

**STANWAY QUARRY INERT LANDFILL
ENVIRONMENTAL PERMIT APPLICATION**

**CONCEPTUAL MODEL, ENVIRONMENTAL SETTING AND
SITE DESIGN REPORT**

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1.0 INTRODUCTION

1.1 Report Context

1.1.1 Sirius Environmental Limited (Sirius) has been commissioned by Tarmac Limited to prepare an Environmental Permit Application for an inert landfill proposed to be operated at Stanway Quarry, Colchester. The landfill operations will support part of the overall wider restoration scheme for the quarry. As part of this application it is necessary to prepare a Conceptual Model, Environmental Setting and Site Design Report. This report has been prepared in accordance with Environment Agency's ESSD template report (Version 1, October 2016)

1.1.2 The inert waste landfill will partially fill the existing void created by sand and gravel extraction operations. A total landfill void space requiring an approximate volume of restoration material of 2.35million m³ of inert waste will be imported, which is a low risk waste type. Other areas of the wider quarry will be restored using waste produced through the quarry operations at the site. These restoration activities will not for part of the landfill operation proposed under this application.

1.1.3 As part of this application, hydrogeological, stability and habitats risk assessments have been carried out. A qualitative amenity risk assessment has also been undertaken. These risk assessments have been completed in accordance with the requirements of the Environmental Permitting (England and Wales) Regulations 2016 and the Landfill (England and Wales) Regulations 2002 (as amended).

1.1.4 This report details the conceptualises the site in terms of the potential source pathway and receptors relationships to support the various risk assessments required to support the Environmental Permit application. These risk assessments (and relevant engineering and environmental controls) are presented in the relevant sections of the main application document.

1.2 Site Details

Location and Access

1.2.1 Stanway Quarry is located on the outskirts of the village of Stanway in the county of Essex. The site is located c. 4.6km south west of the town of Colchester at National Grid Reference: TL 95532248. The location of the quarry relative to its surrounding is presented on **Drawing Nos. B030-00676-01 &-02**. The quarry extends over an area of approximately 94.2 ha, of which the landfill footprint will occupy only c. 52.6Ha.

1.2.2 Access to the site is via Warren Lane located along the western boundary of the quarry.

Site Classification

1.2.3 The application is for the operation of landfill facility for the disposal of inert waste only.

Adjacent Former Waste Management Licences

1.2.4 The applicant currently operates an inert and excavation waste transfer and treatment facility within the western extends of Stanway Quarry under Environmental Permit Ref.: FB3235RV. This facility is located outside of the proposed inert landfill footprint.

1.2.5 The Envirocheck report presented in **Appendix ESSD1** also indicates the presence of a registered landfill site that was operated by Essex County Council towards the south-western corner of the quarry, outside of the proposed inert landfill footprint. There is limited data available in relation to the date that this facility operated, and the types of waste deposited.

1.2.6 Bellhouse Quarry Landfill facility is currently operated by Cory Environmental Limited to the west of Warren Lane, approximately 280m west of the proposed operational boundary of inert landfill facility at Stanway Quarry. The Bellhouse Quarry facility

comprises a non-hazardous landfill facility regulated by Environmental Permit Ref.: EPR/NP3736DS. Prior to Cory Environmental Ltd management of the eastern extends of the Bellhouse landfill facility was operated by Essex County Council. The north-eastern section of the Bellhouse Quarry landfill complex is now 'Closed'.

- 1.2.7 A historical landfill facility is also recorded c. 460m north of the proposed landfill facility. Environment Agency records suggest that this landfill was operated by St Ives Sand & Gravel, although no details relating to the period or types of wastes were deposited. This area has since been restored to residential land use.
- 1.2.8 Shrub End landfill is also recorded at distance of approximately 400m to the northeast of the proposed landfill boundary. This facility was operated by Essex Council Council highways division between 1958 and 1990 for the deposit of inert, household, commercial and industrial wastes. A Civic Amenity site and waste transfer station are currently licensed for operation on a section of this historically landfilled area.

