$ $^{0}88653$, 0.3 kilometres (km) to the west of the town of Wareham, 0.9 km to the north of the village of Worgret, in the Purbeck District of the County of Dorset.

2.1.2 The Site straddles the Carey Road, with its northern limit extending to Bere Road and its southern limit extending towards the Wareham Forest Way walking route.

2.1.3 The Proposed Development is located within the southern site area to the immediate east of the existing mineral workings.

2.1.4 Baseline data collection has focused upon a 3km radius from the Site boundary (the Study Area), which covers an area of approximately 3,000 hectares (ha).

2.1.5 The location of the Site and extent of the Study Area is shown at *figure 1*.

2.2 Topographic Setting

2.2.1 The topography of the Study Area is dominated by the valleys of the Rivers Piddle and Frome. Ground elevations within the north of the Study Area, which locally achieve a maximum elevation of some 36 metres above Ordnance Datum (maOD) at Cold Harbour, 0.5km to the north of the Site, are generally seen to fall towards the valley of the River Piddle.

2.2.2 Ground elevations within the south of the Study Area are generally observed to fall to the north towards the valley of the River Frome.

2.2.3 The valleys of the rivers Frome and Piddle are separated by an west-east trending ridgeline, which locally achieves a maximum elevation of 42maOD in the west of the Study Area. Both valleys are seen to fall ad limited gradient to the east.

2.2.4 The Site is located upon the northern flank of the Piddle Valley, with ground elevations ranging from 35maOD to 13maOD, generally falling southwards.

2.3 Land Use

2.3.1 Land use in the locality is dominated by agriculture, with areas of woodland, heathland and urban development also being present. Quarrying is common across the Study Area.

2.3.2 The Site principally comprises existing mineral workings and associated infrastructure with un-worked areas being dominated by agriculture. The Site is bounded by woodland to the west and agricultural lands to the north, south and east.

2.4 Current Site Operations

2.4.1 Site Operations

2.4.1.1 The area of the Site located to the north of the Carey Road (the Northern Site) is presently used for the stockpiling, processing and sale of aggregates.

2.4.1.2 Mineral processing is undertaken via dry screening using mobile plant with mineral sales being facilitated by a single loading shovel with weighted bucket. This is supported by the operation of a towed, 2,000l double skinned fuel bowser (with all refuelling being undertaken on area of hard standing).

2.4.1.3 Third party operations are also undertaken within the Northern Site by Viridor Waste Management (Viridor), who have undertaken the historic infilling of areas of former mineral extraction with household, commercial and industrial wastes and their subsequent management (including energy from waste operations via landfill gas collection and combustion).

2.4.1.4 The area of the Site to the south of the Carey Road (the Southern Site) presently forms the active mineral extraction area. Mineral extraction is undertaken via excavator with the resultant materials being transported to the Northern Site for processing via dumper.

2.4.1.5 The Proposed Development area, as located to the immediate east of the Southern Site, presently constitutes pastoral farmland.

2.4.2 Site Water Management

2.4.2.1 No water abstraction is undertaken at the Site and no consumptive use is required in support of Site operations.

2.4.2.2 Welfare facilities are provided in the form of a single, regularly emptied portaloo without need for water supply.

2.4.2.3 The Northern and Southern Sites form closed depressions which are drained passively via infiltration.

2.5 Statutorily Protected Sites

2.5.1 Data has been obtained from the EA and Natural England (NE) detailing the locations and nature of statutorily protected sites within the Study Area.

2.5.2 The locations of identified sites are illustrated at *figure 2*, outline details, taken from the Natural England (NE) Citation Database are given below at *table 1*, with citations included at *appendix 1*.

Table 1: Statutorily Protected Sites of Ecological Importance

Identification	Distance (km)*	Type	Summary Description
Morden Bog and Hyde Heath	0.09 N	SSSI, RAMSAR, SPA, SAC, NNR	Dry and wet heath
Wareham Common	0.45 SE	SSSI	Grazing marsh
Wareham Meadows	1.1 E	SSSI, RAMSAR, SPA	Flood plain grassland
Worgret Heath	1.3 SW	SSSI, SPA, SAC	Predominantly dry heath
River Frome	1.7 S	SSSI	Major chalk stream
Povington and Grange Heaths	1.7 S	SSSI, RAMSAR, SPA, SAC	Dry and wet heath
Holton and Sandford Heaths	1.8 E	SSSI	Dry and wet heath
Stokeford Heaths	2.2 W	SSSI, RAMSAR, SPA, SAC	Dry and wet heath
**: at shortest distance from the Proposed Development*			

2.5.3 There are no statutorily protected sites within or directly abutting the Site boundary.

2.5.4 Where additional designations to Sites of Special Scientific Interest (SSSI) apply, this refers to the Dorset Heaths wetland of international importance (RAMSAR), Dorset Heathlands Special Protection Area (SPA), Dorset Heaths Special Area of Conservation (SAC) and Morden Bog National Nature Reserve (NNR), of which these sites form fragments. This is with the exception of Wareham Meadows SSSI which is additionally designated within the Poole Harbour RAMSAR and Poole Harbour SPA.

2.6 Non Statutorily Protected Sites

2.6.1 Data regarding the locations of non-statutorily protected sites of ecological importance within the Study Area has been provided by Dorset Environmental Records Centre (DERC). The locations of these sites are shown at *figure 2* with summary detail at *table 2* below.

2.6.2 There are no non-statutorily protected sites within or directly abutting the Proposed Development.

Table 2: Non-Statutorily Protected Sites of Ecological Importance			
Identification	Distance (km)	Type	Summary Description
Worgret Heath	0.6	SNCI	Remnant bog
North Meadows	0.8	SNCI	Ditches
Trigon Heaths	1	SNCI	Heath and mire
South Heath Binnegar	1.3	SNCI	Heathland, grassland and pools
Worgret Junction	1.5	SNCI	Grassland
Cobbs Leg	2	SNCI	Grassland, ditches, woodland
Sandford	2	SNCI	Grassland, wet and dry heath
Stokeford Heaths	2.6	SNCI	Heathland in old minerals workings

2.7 Landfill Sites

2.7.1 The locations of permitted and known historical landfills within the Study Area, as taken from the EA's public register, are illustrated at *figure 3* with summary details given below at *table 3*.

Table 3: Summary Details for Landfill in the Vicinity of the Site				
Identification	Distance (km)*	Status	Class	Operator
Tatchells Depot	0	Permitted	Household, Commercial, Industrial	Viridor Waste Management
Tatchells Landfill Site	0	Permitted	Household, Commercial, Industrial	Viridor Waste Management
Trigon Landfill	0.9 NW	Permitted	Household, Commercial, Industrial	Viridor Waste Management
Fields 3529 3417 & 4618	1 SE	Historic	Unknown	Unknown
Sandford Lane	1.1 SE	Historic	Inert	Unknown
Puddletown Road	2 SW	Permitted	Inert	Raymond Brown
Landfill (Hines Pit)	2.3 SW	Permitted	Household, Commercial, Industrial	SUEZ UK
Fields at Rushton Farm	2.3 SW	Historic	Unknown	Unknown
Squirrel Cottage	2.6 S	Historic	Inert	

2.7.2 There are no landfill sites within the Proposed Development area. There are 2 no. currently permitted landfills within the Site boundary, including Tatchells Depot landfill and Tatchells Landfill Site (The Tatchells Landfill Sites, TLS) the latter of which abuts the Proposed Development to the north.

2.7.3 Infilling operations and restoration works are complete within the TLS which are currently undergoing post closure monitoring and maintenance. The TLS are both known to have historically received household, commercial and industrial wastes, including putrescible wastes, and are of unknown construction.

2.8 Geology

2.8.1 The geology within and surrounding the Site has been characterised by reference to British Geological Survey (BGS) publications including 1:50,000 scale geological mapping and published well / borehole records.

2.8.2 Regional Geology

2.8.2.1 The geology of the Site and its environs comprises superficial drift deposits overlying solid strata of Paleogene and Cretaceous age.

2.8.2.2 The distribution of geological units at outcrop is illustrated upon an extract from BGS mapping, reproduced here at *figure 4*. The regional stratigraphic sequence is presented at *table 4* below.

Table 4: Summary Stratigraphic Sequence

Age	Formation / Lithology		Description
Quaternary	Head		Clay / silt / sand
	Alluvium		Silt / Sand
	River Terrace Deposits		Sands and gravels
Palaeogene	Bracklesham Group	Poole Formation	Sands with intervening clays
	Thames Group	London Clay Formation	Clay
Cretaceous	Chalk Group		Chalk

2.8.2.3 The regional geology is dominated by the presence of the Wareham Basin. This feature is formed by the Cretaceous Chalks of the Dorset Downs dipping southwards and eastwards, becoming overlain in turn by the Thames Group and Bracklesham Group. The basin is roughly centred around the town of Wareham and Poole Harbour, with the southern limit being marked by the uplifted chalks of the Purbeck Downs on the Dorset Coast.

2.8.2.4 Drift deposits associated with local watercourses obscure much of the bedrock geology, and primarily take the form of River Terrace Deposits, which are in turn overlain by head deposits and Alluvium in association with local minor and major watercourses respectively.

2.8.3 Local Geology

2.8.3.1 The Site is underlain by the sands and clays of the Poole Formation (PF). Site investigation drilling logs (*appendix 2*) show this unit to have a thickness of some 32m,

featuring a series of sands and clayey sands with discontinuous intervening clay layers of up to 0.6m in thickness.

2.8.3.2 The PF is generally seen to dip to the east in line with the regional trend, whilst thinning to the south of the Site due to erosion by local watercourses. Both the River Piddle and River Frome are indicated to be based upon PF at their closest proximity to the Site (This constituting sand members for the River Piddle and Clay members for the River Frome).

2.8.3.3 The PF incorporates a number of more substantial clay members (such as the Oakdale Clay) which can be continuous over a wider area. These units are elevated above the PF as present within the Proposed Development, being present upon higher ground to the north east of the Site.

2.8.3.4 The London Clay (LC), which underlies the PF across the Study Area, is indicated to have a thickness of 30m to 40m, principally constituting blue clays with pebble horizons, and is underlain by Cretaceous chalk.

2.8.3.5 River Terrace Deposits (RTD), in a series of 8 no. terraces, are seen to obscure the bedrock geology over much of the Site locality (having been removed by quarrying over much of the Site itself). The RTD constitute sands and gravels of variable thickness (approximately 2.5m).

2.8.3.6 Where present, head deposits are seen to overlie to the PF and RTD. Such deposits are of limited thickness and distribution, typically following the courses of minor watercourses. Head deposits are indicated to be present to the north and east of the Site.

2.9 Hydrological Setting

2.9.1 Information concerning the surface watercourses and waterbodies of the Study Area has been obtained from OS digital mapping and EA data-sets.