Site Context

- 1.2.9 Stanway Quarry is a long-established sand and gravel quarry which commenced working in 1969. A 2012 planning permission was also awarded for the extraction from a northern extension area, more commonly referred to as the "Five Ways Fruit Farm" (FWFF) northern extension area, together with a revised scheme of restoration for the wider quarry. Stanway Quarry occupies an area of c. 94.2 Ha, of which the footprint of the inert landfill facility will occupy an area of c. 52.6 Ha, as shown in **Drawing No. B030-00676-02**. The remaining northern FWFF extension area and western section quarry will be restored using site-won overburden and quarry fines/waste materials. The restoration of these areas does not form part of the Environmental Permit application.
- 1.2.10 As shown in **Drawing No. B030-00676-03**, the FWFF extension area extends up to between c. 120 to 200m to the north of the landfill footprint, beyond which agricultural land extends north for at least a further c. 225m, towards the outer suburbs of Stanway village. The nearest residential properties within the outer suburbs of Stanway village are located c. 150m northeast of the landfill void.
- 1.2.11 Areas associated with Stanway quarry and other Tarmac operations provide separation of at least c. 225m between the operational areas of the landfill and the public highway of Warren Lane located to the west. Immediately beyond Warren Lane is the Bellhouse Quarry Landfill site operated by Cory Environmental Limited.
- 1.2.12 The residential properties of Priory Lodge, Stanway Hall Farm Cottage, The Chase, Warrens, and Heckford Lodge are located beyond the southern boundary of the landfill, beyond which is the B1022 (Maldon Road) and then Colchester Zoo. Maldon Road routes west-east along the quarry's southern boundary. Residential properties extend eastwards along the Maldon Road at a distance of c.130m from the landfill's south-eastern boundary.
- 1.2.13 Grymes Dyke extends along the landfill eastern boundary beyond which large areas of agricultural land extend. This dyke and the surrounding agricultural land forms the "Gosbecks Iron Age and Romano-British site" that is listed as a Scheduled Ancient Monument (SAM), as shown in **Drawing No. B030-00676-04**.
- 1.2.14 The existing site comprises operational mineral extraction areas, areas undergoing restoration, the current mineral processing plant, bagging plant and associated areas of hardstanding and open storage. These operations are set behind mature vegetation (including perimeter hedgerows) and developing woodland.

Table ESSD1: Land uses and relevant distances from the installation (within 500m)

Receptor Name	Type of Receptor	Approximate nearest distance from the operational boundary	Direction from the operational areas	Description
Footpath	Recreational/ Public Right of Way	Adjacent	West	Public Right of Way that extends northwest from Butchers Wood located southwest of the site and subsequently traverses north-south through the quarry (remains accessible to be public)
Warren Plantation & Policeman's Lagoon	Woodland and water body	Adjacent	West/ Southwest	Woodland plantation and wetland/pond to the south of the quarry and north of Maldon Road (B1022)
Gryme Dyke	Public Right of Way, Scheduled Ancient Monument and Local Wildlife Site	Adjacent	East	A historical dyke which is accessible to the public and designated as a LWS for its ancient and deciduous woodland habitats
Residential properties along Warren Lane	Residential	15m	Northwest	Several residential properties located off Warren Lane: including Milneburg, Bullace Lodge, Kestrels, Guidepost Cottages (Nos. 1-4), Nos 45,47 & 49 Warren Lane, and Streamlines
Furzehill	Residential	20m	North	Secluded residential property
Gosbecks Iron Age and Romano-British site	Scheduled Ancient Monument and Agricultural Land	25m	East	Known former site of a Roman Fort and Iron Age & Roman Settlement, currently utilised for agriculture
Maldon Road (B1022)	Public Highway	25m	Clockwise from southeast to southwest	Public Highway running parallel to the quarry's southern boundary in an east/west alignment
Agricultural Land	Agricultural	35m; 50m; 250m.	South; East; North	Agricultural land used for cultivation of arable crops and/or the grazing of livestock. To the north of the site lies a fruit
Residential Properties along Maldon Road (B1022)	Residential	35m; 50m; 100m	Southwest; Southeast; East.	Numerous properties located along Maldon Road, including Priory Lodge, Stanway Hall Farm Cottage, Warrens, The Chase and The Firs to the south/southwest, Springfields to the southeast, and 8 properties to the east (nearest being Randoms).
Warren Lane	Public Highway	45m	Clockwise from Southwest to northwest	Unclassified public highway
Stanway Hall & Colchester Zoo	Commercial/ Industrial	140m	Southwest	Private Zoo attraction comprising various buildings, a car park, open land and several surface water bodies
Dyers Lane	Public Highway	140m	North	Unclassified public highway
Stanway Village	Residential	140m	Clockwise from northwest to north east	Residential properties to the west of Stanway Green, including Wisemans' Farm, and properties along Heath

Receptor Name	Type of Receptor	Approximate nearest distance from the operational boundary	Direction from the operational areas	Description
				Road, Gryme's Dyke Way and adjoining residential streets
Northbank Stream/Drain	Water Body	150m	West/southwest	Unnamed tributary to the Roman River
Olivers Thicks/ Butchers Wood	Local Wildlife Site	175m	Southeast	Designated as a LWS for its ancient and lowland mixed deciduous woodland, dry acid grassland, ancient and species-rich hedgerows and green lanes and urban habitats
Bellhouse Quarry Landfill	Industrial	250m	West	Active landfill facility for accepting non-hazardous waste
Northbank Stream/Drain	Water Body	350m	Southeast	Unnamed tributary to the Roman River
Stanway Pits	Local Wildlife Site	425m	Northwest	Designated as a LWS for its open mosaic habitats on previously development land

- 1.2.15 The landfill operations will be restricted to central, eastern and southern areas of the main Stanway Quarry facility, as illustrated in **Drawing No. B030-00676-02**. For the duration of landfill operations (including aftercare) the existing perimeter security fencing and CCTV infrastructure to the wider quarry site will be maintained, as shown in **Drawing No. B030-00676-07**. The landfill operations will also be supported by the existing weighbridge facilities at the quarry.

Topography

- 1.2.16 The site is located within an area of generally flat topography in which surrounding land is at a typical elevation of around 35-36m AOD, sloping gently to the south/southwest towards the Roman River. The remnants of a former tributary valley to the Roman River exist at Furzehill to the northwest and Warren Plantation to the southwest. To the south of the quarry surface gradients steepen towards the fluvial channel of the Roman River, which flows approximately west-northwest to south-southeast at a distance of at least c. 650m from the quarry.
- 1.2.17 The quarry has been excavated to the upper boundary of the London Clay, to an elevation of c19-20m AOD, with operational lagoons excavated to depths of c. 15m AOD. Sidewalls are typically graded to safety gradient of no greater than 1 in 2, with soil bunds also constructed for amenity purposes at the perimeters adjacent to receptors.

Compliance with landfill development: groundwater risk assessment for leachate (replaces former GPP3 Guidance)

- 1.2.18 The landfill operation at Stanway will only include the disposal of inert wastes. Consequently, as the facility is not located within a Source Protection Zone 1 (SPZ1) it accords with the decision framework for Position Statement E1 under "The Environment Agency's Approach to Groundwater Protection" (v1.; Nov 2017). Nonetheless, as the landfill is situated sub-water table within a Secondary A aquifer that contributes to baseflow to the Roman River, this triggers the requirement for a Hydrogeological Risk Assessment (HRA) which can be found in **Section E** of the application.

2.0 SOURCE

2.1 Site Development

Sources of Information

2.1.1 The baseline of this report has been determined from a review of available published information, including:

- Landmark Envirocheck Report dated 16/3/2016 (**Appendix ESSD1**)
- BGS 1:50,000 scale geology maps
- Environment Agency web-based data

2.2 Historical Development

Historical use of land

1.1.1 The development history of the permitted facility has been established through a review of available historical county series, ordnance survey and online maps. Details of the site history is provided in **Table ESSD2**.