2.9.2 The published data have been combined with the results of water features surveying (WFS) made during May 2018 to give an overview of the local hydrological setting.

2.9.3 The hydrological setting of the Site is as presented at *figure 5*.

2.9.2 Surface Water-courses

River Piddle

2.9.2.1 The River Piddle rises at Alton Pancras in the Dorset Downs before flowing southwards and eastwards, across the Study Area and within 0.2km of the Site (to the south) before ultimately discharging to the English Channel via Poole Harbour.

2.9.2.2 Data regarding flows within the River Piddle have been attained from the Centre for Ecology and Hydrology (CEH) National River Flow Archive (NRFA). The available data demonstrates the River Piddle to have a Q95 (flow rate exceeded 95% of the time) of 0.795m^3/s with a mean flow of 2.49m^3/s at Baggs Mill, 0.7km to the south east of, and downstream of, the Site.

2.9.2.3 The River Piddle was observed during the 2018 WFS as comprising an approximately 6m wide, 3m deep meandering channel with 2m wetted depth (WFS1, *figure 5*)

River Frome

2.9.2.4 The River Frome rises at Evershot in the Dorset Downs before flowing southwards and eastwards, across the Study Area and within 1.6km of the Site (to the south) before ultimately discharging to the English Channel via Poole Harbour.

2.9.2.5 Data regarding flows within the River Piddle have also been attained from the NRFA. The available data demonstrates the River Frome to have a Q95 of 2.521m^3/s with a mean flow of 6.69m^3/s at East Stoke, 3.4km to the south east of, and upstream of, the Site.

Minor Water-courses

2.9.2.6 A drainage ditch is seen to be present to the south of the Site, flowing from east to west upon the Piddle flood plain with frequent connections to it (the Piddle Drain, WFS2, *figure 5*).

2.9.2.7 A further unnamed watercourse is seen to be present to the north of the Northern Site at WFS3, *figure 5* (the Northern Stream). This watercourse flows southwards and eastwards, discharging to the River Piddle at Wareham to the east of the Site. This watercourse was dry when observed during the WFS and is indicated to rise upon outcropping clays within the PF.

2.9.2.8 To the north west of the Site, a minor watercourse is seen to rise at Cold Harbour Heath (also indicated to be upon PF clays). This watercourse (the North Western Stream, WFS4, *figure 5*) flows northwards and eastwards before meeting a further stream (the Morden Stream, WFS5, *figure 5*) which flows southwards to the River Piddle at Wareham. These watercourses are also indicated to rise upon outcropping PF clays.

2.9.2.9 An unnamed minor watercourse is seen to rise to the west of the Site (the Western Stream, WFS6, *figure 5*). This watercourse rises on PF clays before flowing southwards to the River Piddle.

Surface Water Catchments

2.9.2.10 The Site, in its entirety, is located within the surface water catchment of the River Piddle. A significant area of the Northern Site is located within the sub-catchment of the Northern Stream.

2.9.3 Springs and Seepages

2.9.3.1 No springs of seepages were identified during the WFS in meaningful proximity to the Site.

2.9.4 Surface Water-Bodies

2.9.4.1 There are 2 no. surface waterbodies within the Northern Site formed by mineral extraction / restoration operations (WFS7 & WFS8, *figure 5*). These waterbodies are assumed to be perched and principally maintained by surface runoff.

2.9.4.2 Within the Southern Site there is a large former silt lagoon (assumed to be partially silt lined and perched) at WFS9, *figure 5*. This waterbody is known to receive runoff from restored (and infilled) areas of the Northern Site via buried pipeline beneath the Carey Road (WFS10, *figure 5*).

2.9.4.3 There are 3 no. further waterbodies within the main void of the Southern Site (WFS11 – 13, *figure 5*). These waterbodies are assumed to be perched, being based upon low permeability horizons within the PF and principally being sustained by rainfall / runoff.

2.9.4.4 Further surface waterbodies in the vicinity are largely confined to historic and active mineral workings though also include a pond within a golf course to the north east of the Site (WFS14, *figure 5*).

2.9.5 Flooding

2.9.5.1 Data has been obtained from the EA detailing areas in the vicinity of the Site which are vulnerable to fluvial flooding.

2.9.5.2 *Figure 6* highlights areas in the vicinity of the Site with flood return periods of both 1:100-years and 1:1,000-years[1].

2.9.5.3 The Site, in its entirety, is designated within FRZ1, the lowest class of flood risk[2], which is applied to all areas not classified as FRZ2 or FRZ3.

2.9.5.4 Areas of FRZ2 and FRZ3 are primarily associated with local major watercourses, being situated 0.1km to the south of the Site at closest approach (within the Piddle Valley).

2.9.6 Meteorological Data

Rainfall

2.9.6.1 The Standard Average Annual Rainfall (SAAR) for the Site area as recorded by the Centre for Ecology and Hydrology (CEH) Flood Estimation Handbook (FEH) web service is 839 millimetres (mm).

2.9.6.2 Data has been obtained from the EA for the Trigon Rain Gauge (NGR ^{3}88666 ^{0}88941), identified as the closest gauge to the Site. Monthly rainfall totals recorded at the gauging-station are presented below at *table 5*.

2.9.6.3 The data record covers a period from 2013 to 2018 and indicates an average monthly total rainfall of some 66.2mm, with an annual average rainfall of some 794.1mm.

1 Classified as Flood Risk Zones FRZ3 and FRZ2 respectively. Areas which fall beyond the 1:1,000 year FRZ are classified as FRZ 1.

2 Less than 1 in 1,000 chance of flooding in any given year.

2.9.6.4 The available data spans a number of wet years (2013 & 2014) and a number of dry years (2016 and 2017), typically following the expected pattern for UK rainfall, showing an annual trend with wet winters and dry summers

Table 5: Monthly Total Rainfall (mm), EA Trigon Rain Gauge

Month / Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total as % of mean
2013	132	29.8	69.6	40.2	55.7	26.2	32.9	21.9	34.4	108.6	50.8	176.6	98.1
2014	235.5	135.2	49.9	94.1	72.8	21	76	73.8	9.6	139.5	152.1	38.9	138.3
2015	111.1	59.2	19.5	17.7	56.7	27.2	39.2	116	56.2	62.6	82.8	80.9	91.8
2016	149	47.2	77.3	39.5	79.8	64.8	2.8	35	68.8	33.6	87.3	25.6	89.5
2017	91.8	49.4	50.8	8	50.6	47.4	76	46	80.5	44.2	39.7	103.2	86.6
2018	73.1	40.3	101.8	45.3									
Mean	132.1	60.2	61.5	40.8	63.1	37.3	45.4	58.5	49.9	77.7	82.5	85.0	AAR 794.1

Effective Rainfall

2.9.6.5 Estimates of monthly effective rainfall for the existing ground cover present across the Proposed Extension, and for the open water-bodies present within the Site have been calculated following the method of Grindley (Shaw, 1988) and EA R&D Handbook W6-043/HB and are presented below at *table 6*.

2.9.6.6 Effective rainfall is the amount of precipitation available for infiltration to the water table and for surface water run-off, after satisfying any soil moisture deficit and actual evapotranspiration[3].

2.9.6.7 The derived annual average effective rainfall rate at the Site is estimated as 270mm/a, and 159mm/a for open water.

[3] these later two parameters being influenced by vegetation cover.

Table 6: Derivation of Effective Rainfall using the Grindley Water Budget Method													
rc = 75 (Permanent Grassland)													
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
Rainfall	79	60	50	50	56	50	60	72	70	78	95	87	807
Pe	4	11	32	57	82	98	97	79	47	24	9	3	543
rf-Pe	75	49	18	-7	-26	-48	-37	-7	23	54	86	84	264
dPsmd	0	0	0	7	26	48	37	7	-23	-54	-48	0	
dAsmd	0	0	0	7	26	48	34	4	-23	-54	-42	0	
Psmd	0	0	0	7	33	81	118	125	102	48	0	0	514
Asmd	0	0	0	7	33	81	115	119	96	42	0	0	493
Ae	4	11	32	57	82	98	94	76	47	24	9	3	537
Effective Rainfall	75	49	18	0	0	0	0	0	0	0	44	84	270
Open Water													
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
Correction Constants	1.4	1.1	0.9	1.0	0.9	1.0	1.2	1.4	1.5	2.0	2.3	2.0	
Ae	5.7	12.5	29.4	54.2	74.6	100.0	120.3	108.2	69.1	47.8	20.6	5.9	648.3
Effective Rainfall	73.3	47.5	20.6	-4.2	-18.6	-50.0	-60.3	-36.2	0.9	30.2	74.4	81.2	158.8
rc: Root Constant, Pe: Potential Evaporation, rf: Rainfall, Psmd: Change in Potential Soil Moisture Deficit dAsmd: Change in Actual Soil Moisture Deficit, Psmd: Potential Soil Moisture Deficit, Asmd: Actual Soil Moisture Deficit, Ae: Actual Evaporation, All units excepting correction constants are millimetres.													

2.9.7 Surface Water Quality

2.9.7.1 The River Frome, as present within the Study Area, falls within the Piddle (Lower) reach of the Poole Harbour Rivers Operational Catchment, Dorset Management Catchment, within the South West River Basin District (as administered by the EA).

2.9.7.2 The River Piddle has an overall ecological classification of 'Moderate', with a target objective of 'Good' by 2027, and a chemical classification of 'Good' with target objective of 'Good' by 2027.

2.9.7.3 Surface water quality data for the Study area as held by the EA has been requested, though has not been able to be provided within the period of time over which assessment has been conducted (which has exceeded the EA's 20 working day target response time). This data thus cannot be presented at this time.

2.10 Hydrogeological Setting

2.10.1 The hydrogeological regime of the area has been elucidated on the basis of:

i. Review of published geological data;

ii. Water features surveying undertaken by BCL during November 2017; and

iii. Experience of similar hydrogeological terrains within the UK.

2.10.2 Aquifer Classification

2.10.2.1 Aquifer classifications for the Study area have been sourced from the EA's publically available Aquifer Designation Mapping.

2.10.2.2 Where present, head deposits are classified as a 'Secondary Undifferentiated' aquifer. This designation is applied where the unit in question has previously been designated as either a minor aquifers or non-aquifer (due to spatially variable aquifer properties).

2.10.2.3 The RTD and PF are classified as 'Secondary A' aquifers, defined as layers capable of supporting water supply at the local scale, that may form an important source of river baseflow.

2.10.2.4 The LC, which underlies the PF across the area, is classified as 'Unproductive Strata'. This designation implies negligible significance for water supply and river baseflow.

2.10.2.5 The underlying chalk is classified as a 'Principal Aquifer', defined as layers with high permeability, typically featuring high storage, that may support water supply and / or river baseflow at the strategic scale.

2.10.3 Groundwater Flow Mechanism

2.10.3.1 The RTD, alluvium and PF are assumed to be in hydraulic continuity, forming a single, unconfined, granular aquifer (the Aquifer) featuring diffuse inter-granular groundwater flow.

2.10.3.2 Anisotropy within the PF is anticipated to occur due to the presence of intervening clay layers within this unit. These layers are expected to form aquitards (barriers to groundwater flow / infiltration), commonly leading to perched groundwater levels and potentially resulting in confined conditions at depth in some areas. The distribution and elevation of these layers is anticipated to be heterogeneous.

2.10.3.3 Despite the prevalence of perching within the PF, which is of increased importance at the local scale, groundwaters are anticipated to ultimately migrate to the base of the Aquifer, effectively forming a single aquifer of moderate permeability.

2.10.3.4 The underlying LC forms a regionally pervasive aquiclude of low permeability and significant thickness, and is assumed to form a barrier to groundwater flow, effectively hydraulically isolating the Site from underlying strata.

2.10.4 Aquifer Boundaries

Lateral Aquifer Boundaries

2.10.4.1 The Aquifer is pervasive across the Study Area, being of effectively unlimited extent at the scale of interest.

Aquifer Upper and Lower Boundaries

2.10.4.2 The Aquifer is unconfined with its upper boundary being formed by ground surface.

2.10.4.3 The Aquifer lower boundary is formed by the underlying LC aquiclude, which forms its effectively impermeable base and thus hydraulically isolates the Site from underlying strata.

Aquifer Internal Boundaries

2.10.4.4 Though indicated to be partially penetrating, both the River Piddle and River Frome are understood to be gaining flow from the Aquifer with which they are assumed in hydraulic continuity. These watercourses thus form internal Aquifer boundaries to the south of the Site.

2.10.5 Aquifer Recharge

2.10.5.1 As the Aquifer is unconfined, recharge is assumed to be diffuse and autogenic (derived from within the Aquifer's distribution).

2.10.5.2 Rainfall recharge to the Aquifer is anticipated to be relatively rapid and vertical although the existence of discrete lower permeability horizons within the strata will serve to retard recharge.

2.10.6 Groundwater Occurrence and Levels

The Available Data

2.10.6.1 There are 5 no. piezometers located to the north of the Proposed Development, installed and operated in association with the TLS, for which groundwater elevation data has been made available by AI / Viridor (piezometers 1TA126/WM,

1TA128WM, 1TA129WM, 1TA131WM and 1TA131WM, *figure 7*) covering a data period of January 2011 to April 2018 at monthly frequency.

2.10.6.2 Drilling and piezometer construction logs for the 1TA series piezometers are not available. These boreholes are assumed to partially penetrate the Aquifer and to monitor groundwater elevations within it's saturated zone, being situated outside of the waste mass within the TLS.

2.10.6.3 Insufficient data is available to confirm the datum elevations and locations of piezometers 1TA128WM and 1TA129WM. These piezometers have thus been excluded from further assessment.

2.10.6.4 A further piezometer (TA2017/001, *figure 7*) was installed by AI in 2017 for which data is available from March 2017 to March 2018. This piezometer is located within the Proposed Development and was completed to monitor groundwater elevations within the Aquifer (with its screen being situated within PF sands).

Groundwater Head Distribution

2.10.6.5 The available data, being corrected to account for a higher variation in groundwater elevations at piezometer TA2017/001 of 2.2m as detailed above, has been used to generate interpolated groundwater elevation contours under minimum, maximum and average groundwater elevations, as presented at *figures 7, 8* and 9 respectively.

2.10.6.6 Under minimum conditions, groundwater elevations are seen to range from 5.6maOD to 7maOD, being at their lowest at piezometer TA2017/001 (within the Proposed Development), falling southwards at a gradient of 0.004, indicating groundwater flow to be made southwards towards the River Piddle.

2.10.6.7 Under maximum conditions, groundwater elevations are seen to range from 7.8maOD to 9.2maOD, featuring a similar head distribution, gradient and groundwater flow direction as observed under minimum conditions.

2.10.6.8 Under average conditions, groundwater elevations are seen to range from 6.5maOD to 7.9maOD, featuring a similar head distribution, gradient and groundwater flow direction as observed under minimum and maximum conditions.

Saturated and Unsaturated Thickness

2.10.6.9 The majority of drilling undertaken in the area is of insufficient depth to prove the full thickness of the Aquifer. Insufficient data is thus available to estimate Aquifer saturated thickness.

2.10.6.10 The available maximum groundwater elevation data has been combined with publically available 1m spatial resolution Light Detection And Ranging (LIDAR) data for the Site and surrounding area to allow estimation of Aquifer minimum unsaturated thickness, as presented at *figure 10*.

2.10.6.11 The available data shows unsaturated thickness to range from 17m to 28m, being thickest within the TLS (where ground elevations are highest), and thinning to the south east.

2.10.6.12 Unsaturated thickness is indicated to range from 19.4m to 23.5m within the Proposed Development area, and is estimated at some 7.2m within the Southern Site (excavated to some 15maOD).

2.10.7 Temporal Groundwater Level Variations

2.10.7.1 The available groundwater elevation data is presented in hydrograph from at *figure 11*.

2.10.7.2 Groundwater elevations are seen to follow the typical trend exhibited by UK unconfined aquifers such as that underlying the Site, demonstrating high winter elevations followed by a summer recession.

2.10.7.3 Groundwater elevations across the available piezometers are seen to exhibit a concurrent trend, demonstrating peak levels to have been recorded within 2014 with no underlying long term trends in rising / falling elevations being observed.

2.10.7.4 Groundwater elevations at individual piezometers are shown to range by approximately 2.2m across the Site. The observed range at TA2017/001 is notably lower at 0.55m due to the shorter data period available at this borehole. Groundwater elevations at this location are assumed to exhibit a comparable range to that observed within the wider Site (2.2m).

2.10.8 Aquifer Parameters

2.10.8.1 Information upon aquifer parameters has been taken from the Aquifer Properties Manual[4] (APM). The APM reports that the EA employ an estimated regional transmissivity of 20m^3/d for the PF, with a storage coefficient of 1%.

2.10.8.2 The APM states that, within the PF '*most groundwater percolates to the base of the beds and emerges in the river valleys*'. This implies that although vertical anisotropy is present, and perching / confined conditions do occur within the unit, vertical permeability is sufficient to allow the passage of groundwaters (though is likely to be lower than the lateral permeability as approximated above). This may in part be attributable to the discontinuous nature of many clay horizons and their inherent lack of connectivity.

2.10.9 Water Abstractions

Licensed Abstractions

2.10.9.1 Details of licensed abstractions (abstractions of more than 20m^3/d for which an abstraction licence is required) within the Study have been provided by the EA, as detailed at *table 7* with abstraction locations as shown at *figure 12*.

2.10.9.2 Abstraction A is located upstream and cross hydraulic gradient from the Site and is thus considered to be hydraulically isolated from it.

2.10.9.3 Abstractions B and C are located upstream of the Site and are separated from it by the River Piddle. These abstractions are thus considered to by hydraulically isolated from the Site.

2.10.9.4 There are no identified groundwater abstractions within the Study Area (only surface water abstractions having been identified).

Table 7: Inventory of Licensed Abstractions

Map Code (*figure 12*)	Licence Number	Holder	Source	Purpose
A	13/44/045/S/108	Wessex Fish Farms	Surface Water	Aquaculture
B	13/44/045/S/018	Suez Recycling and Recovery UK	Surface Water	Mineral Washing
C	13/44/045/S/032	Suez UK Environment	Surface Water	Mineral Washing

[4] Hydrogeology Group Technical Report WD/00/04, *'The physical Properties of Minor Aquifers in England & Wales'*, Environment Agency / British Geological Survey, 2000.

De-regulated Abstractions

2.10.9.5 Details of unlicensed abstractions (deregulated private water supply abstractions of less than $20m^3/d$) within the Study area as held by Purbeck District Council have been requested, though have not been able to be provided within the period of time over which assessment has been conducted. This data thus cannot be presented at this time.

2.10.10 Source Protection Zones

2.10.10.1 Local groundwater Source Protection Zones (SPZ) mapping has been obtained from the EA. There are no SPZs within the Study Area.

2.10.11 Groundwater Quality

2.10.11.1 The Aquifer is classified by the EA in terms of groundwater vulnerability as a 'Minor Aquifer, High Vulnerability', likely due to the Aquifer being unconfined.

2.10.11.2 Groundwater quality data for the Site has been provided by Viridor for the 1TA series piezometers around the TLS, covering a period from 2015 to 2018, having been collected on a quarterly basis. The available data is summarised at *table 7* below.

2.10.11.3 The groundwater quality data indicates groundwaters to have near neutral pH and elevated electrical conductivity indicative of abundant dissolved mineralogy.

2.10.11.4 A number of determinands feature elevated concentrations potentially indicative of groundwater contamination. This includes concentrations of Chloride and Ammonical Nitrogen in excess of the UK Drinking Water Standards (DWS) of 250mg/l and 0.5mg/l respectively, and high Chemical Oxygen Demand (COD), which forms a qualitative indicator of groundwater quality with regards to oxidizable pollutants.

2.10.11.5 The indicated derogation of groundwater quality is potentially related to the TLS. It should however be noted that the Site permit limits for the below determinands have only been breached on one isolated occasion and at one piezometer for Chloride only (permit limit of 250mg/l).

2.10.11.6 Sub-surface gas monitoring data for the piezometers around the TLS has also been provided by Viridor. Covering the period 2013 to 2018 at a monthly frequency.

2.10.11.7 The available data shows the periodic detection of low methane concentrations (below permit limits of 1%) and elevated CO_2 concentrations, the latter having breached

permit limits (2.6% to 3%) on a number of occasions, with peak values of 8.4% having been recorded.

2.10.11.8 The sub-surface gas data thus indicates the potential presence of landfill gases within the sub-surface which may be associated with the TLS.

Table 7: Groundwater Quality Data, Site Piezometers

Determinand	Units	Minimum Concentration	Maximum Concentration	Average Concentration
Alkalinity	mg/l	<2.8	133.0	61.4
Ammoniacal Nitrogen	mg/l	<0.41	17.5	6.2
Arsenic	ug/l	<1	13.0	4.2
BOD	mg/l	<1	19.0	6.1
Calcium	mg/l	10.9	56.0	34.2
Cadmium	ug/l	<0.6	<6	LOD
Chloride	mg/l	23.8	385.0	90.5
COD	mg/l	39.0	1520.0	404.7
Conductivity	uS/cm	141.0	564.0	310.9
Chromium	ug/l	<2	10.0	3.6
Copper	ug/l	<9	28.1	16.0
Iron	mg/l	<0.23	6.4	2.3
Potassium	mg/l	0.8	68.5	6.5
Magnesium	mg/l	2.7	12.8	5.6
Manganese	mg/l	0.1	1.1	0.4
Sodium	mg/l	<3	27.2	11.0
Nickle	ug/l	3.6	66.5	22.9
Nitrite	mg/l	<0.08	1.2	0.4
Nitrate	mg/l	<0.7	3.3	1.7
Lead	ug/l	<6	61.8	27.6
pH	pH Units	4.1	6.8	6.0
Phosphate	mg/l	<0.12	1.3	1.3
Sulphate	mg/l	26.1	347.0	124.0
TOC	mg/l	<0.7	26.8	8.8
TON	mg/l	<0.7	3.3	1.7
Zinc	ug/l	<18	237.0	105.5

LOD= Limit of Detection, <= At or below LOD

2.11 Conceptual Hydrogeological Model

2.11.1 The Site is underlain by the sands and gravels of the RTD and the sands, silts and clays of the PF, which form a single Aquifer of approximately 32m thickness capable of supporting local abstraction and forming an important component of baseflow to surface watercourses.

2.11.2 The Aquifer is unconfined, featuring diffuse, intergranular groundwater flow, relatively high unsaturated thickness (approximately 20m) and rapid, vertical, autogenic recharge. Permeability is anticipated to be relatively high.

2.11.3 The base of the Aquifer is formed by the regionally pervasive LC, which forms an aquiclude of low permeability, hydraulically isolating the Site from underlying strata.

2.11.4 Groundwater elevations within the Aquifer are indicated to fall southwards, with groundwater flow within the Proposed Development thus being made in this direction, towards the River Piddle.

2.11.5 The River Piddle is assumed to be in hydraulic continuity with the Aquifer which it is indicated to partially penetrate and from which it is assumed to gain flow.

2.11.6 The PF is known to feature interbedded low permeability horizons which function as aquicludes. These aquicludes can support perched groundwaters, springs and seepages and are known to retard recharge.

2.11.7 The interbedded aquicludes within the PF are discontinuous with their distribution and elevation being heterogeneous. The influence of these aquicludes is considered minor at the regional scale, though they can exert a strong control on groundwaters locally.

2.11.8 The Aquifer is not known to support any licenced abstractions within the Study Area. Such abstractions are limited to being made from surface waters upstream of the Site (which are supported by groundwater baseflow).

2.11.9 Groundwater quality derogation in proximity to the Site is indicated to have occurred, potentially being associated with historic landfill operations within the TLS.

3 THE PROPOSED DEVELOPMENT

3.1 Overview

3.1.1 It is proposed that the existing, consented mineral extraction operation within the Southern Site be extended laterally to the east into the area known as Baggs Land, to release some 230,000 tonnes of fine sands and 50,000 tonnes of overlying clay over a period of some 4 years.

3.1.2 Mineral extraction is to be undertaken using the same method as currently employed at the Site, with mineral being extracted by excavator prior to transportation to the northern Site via dumper. The mineral will then be processed (via dry screening) and sold in line with current, permitted, Site operations.

3.1.3 Mineral extraction operations are to attain a maximum depth of some 10maOD and will thus maintain an estimated minimum standoff from groundwaters of some 2m. The Proposed Development will thus be worked dry without need for dewatering.

3.1.4 Mineral extraction operations are to commence via the stripping of soils and overburdens. This is to be followed by the extraction of the underlying mineral to a basal elevation of 20maOD, with subsequent deepening to 10maOD accompanied by the lowering of the existing Southern Site void to the same level (under existing permissions).

3.1.5 The Proposed Development and existing Southern Site void will be simultaneously restored to form a closed depression with basal elevation of 13maOD as shown at *figure 13*, without use of imported infill materials. This is to be facilitated via the replacement of stripped overburdens and soils and will return the Proposed Development to an agricultural and nature conservation afteruse.

3.2 Water Management

3.2.1 During Operations

3.2.1.1 During mineral extraction, the Site will form a closed depression within which all incident rainfall / runoff will be captured and contained. Attenuated storm waters stored within the base of works will then soak away to the Aquifer.

3.2.1.2 Mineral extraction, processing and sale will continue to be operated without consumptive water use in line with current Site operations and under existing permissions (within the Northern Site).

3.2.1.3 There is no requirement for water abstraction or for the discharge of waters from the Site.

3.2.2 Following Restoration

3.2.2.1 Following restoration, the Site will continue to form a closed depression within which all incident rainfall / runoff will be captured and contained. A pond is to be created within the lowest point of the restored landform within which intercepted waters will be able to dissipate to the Aquifer.

4 ASSESSMENT OF POTENTIAL IMPACTS

4.1 Background

4.1.1 Assessment has facilitated the conceptualisation of the extant groundwater and surface water regimes operating within and around the Site.

4.1.2 This understanding has been utilised to inform assessment of the potential impacts that may be posed by the Proposed Development upon the water environment.

4.1.3 Where significant potential for adverse impact is identified, recommendations for specific mitigation measures are proposed.

4.1.4 Both specific mitigation measures and those incorporated into the design of the Proposed Development are described.

4.2 Generic Potential Impacts

4.2.1 Direct Impacts

4.2.1.1 As is typical of the majority of operations of this type and scale, the Proposed Development has the potential to impact upon the water environment in the following direct ways:

i. Potential for impact upon groundwater levels and flow;
ii. Potential for impact upon surface water flows & water-bodies;
iii. Potential for derogation of groundwater quality;
iv. Potential for derogation of surface water quality; and
v. Potential for the Site to increase extant flood risk.

4.2.2 Indirect Impacts

4.2.2.1 The direct impacts outlined above may lead, in-turn, to indirect impacts upon:

i. Potential for indirect derogation of surface water flow rates and / or water-bodies;
ii. Potential for impact upon volume of groundwater and / or surface water available for existing and potential abstractions;
iii. Potential for impact upon the quality of groundwater and / or surface water available to existing and potential abstractions; and
iv. Potential impact upon floral and / or faunal habitats as a result of flow / quality derogation within surface water-courses / wetland areas.

4.2.3 Preliminary Risk Screening

4.2.3.1 A preliminary screening of the potential impacts of the Proposed Development upon the water environment has been undertaken to identify where such impacts are potentially significant.

4.2.3.2 Where potential for significant impact is identified, further assessment has been undertaken at *section 4.3* with mitigation measures / planning controls being formulated as required (summarised at *section 5*).

4.2.3.3 The screening and subsequent assessment of potential impacts upon extant flood risk has been undertaken separately within the Site Specific Flood Risk Assessment (FRA) as presented at *appendix 4*. Summary findings and recommended mitigation resulting from this assessment is summarised at *section 4.3.5*.

4.2.2 Both specific mitigation measures and those incorporated into the design of the Proposed Development are described.

4.2.3.4 The results of preliminary risk screening are presented at *table 9* below.

Table 9: Preliminary Risk Screening					
Activity	Impact Class	Potential Primary Impact	Note	Potential Secondary Impacts	Requirement for Further Assessment
Alteration of Surface Cover and Removal of Aquifer Material During Mineral Extraction	Groundwater Levels and Flows	Alteration of Aquifer recharge	Aquifer recharge is rapid and vertical. Low permeability horizons of limited extent. Changes in recharge rate unlikely to be significant.	No significant primary impact	No
		Groundwater Interception	Maximum groundwater elevations estimated at 2m below maximum working depth. Negligible potential for groundwater interception.	No significant primary impact	No
		Interception of Perched Groundwaters	Perching prevalent in PF.	Availability of water to abstractors / ecology	Yes
	Surface water levels and flows	Alteration of runoff rates / routes	Proposed Development will form closed depression with no off Site discharge. Intercepted waters to dissipate to Aquifer in base of works. Ultimate destination of runoff waters unchanged from present conditions.	No significant primary impact	No
		Groundwater Interception	Negligible potential for groundwater interception and thus impact upon surface water features in groundwater continuity.	No significant primary impact	No
		Interception of perched groundwaters	Perching prevalent in PF.	Availability of water to abstractors / ecology	Yes
	Groundwater quality	Reduction in natural attenuation capacity	Aquifer recharge is rapid and vertical. Low permeability horizons of limited extent. Natural attenuation capacity limited. Negligible potential for impact.	No significant primary impact	No
		Interception / disturbance of pre-existing contamination	Historic landfill in vicinity of Proposed Development.	Derogation of water quality available to abstractors / ecology	Yes
	Surface water quality	Derogation of groundwater quality as above	Aquifer provides baseflow to surface watercourses.	Derogation of water quality available to abstractors / ecology	Yes
		Alteration of runoff rates / routes	Proposed Development will form closed depression with no off Site discharge.	No significant primary impact	No
Storage and use of Fuels / Oils / Lubricants	Groundwater quality	Accidental spillage / long term leakage	Aquifer is unconfined. Mobile plant to be operated and maintained.	Derogation of water quality available to abstractors / ecology	Yes
	Surface water quality	Derogation of groundwater quality as above	Aquifer provides baseflow to surface watercourses.	Derogation of water quality available to abstractors / ecology	Yes
Restoration of Proposed	Groundwater Levels and Flows	Alteration of Aquifer recharge	Majority of restoration materials of low permeability which may form barrier to recharge.	Availability of water to abstractors / ecology	Yes

Development using Stripped Soils and Overburdens		Impedance of groundwater flows	Maximum groundwater elevations estimated at 5m below minimum restoration level. Negligible potential for impact.	No significant primary impact	No
		Introduction of new waterbodies	Restoration of Southern Site will incorporate fewer waterbodies than present under existing conditions. Evaporative losses will thus not be increased.	No significant primary impact	No
	Surface water levels and flows	Alteration of runoff rates / routes	Restored landform will form closed depression with no off Site discharge	No significant primary impact	No
	Groundwater Quality	Placement of restoration materials	Restoration to be completed without use of imported infill with all materials being native to the Site. Negligible potential for impact.	No significant primary impact	No
	Surface Water Quality	Alteration of runoff rates / routes	Restored landform will form closed depression with no off Site discharge. Agricultural landuse proposed in line with pre-development conditions.	No significant primary impact	No

4.3 Further Assessment of Potential Impacts

4.3.1 Groundwater Levels and Flows

Background

4.3.1.1 The Proposed Development as described herein is considered to have the potential to impact upon groundwater levels and flows in the following ways:

i. Interception of perched groundwaters

ii. Restoration of Site using stripped soils and overburdens

Interception of Perched Groundwaters

4.3.1.2 As previously stated, clay horizons within the PF have the potential to support perched groundwaters within the Aquifer unsaturated zone. The removal of part of the Aquifer unsaturated zone during mineral extraction within the Proposed Development has the potential to intercept perched groundwaters where clay horizons are worked through, with associated potential to impact upon groundwater levels and flows.

4.3.1.3 It should be noted that no discrete inflows of water to, or areas of seepage upon quarry faces within, the existing mineral workings within the Southern Site were identified during waters features surveying. The prevalence of perched groundwaters in this area (which is directly adjacent the Proposed Development) is thus indicated to be limited.

4.3.1.4 In the event that perched groundwaters are intercepted by the works, such waters will be able to drain to the base of workings where they will be able to soak away to the Aquifer (as the base of works will be elevated above maximum groundwater elevations and will constitute in-situ Aquifer material).

4.3.1.5 As discussed, due to the discontinuous nature of, and poor connectivity between, clay horizons within the PF, it is considered to function as a single Aquifer unit with retarded vertical permeability within which all recharge ultimately drains to the base of the Aquifer. The ultimate destination of any intercepted groundwaters will thus remain the Aquifer saturated zone (and will therefore be unchanged from present conditions).

4.3.1.6 Although no significant potential for impact upon groundwater levels and flows is anticipated as a result of the interception of perched groundwaters by mineral extraction, it is considered prudent that the current monitoring of groundwater levels

at the Site be continued, being accompanied by periodic review. This will allow the identification of any impacts upon groundwater levels and flows in excess of that estimated above.

Potential for Associated Secondary Impacts

4.3.1.7 In the event that perched groundwaters are intercepted by mineral extraction operations, the volumes of water within the affected perched system may potentially be derogated. This has the potential to impact upon any abstractions made from such systems and any aquatic ecology that may be dependent upon them.

4.3.1.8 Baseline assessment has not identified any licenced groundwater abstractions within the Study Area, with all licenced surface water abstraction being indicated to be hydraulically isolated from the Site. Impacts upon such abstractions are thus not anticipated.

4.3.1.9 The discontinuous nature of interbedded clay horizons within the PF severely limits their potential for supporting water abstraction. Significant impacts upon the volumes of water available to any other abstractors (such as deregulated abstractions) is thus not anticipated as a result of the potential interception of perched groundwaters by the Proposed Development.

4.3.1.10 The discontinuous nature of interbedded clay horizons within the PF also severely limits the area over which they may be of importance to aquatic ecology. Baseline assessment did not identify any statutorily or non-statutorily protected sites in immediate proximity to the Site which are indicated to be dependent upon perched groundwaters that may potentially be derogated.

Restoration of Site Using Stripped Soils and Overburdens

4.3.1.11 The restoration of the Site is proposed to take the form of a dry, low level landform with an agricultural and conservation afteruse. This landform is to be formed through a combination of the landscaping of the quarry faces and the placement of stripped soils and overburdens.

4.3.1.12 As the stripped overburden materials are in the form of clays native to the Site, these materials will be of lower permeability than that of the Aquifer as a whole. The

widespread deposition of these materials has the potential to form a barrier to recharge with associated potential to impact upon groundwater levels and flows.

4.3.1.13 It is proposed that the restored Site be drained via the dissipation of intercepted waters to the Aquifer within the base of the landform, in which event the ultimate destination of intercepted waters will be unchanged and from which negligible potential for significant impact upon groundwater levels / flows may result.

4.3.1.14 It is however considered that the formation of the restoration landform should be undertaken in a manner that precludes the widespread deposition of low permeability materials in a manner which may effectively line the restored Site, and maintains pathways through which intercepted waters are able to be transmitted to permeable horizons within the PF.

Potential for Associated Secondary Impacts

4.3.1.15 Mitigation measures formulated for potential primary impacts upon groundwater levels and flows associated with the placement of stripped soils / overburdens during restoration are considered sufficient to additionally mitigate against any potential secondary impacts in this regard.

Requirement for Mitigation / Planning Controls

4.3.1.16 A Hydrometric Monitoring Scheme (HMS) should be drafted, submitted and implemented, detailing the monitoring of groundwater elevations at the Site at a minimum quarterly frequency (subject to agreement of routine access to the TLS piezometers).

4.3.1.17 The HMS should further detail requirement for an Annual Data Review (ADR), requiring the annual assessment of the data collected under the HMS. This assessment should include consideration of both groundwater elevations relative to the maximum proposed extraction depth and any impact upon groundwater levels / flows that may be attributable to Site operations.

4.3.1.18 The restoration of the Site should be undertaken in a manner which precludes the blanket placement of low permeability overburdens without maintaining pathways through which intercepted rainfall / runoff waters are able to dissipate to permeable horizons within the surrounding Aquifer.

4.3.2 Surface Water Flows and Waterbodies

Background

4.3.2.1 The Proposed Development as described herein is considered to have the potential to impact upon surface water flows and waterbodies in the following ways:

i. Interception of Perched Groundwaters

Interception of Perched Groundwaters

4.3.2.2 As discussed, there is potential for localised impact upon groundwater levels and flows via the interception of perched groundwaters within the Aquifer unsaturated zone via the removal of Aquifer materials during mineral extraction. This has the potential to result in the derogation of surface water levels / flows where dependent on perched groundwaters.

4.3.2.3 The River Piddle, which is down hydraulic gradient from the Site, and is indicated to be in hydraulic continuity with the Aquifer, has an estimated elevation of some 3.56maOD to the south of the Site. Groundwater within the Aquifer saturated zone underlying the Proposed Development holds an average elevation of some 7.8maOD, suggesting a head gradient to this feature of 0.01.

4.3.2.4 Though this represents a more shallow gradient than observed across the Site (0.04), this is in agreement with typical trends observed within unconfined aquifers which show a reduction in head gradient in proximity to gaining surface water features. It is thus considered that the River Piddle is in continuity with groundwaters at the base of the PF and is not directly dependent upon perched groundwaters.

4.3.2.5 As any perched groundwaters that may be intercepted by the Proposed Development are to be allowed to dissipate to the Aquifer within the base of works, significant associated impacts upon surface water levels / flows within the River Piddle and associated drainage ditches are not anticipated to occur.

4.3.2.6 Water features surveying did not identify any springs or seepages in proximity to the Proposed Development. Though a number of minor watercourses were identified with elevations above the proposed base of works (the Northern Stream, North Western Stream and Western Stream), these watercourses are at significant distance from the Proposed Development and were all indicated to be supported by outcropping clay

units within the PF which are absent within the Proposed Development (and elevated above it), and are thus hydraulically isolated from it.

4.3.2.7 Water features surveying identified a number of surface waterbodies within the Southern Site which are indicated to be perched (WFS9, 11, 12 and 13, *figure 5*). These waterbodies are indicated to be based upon low permeability materials (silt for WFS9 and low permeability horizons within the PF for WFS 11-12) with their levels being sustained by rainfall / runoff. Of these, the waterbodies at WFS 11-12 are to be worked out under existing permissions. Significant impact upon these features associated with the potential for interception of perched groundwaters by the Proposed Development is therefore not anticipated.

Potential for Associated Secondary Impacts

4.3.2.8 As no significant potential for impact upon surface water levels / flows associated with the interception of perched groundwaters by the Proposed Development in anticipated, no significant secondary impacts are expected in this regard.

Requirement for Mitigation / Planning Controls

4.3.2.9 As no significant potential for impact upon surface water levels / flows associated with the Proposed Development has been identified, mitigation measures / planning controls in this regard are not required.

4.3.3 Groundwater Quality

Background

4.3.3.1 The Proposed Development as described herein is considered to have the potential to impact upon groundwater quality in the following ways:

i. Interception / disturbance of pre-existing contamination

ii. Accidental spillage / long-term leackage of potentially contaminating substances (fuels, oils, lubricants, solvents).

Interception / Disturbance of Pre-Existing Contamination

Introduction:

4.3.3.2 Baseline assessment has identified a number of active and historic landfill sites within the Study Area which have the potential to form sources of pre-existing groundwater

contamination. Potential exists for any such contamination to be exacerbated by the Proposed Development.

4.3.3.3 As a result of the above, a preliminary contamination assessment has been undertaken below, utilising the Source, Pathway, Receptor (SPR) methodology including the following elements:

i. Establishment of Conceptual Site Model (CSM)
ii. Estimation of risk posed by identified hazards
iii. Evaluation of risk posed to identified hazards
iv. Recomendations

Conceptual Site Model:

Hazard Identification:

4.3.3.4 Baseline assessment has identified a number of active and historic landfill sites within the Study Area as detailed at *table 3*.

4.3.3.5 The majority of the identified landfills are located to the south of the River Piddle. This watercourse is understood to gain flow from the Aquifer and is thus assumed to form an internal boundary within it, hydraulically isolating the Site from such landfills.

4.3.3.6 The historic landfill at Sandford Lane and the active landfill at Trigon are located at significant distance to the northwest and southeast of the Site respectively and are cross hydraulic gradient. These landfills are thus not considered to form potential sources of pre-existing contamination at the Site.

4.3.3.7 The TLS are located within the Northern Site and are thus in immediate proximity to the Proposed Development (to the north) and up hydraulic gradient. The TLS are thus considered to form a potential hazard in this regard.

Potential Contaminant Source:

4.3.3.8 The TLS have been formed via the infilling of historic mineral workings within the Northern Site and are known to have received household, commercial and industrial wastes, including putrescible wastes, and are known to have received waste since the 1960s. These landfills are operated by Viridor.

4.3.3.9 The most recent cells within the TLS (Tatchells Depot, upon the boundary of the Northern Site and Carey Road) are understood to have been lined and feature active gas management (with energy from waste being undertaken via on Site gas combustion). The older areas of landfill (Tatchells Depot) are of unknown construction.

4.3.3.10 The TLS are operated under current Environmental Permit by Viridor, whom are known to undertake groundwater level, groundwater quality and landfill gas monitoring in and around the Site in support of the management of the landfills.

4.3.3.11 As parts of the TLS are of significant age and are of unknown construction, in order to form basis for conservative assessment, it must be assumed that they have at least in part been formed via the deposition of putrescible wastes without use of an engineered liner. The TLS are thus assumed to form a potential source of pre-existing groundwater contamination via the release of landfill leachate and landfill gas to the Aquifer.

Potential Contaminant Pathway:

4.3.3.12 Assuming the TLS to be at least in part unlined, the primary contaminant pathway is considered to be via groundwater flow within the Aquifer saturated zone (the Primary Pathway). Groundwater flow at the landfill locations is indicated to be to the south.

4.3.3.13 Given the prevalence of low permeability horizons within the PF, potential exists for a secondary pathway to exist via the transmission of contaminated groundwaters within perched systems within the unsaturated zone (the Secondary Pathway).

4.3.3.14 As the TLS are known to have received putrescible wastes and feature active gas management, potential exists for a tertiary pathway to exist in the form of landfill gas migration (the Tertiary Pathway). This has the potential to transmit groundwater contamination in directions contrary to groundwater flow.

4.3.3.15 The waterbody at WFS9, ***figure 5***, is known to receive runoff from the TLS via a buried pipeline under the Carey Road (WFS10, ***figure 5***). An additional pathway exists via the transmission of contaminated runoff waters to this feature (the Quaternary Pathway).

4.3.3.16 It should be noted that, as the Aquifer is readily permeable, and that interbedded clays would have been worked through during mineral extraction prior to infilling, any release of landfill leachate is likely to occur via the base of the landfill, limiting the likelihood of contaminant transmission via the Secondary Pathway.

4.3.3.17 As the low permeability horizons within the Aquifer are discontinuous and feature poor connectivity, it is assumed that any contamination transmitted within the Secondary Pathway will ultimately contribute to the Aquifer saturated zone (in line with the Primary Pathway).

4.3.3.18 Any contamination transmitted via the Tertiary Pathway is also assumed to ultimately contribute to the Aquifer saturated zone and thus the Primary Pathway.

4.3.3.19 Any contamination transmitted via the Quarternary Pathway is also assumed to ultimately contribute to the Aquifer saturated zone (and thus Primary Pathway) via infiltration from the waterbody at WFS9, *figure 5*.

Potential Contaminant Receptor:

4.3.3.20 The Primary Pathway (and ultimately the Secondary, Tertiary and Quaternary Pathways) ultimately contribute baseflow to the River Piddle to the south of the Site.

4.3.3.21 The River Piddle forms an important habitat, is known to ultimately flow to downstream statutorily protected sites and is known to support water abstraction and to have local amenity value. The River Piddle (and associated drainage ditches) are thus considered to form the primary receptor for the identified source.

Risk Estimation:

Risk at Source:

4.3.3.22 There is no available information as to the exact construction or content of the TLS. It must therefore be assumed that they pose a significant risk to groundwater quality.

Evidence of Contamination:

4.3.3.23 As discussed at *section 2.10.11*, the available groundwater quality data shows elevated concentrations of determinands indicative of landfill leachate (including Chloride and

Ammoniacal Nitrogen). Landfill gases are also indicated to be present within the sub-surface.

4.3.3.24 The above indicators form evidence of groundwater contamination up-hydraulic gradient from the Site and thus potentially within the Site itself.

4.3.3.25 It should be noted that the available groundwater quality data has been attained from boreholes constructed to sample from the Aquifer saturated zone, and does not provide evidence of groundwater contamination within the Secondary Pathway (perched groundwaters).

Potential for Proposed Development to Impact Upon Source:

4.3.3.26 The TLS are located to the north of the Carey Road and are thus outside of the Proposed Development area. No physical disturbance of the TLS is to be undertaken as part of the Proposed Development.

4.3.3.27 The potential for the Proposed Development to impact upon the identified source is considered to be negligible.

Potential for Proposed Development to Impact Upon Pathway:

4.3.3.28 The Proposed Development is to be entirely worked within the Aquifer unsaturated zone with an estimated 2m standoff being maintained from groundwater under maximum groundwater elevations at the maximum depth of working. The potential for the Proposed Development to impact upon the Primary Pathway is thus considered to be negligible.

4.3.3.29 Potential has been identified for the interception of perched groundwaters during mineral working. Due to the close proximity of the Proposed Development to the TLS, there is potential for the Proposed Development to impact upon the Secondary Pathway.

4.3.3.30 As the Proposed Development will require the removal of the Aquifer unsaturated zone during mineral extraction, potential exists for the interception of landfill gas, and thus impact upon the Tertiary Pathway.

4.3.3.31 The waterbody at WFS9, *figure xxx,* will be unaltered by the Proposed Development. Impacts upon the Quaternary Pathway are thus not anticipated.

Potential for Proposed Development to Impact Upon Receptor:

4.3.3.32 Impact assessment has not identified any significant potential form impact upon surface water levels or flows within the River Piddle. The Proposed Development is thus not anticipated to result in any impact upon the receptor.

Risk Evaluation:

4.3.3.33 Risk estimation has identified the potential for the Proposed Development to impact upon the Secondary Pathway via the potential interception of contaminated perched groundwaters.

4.3.3.34 In the event of any contaminated perched groundwaters being intercepted by the Proposed Development (the likelihood of which is limited), such waters will be allowed to drain to the base of works prior to their dissipation to the Aquifer saturated zone. This is the case for both the mineral extraction and restoration phases of the Proposed Development.

4.3.3.35 As no dewatering or discharge of any kind is proposed at the Site, these waters will thus continue to contribute to the Primary Pathway in line with present conditions (and thus the identified receptor.

4.3.3.36 In view of the foregoing, it is considered that the potential interception of contaminated perched groundwaters during mineral extraction would not result in any significant shortcutting of the natural attenuation provided by the Aquifer, and thus poses a negligible risk to groundwater quality.

4.3.3.37 Risk Estimation has additionally identified the potential for the Proposed Development to impact upon the Tertiary Pathway via the removal of Aquifer unsaturated zone and associated potential for the interception of landfill gases.

4.3.3.38 In the event of mineral extraction resulting in the interception of landfill gases, any such gases would be able to escape to the atmosphere. Gas migration would thus not be affected in a manner which may pose further risk to groundwater quality than is presently observed. This is the case for both the mineral extraction and restoration phases of the Proposed Development.

4.3.3.39 It is thus considered that the potential for interception of landfill gases by the Proposed Development poses a negligible risk to groundwater quality.

Recommendations:

4.3.3.40 Risk evaluation has not identified any significant potential for the derogation of groundwater quality as a result of the interception / disturbance of pre-existing sources of groundwater contamination as a result of the Proposed Development. Recommendations in this regard are thus considered unnecessary.

Potential for Associated Secondary Impacts

4.3.3.41 As no significant potential for the derogation of groundwater quality due to the interception / disturbance of pre-existing sources of contamination has been identified as a result of the Proposed Development, secondary impacts in this regard are not anticipated to occur.

Accidental Spillage / Long-Term Leakage

4.3.3.42 The operation of mobile plant and associated storage of fuels / oils / solvents / lubricants at the Site has the potential to result in the derogation of groundwater quality via accidental spillage / long-term leakage of potentially contaminating substances.

4.3.3.43 It is important to recognise that the likelihood or consequences of accidental spillages / long term leakage of fuels / oils / solvents are considered no greater than currently prevail for the existing, consented mineral extraction and infilling operations undertaken at the Site.

4.3.3.44 It should be recognised that mineral workings are a historical activity in the wider locality and that workings within the extraction area will be carried out in an equivalent manner to that undertaken elsewhere, and within the same hydrostratigraphic environment. Therefore, neither the potential scale, nor likelihood of occurrence, of derogation of groundwater quality will significantly increase as a result of the Proposed Development.

4.3.3.45 Notwithstanding the foregoing, in recognition of the potential for impact, measures to minimise the likelihood of occurrence during operation of the Proposed Development have been formulated. These measures, which comply with EA guidelines (the Oil Care Code), are advanced below.

i. Fuel-oil powered mobile plant shall be restricted to that necessary to undertake mineral extraction, remedial measures and subsequent restoration of the Site

ii. A code of practice should be developed for the refuelling and maintenance of machinery. This code should be incorporated into a formal Environmental Management System (EMS, or similar) that should be incorporated into the overall Site management system. Such work should be carried out only by trained personnel and take place within anarea surfaced with hard standing.

iii. Any oil storage tanks to be located within the Proposed Development should be sited upon impermeable bases enclosed by oil-tight walls. The enclosure should remain at a volume of at least 110% of the capacity of the oil tank and maintained free of accumulations of rainwater. Any mobile storage tanks should be double skinned and well maintained.

iv. All fill and draw pipes emanating from oil storage tanks should be provided with locking mechanisms and be contained within the impermeable enclosure.

v. No refuelling or maintenance should be carried out in areas where aquifer material is exposed at ground surface..

vi. Operators should check their vehicles on a daily basis before starting work to confirm the absence of leakages. A reporting system should be implemented to ensure that repairs are undertaken to that vehicle before it enters the working area.

vii. Sufficient oil sorbent material (3M Oil-Sorb or similar) should be available on Site to cope with a loss equal to the total fluid content of the largest item of plant. Following the use of such oil sorbent material, any contaminated materials should be disposed of from Site in accordance with current waste disposal legislation.

viii. Hydraulic & fuel oil lines on all plant operated within the extraction areas shall be renewed at the manufacturers recommended service intervals to minimise the potential for contamination relating to failure of hoses or lines.

4.3.3.46 The foregoing measures have been incorporated into a preferred fluids handling protocol presented here at *appendix 3*.

Potential for Associated Secondary Impacts

4.3.3.47 Mitigation measures formulated for the prevention of the direct derogation of groundwater quality resulting from the accidental spillage / long term leakage of fuels / oils / lubricants are considered additionally sufficient to prevent against any secondary impact in this regard.

Requirement for Mitigation / Planning Controls

4.3.3.48 The above measures designed to limit the risk of groundwater quality derogation via the accidental spillage / long term leakage of fuels / oils / solvents should be

implemented in full and continued throughout the operation of the Site and the completion of restoration works.

4.3.4 Surface Water Quality

Background

4.3.4.1 The Proposed Development as described herein is considered to have the potential to impact upon surface quality in the following ways:

i. Derogation of groundwater quality.

Derogation of Groundwater Quality

4.3.4.2 Potential exists for the derogation of surface water quality within water features to which the aquifer contributes flow as a direct result of any derogation of groundwater quality that may result from the Proposed Development.

4.3.4.3 Mitigation measures formulated for the prevention of the derogation of groundwater quality are considered additionally sufficient to mitigate against any risk of impacts upon surface water quality in this regard.

Potential for Associated Secondary Impacts

4.3.4.4 Mitigations measure formulated for the prevention of the derogation of groundwater quality are considered sufficient to additionally prevent against any significant derogation of surface water quality in this regard.

Requirement for Mitigation / Planning Controls

4.3.4.5 Mitigation measures / planning controls in excess of those already formulated are considered unnecessary for the prevention of surface water quality derogation.

4.3.5 Flood Risk

Background

4.3.5.1 The National Planning Policy Framework[5] states that a site specific Flood Risk Assessment (FRA) is required for "*any planning proposals of 1 hectare or greater in Flood Zone 1* (FRZ 1: *i.e.* outside the 1:1,000-year flood envelope*); all proposals for*

[5] NPPF: Department for Communities and Local Government [DCLG], March 2012; superseding Planning Policy Statement 25: Development and Flood Risk.

new development (including minor development and change of use) in Flood Zones 2 (FRZ2: 1:1,000-yr to 1:100-yr*) and 3* (<1:100-yr)".

4.3.5.2 As the area of the Proposed Development exceeds 1ha, it falls within the scope of NPPF requirements regarding the need for Site Specific FRA on scale alone.

4.3.5.3 A stand-alone FRA has thus been undertaken, included here at ***appendix 4*** and summarised below.

Scope of FRA

4.3.5.4 Assessment has included:

i. Assessment of the flood risk posed to the Site;

ii. Assessment of the Proposed Development against the requirements of the sequential test; and

iii. Assessment of the potential for increasing extant downstream flood risk

Flood Risk Posed to the Site

4.3.5.5 The flood risk posed to the Site has been considered for both the mineral extraction and post restoration stages of the Proposed Development.

4.3.5.6 Risk screening identified the need for further consideration of fluvial flood risk, groundwater flood risk and surface water flood risk.

4.3.5.7 Where identified by assessment, mitigation measures have been formulated to limit the flood risk posed to the Site to acceptable levels.

The Sequential Test

4.3.5.8 Both the working of the Site and the completed restoration are 'water compatible' activities.

4.3.5.9 Reference to policy statements and accompanying guidance concludes that the Proposed development constitute 'appropriate development' in the context of the sequential test irrespective of the form of flooding to which the Site may be subject.

4.3.5.10 In addition, FRA has demonstrated that the most sensitive parts of the Site are located in the areas at the lowest risk of flooding.

Potential for Increasing Extant Downstream Flood Risk

4.3.5.11 The potential impact of the Proposed Development upon off-site flood risk has been considered for both its operational and post restoration stages for both fluvial / surface water flood risk and for groundwater flood risk.

4.3.5.12 Where required, mitigation measures have been formulated to limit the off-site flood risk posed by the Proposed Development to acceptable levels.

Requirement for Mitigation and / or Planning Controls

4.3.5.13 Mitigation measures and or planning controls advanced by the Site Specific FRA are summarised below.

i. The placement of stripped soils / overburdens during the restoration of the Proposed Development should be undertaken in a manner so as to preclude the blanket coverage of the restored landform with low permeability materials, with permeable pathways being maintained to facilitate the free drainage of the restored Site.

5 SUMMARY IMPACT & MITIGATION SCHEDULE

5.1 The measures and procedures incorporated into the design of the Proposed Development, together with additional specific measures and planning condition requirements recommended for the minimisation of impact upon the water environment assessment are summarised overleaf at *table 10*.

Table 10: Summary Impacts & Mitigation Schedule			
Potential Impact	Mitigation by Design	Mitigation by Procedure	Contingency Action
Groundwater Levels and Flows	Site to be worked dry without need for dewatering with a standoff from maximum groundwater elevations being maintained. Drainage of Site via infiltration to groundwater (for mineral extraction and restoration phases) within unconfined, readily permeable, Aquifer.	Drafting, submission and implementation of HMS detailing groundwater monitoring at minimum quarterly frequency with provision for periodic ADR. Restoration of Site in manner precluding placement of low permeability overburdens without maintaining permeable pathways to facilitate the free drainage of the Site.	Implementation of any further mitigation as detailed within ADR.
Surface Water Levels and Flows	Proposed Development will form closed depression with no off Site discharge. Intercepted waters to dissipate to Aquifer in base of works. Site to be worked dry without need for dewatering with a standoff from maximum groundwater elevations being maintained.	None.	None.
Groundwater Quality	Restoration to be completed without use of imported infill with all materials being native to the Site. No physical disturbance of adjacent landfills. Site to be worked dry without need for dewatering with a standoff from maximum groundwater elevations being maintained.	Implementation of measures to minimise likelihood of accidental spillage / long term, leakage of fuels / oils / lubricants as detailed at *section 4.3.3*.	Emergency containment of any accidental; spillages / long term leakage of fuels / oils / lubricants.
Surface Water Quality	Restoration to be completed without use of imported infill with all materials being native to the Site. No physical disturbance of adjacent landfills. Site to be worked dry without need for dewatering with a standoff from maximum groundwater elevations being maintained. No discharge to be made from the Site.	Implementation of measures to minimise likelihood of accidental spillage / long term, leakage of fuels / oils / lubricants as detailed at *section 4.3.3*.	Emergency containment of any accidental; spillages / long term leakage of fuels / oils / lubricants.
Flood Risk	See FRA at *appendix 4*.	Restoration of Site in manner precluding placement of low permeability overburdens without maintaining permeable pathways to facilitate the free drainage of the Site.	None.

6 CONCLUSIONS

6.1 In view of the findings of assessment and the planned approach to the Proposed Development, which includes specific measures for the protection of the water environment, there are considered to be no over-riding hydrogeologically or hydrologically based reasons why the planned development should not proceed in the manner described by the Submission.

6.2 This conclusion assumes that any permission, if granted, should be conditioned by implementation and adherence to any relevant recommendations advanced within this report and other such conditions that may be reasonably imposed by the Planning Authority.

Peter Simpson B.Sc (hons), M.Sc., FGS
Hydrogeologist
BCL Consultant Hydrogeologists Limited

14th June 2018

Aggregate Industries UK Limited

Tatchells Quarry
Wareham, Dorset

Extension to Existing Mineral Workings
Baggs Land Extension

Hydrogeological & Hydrological Assessment

Version 1

14th June 2018

Figures

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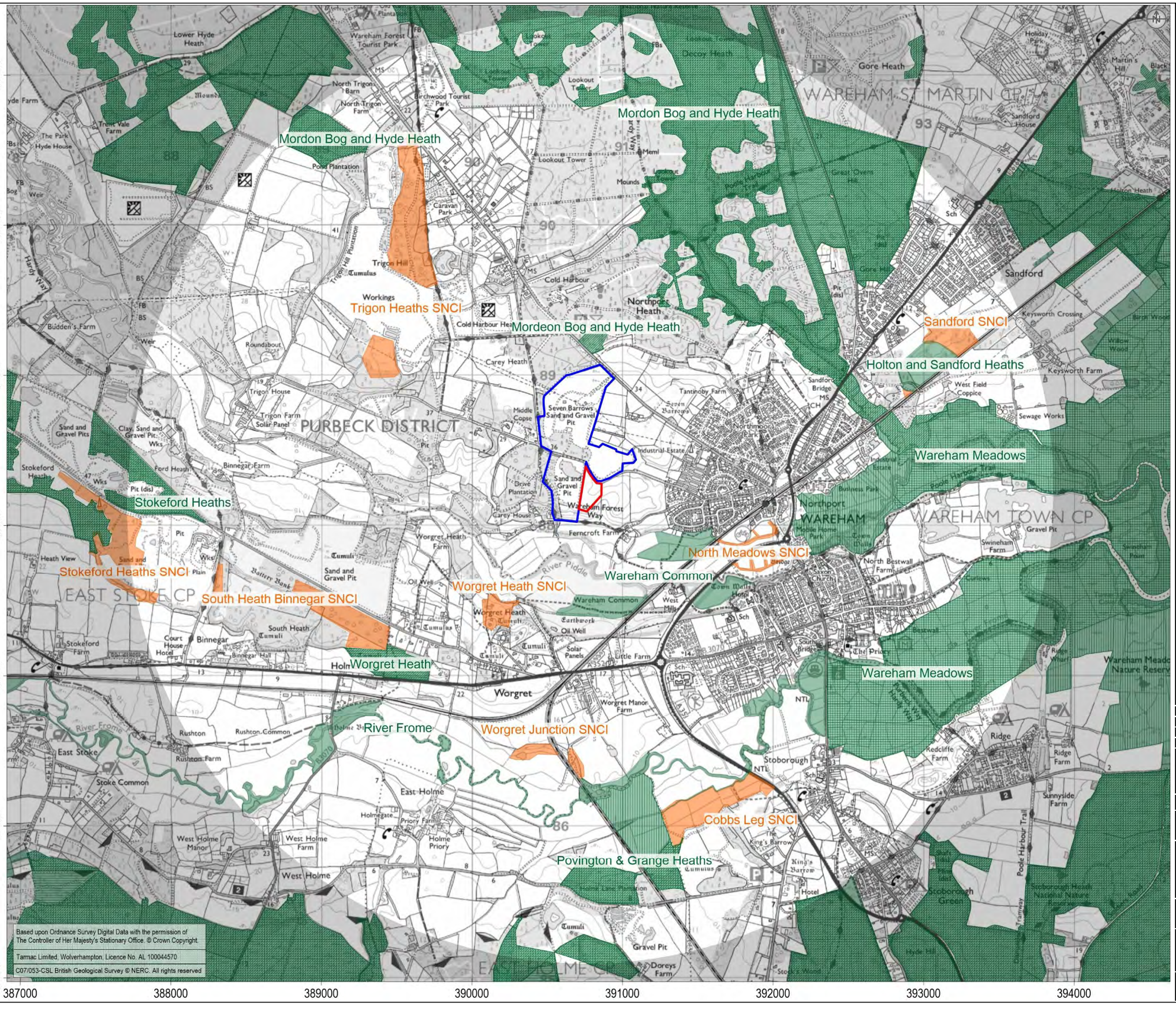
Extension to Existing Mineral Workings Baggs Land Extension

Hydrogeological & Hydrological Assessment

Site Location and Study Area

Drawn By:	PS	Scale:	1:23,500
Date:	14/06/18	Figure No.	1



Existing Site

Proposed Development

SNCI

SSSI

RAMSAR

SPA

SAC

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Extension to Existing Mineral Workings Baggs Land Extension

Hydrogeological & Hydrological Assessment

Sites of Ecological Importance

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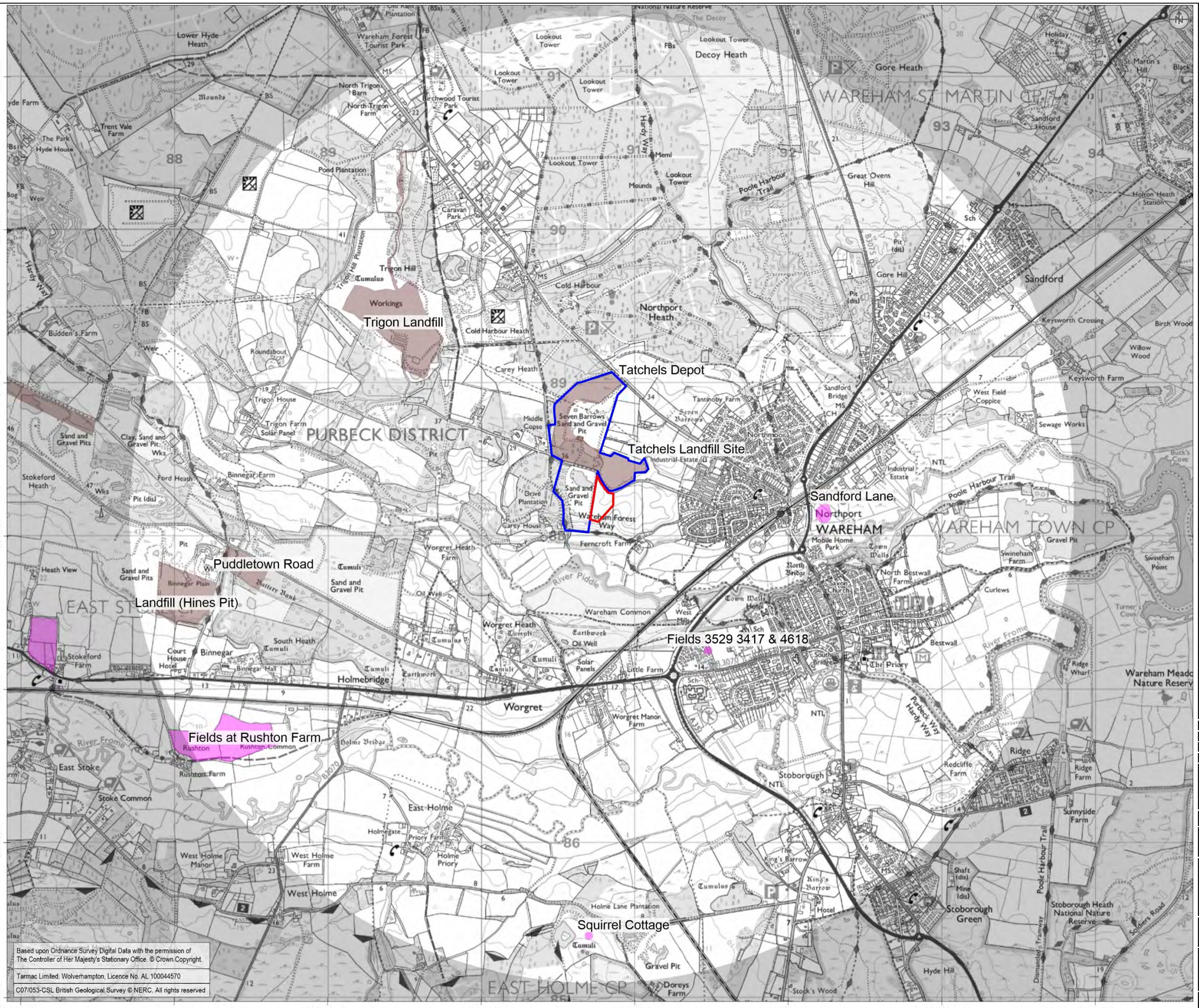
Date:	14/06/18	Figure No.	2



Existing Site

Proposed Development

Permitted Landfill

Historic Landfill

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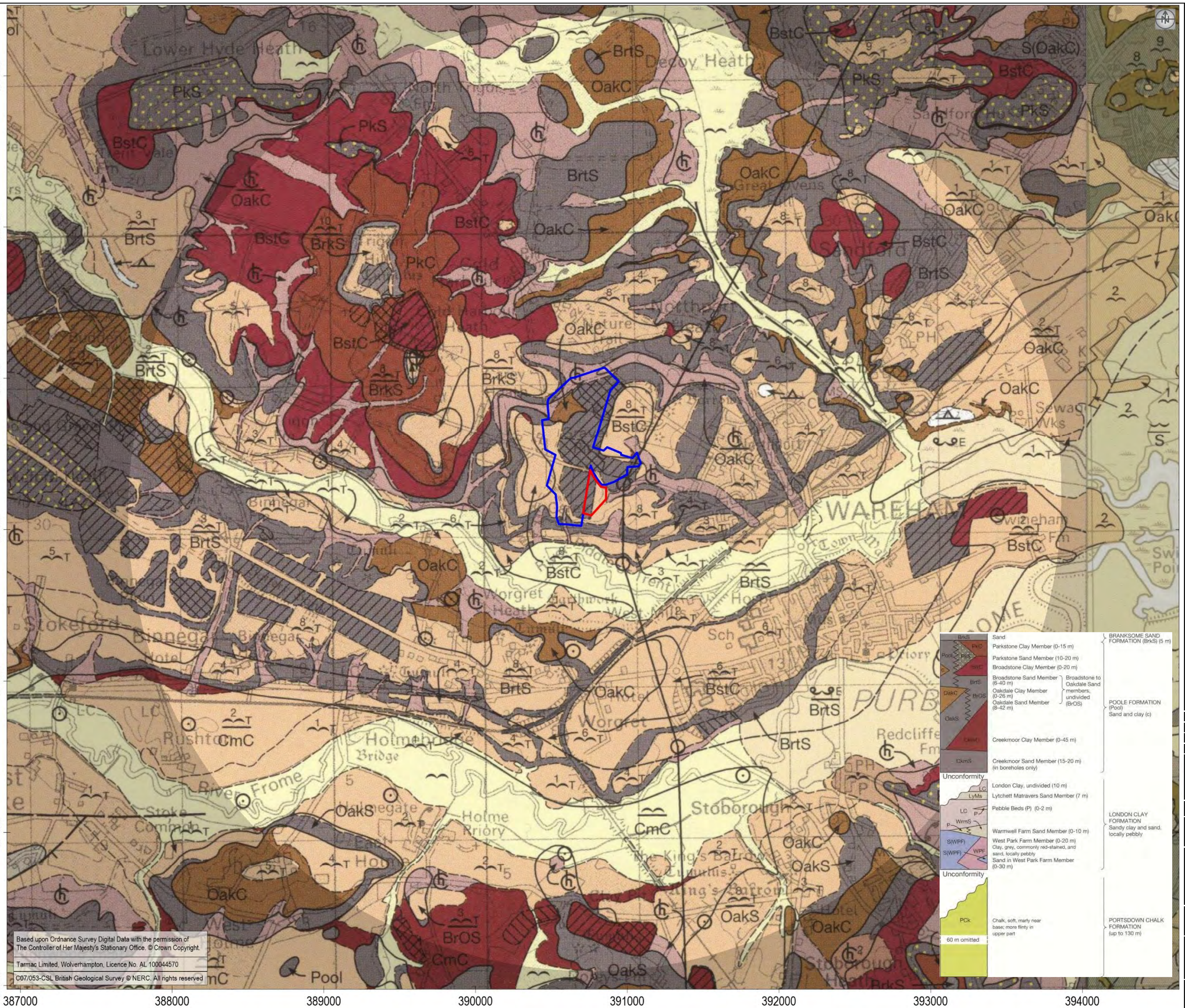
Extension to Existing Mineral Workings Baggs Land Extension

Hydrogeological & Hydrological Assessment

Landfill Sites

Drawn By:	PS	Scale:	1:23,500
Date:	14/06/18	Figure No.	3



Existing Site

Proposed Development

QUATERNARY

- Made Ground
- Worked Ground
- Infilled Ground
- Landslip
- Head
- Older Head
- Clay-with-flints
- Blown Sand
- Peat
- Alluvium
- River Terrace Deposits: 1-15 as numbered
- River Terrace Deposits: undifferentiated
- Marine or Estuarine Alluvium

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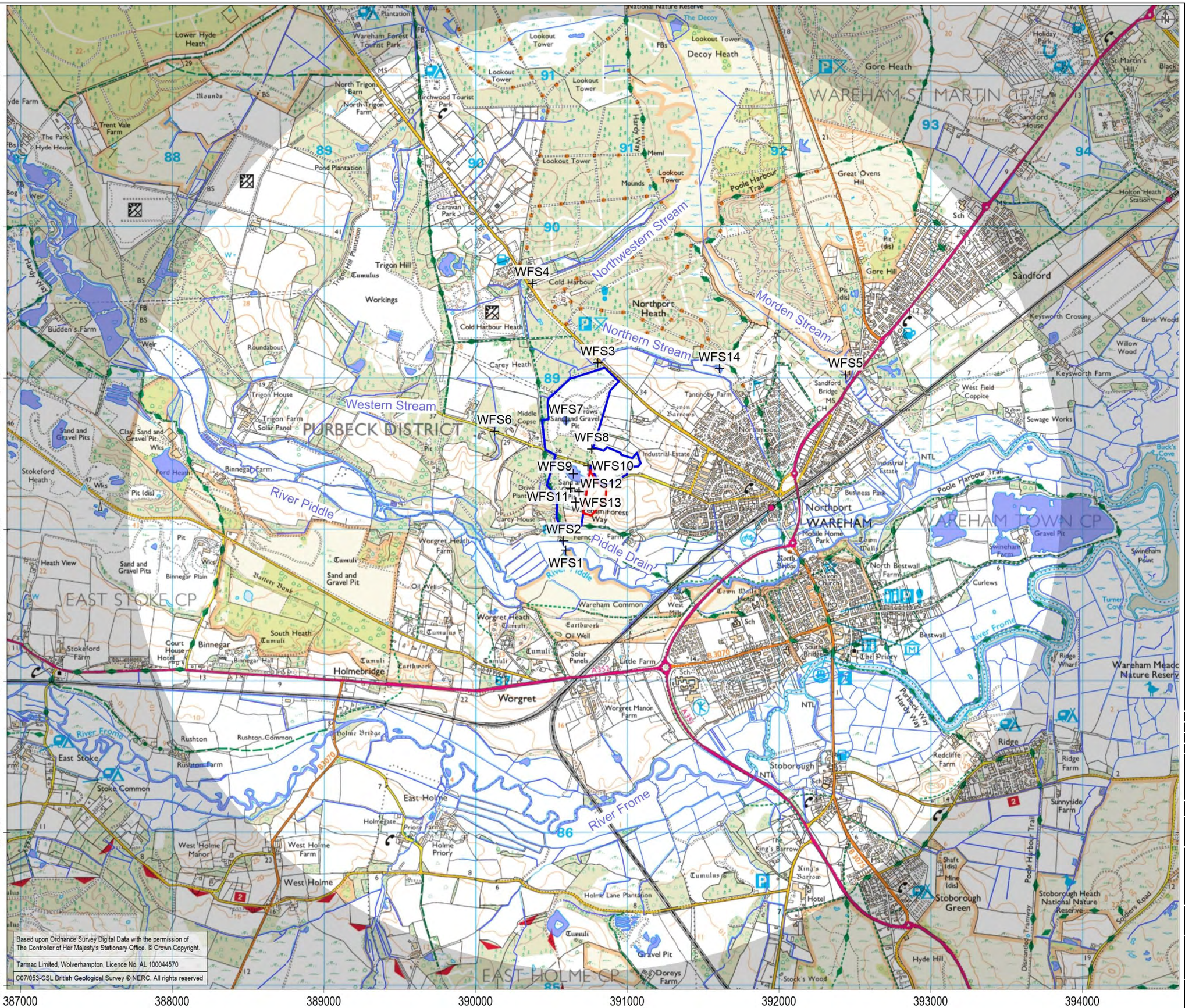
Tatchells Quarry, Wareham, Dorset

Extension to Existing Mineral Workings Baggs Land Extension

Hydrogeological & Hydrological Assessment

Geological Setting

Drawn By:	PS	Scale:	1:23,500
Date:	14/06/18	Figure No.	4



Existing Site

Proposed Development

Surface Watercourse

Surface Waterbody

Water Features Survey Location

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Aggregate Industries Limited

Tatchells Quarry, Wareham, Dorset

Extension to Existing Mineral Workings Baggs Land Extension

Hydrogeological & Hydrological Assessment

Hydrological Setting

Drawn By:	PS	Scale:	1:23,500
Date:	14/06/18	Figure No.	5