Table ESSD2: Development history of site and surrounding land

Date	On site	Surrounding Land (within c. 500m)
1881	The site is comprised entirely of agricultural land and associated hedgerow. The eastern boundary consists of an entrenchment.	The surrounding area consists predominantly of agricultural land. Stanway Hall, Stanway Hall Farm and All Saints Church are located 200m south of the proposed landfill site. Several residential properties associated with the hamlet of Heckfordbridge lie 300m south west of the site. Wisemans Farm is located c. 250m north. A river is located c.225m south of the site and flows in southeast direction. There are several pockets of woodland in the area surrounding the site including Oliver Thicks (southeast), Gol Grove (southwest) and Bakers Grove (south). A road/track runs adjacent to the sites western and southern boundary.
1898	An area of woodland labelled Warren Plantation now occupies a portion of the sites south western area.	A residential building has been erected adjacent to the sites southern boundary. Butchers Wood plantation occurs 115m south east.
1924-1925	No change since previous mapping period.	An allotment garden now occurs c.125m north east of the site.
1938	No change since previous mapping period.	Two buildings have been constructed on land c. 200m east of the site. An additional four buildings now occupy land 70m and 230m northwest of the site.
1958	No change since previous mapping period.	Several builds now occur c. 250m northeast of the site.
1968	No change since previous mapping period.	Three residential properties including The Bungalow are now situated 70m south west. Six additional properties including Well House now occur on land 250m southeast from the site boundary.
1975-1977	A large portion of the sites western area is now comprised of a sand and gravel pit.	Land 250m to the west of the site consist of Bell House Pit sand and gravel quarry. Colchester Zoo also occurs c. 240m south of the site. An orchard occupies land adjacent to the sites northern boundary.
2006	The quarry has undergone considerable expansion and now occupies the majority of the site. As a result, the Warren Planation has been reduced in size. The quarry area now contains 4 large surface water bodies.	Bell house pit quarry has expanded north and eastward. The quarry comprises 6 various sized surface water bodies, conveyors and washing plant. Colchester Zoo has expanded westward, and three medium sized water bodies are present within the grounds. Land c. 250m northeast of the

Date	On site	Surrounding Land (within c. 500m)
		site has undergone developments and comprises several properties associated with the village of Stanway.
2016	The quarry area now occupies the entire site. A large surface water lagoon is present within the south western corner of the site. The four varying sized buildings are present within the site.	Bellhouse quarry has further expanded north and westwards. Colchester Zoo has also expanded eastwards. The surface water body located within the north eastern area on site has reduced in size. The surface water body in the south western area has increased in size. The car parking area associated with Colchester Zoo has expanded.

2.3 Proposed Development

2.3.1 The proposed development is for the infilling of inert materials to reach final restoration levels. Final landforms will provide recreational benefits to the local community, as well as biodiversity and landscape improvements.

2.3.2 To achieve the restoration scheme, c. 2.35 million cubic metres of inert material will be deposited over an anticipated period of c. 23 to 24 years.

Proposed Waste Types

2.3.3 A full list of waste to be accepted at the site is presented in **Appendix ESSD2**. The facility will accept up to 200,000 tonnes of waste per annum for disposal.

2.3.4 Only inert wastes that accord with the standard criteria set out in Section 2.1 of the Annex to the Council Decision of 19 December 2002 will be accepted for deposit at the site. The waste materials will be suitable for their intended purpose from a chemical, physical and biological perspective, which will be appropriately characterised and verified prior to deposit at the site.

2.3.5 The upper limits to the leachable and pollutant content of the inert wastes are determined by a ratio of 10 litres of distilled water to 1 kg of waste, with the result quoted as concentration per unit of mass i.e. mg/kg. The WAC leachable limits for inert waste and their equivalent concentration per liquid volume are presented in **Table ESSD3**. These concentrations are considered to be representative of a worst-case leachate source term for an inert landfill facility.

Table ESSD3: WAC and equivalent inert waste 'leachate' quality

Parameter	Inert Waste WAC (L/S 10L/S 10l/kg) [mg/kg]	Equivalent Liquid Concentration [mg/l]
Arsenic	0.5	0.025
Barium	20	2
Cadmium	0.04	0.004
Chromium	0.5	0.05
Copper	2	0.2
Mercury	0.01	0.001
Molybenium	0.5	0.05
Nickel	0.4	0.04
Lead	0.5	0.05
Antimony	0.06	0.006
Selenium	0.1	0.01
Zinc	4	0.4
Chloride	800	80
Fluoride	10	1
Sulphate	1000	100
Phenol Index	1	0.1

Phasing

- 2.3.6 The restoration of the Stanway Quarry will commence in parallel with ongoing mineral extraction and processing operation for a brief period (less than 6 years commencing from 2018), with landfilling then continuing in isolation until c. 2045 with a view to achieving the final landform.
- 2.3.7 Mineral extraction and restoration of the quarry will progress with a total of seven key phases, which entails four extraction phases in the northern FWFF extension combined with restoration of the main quarry areas with imported wastes, with a subsequent three phases involving restoration of the remaining areas of Stanway Quarry, which includes the northern extension and western areas outside of the landfill footprint using overburden and quarry wastes/fines. Each of these phases are illustrated in **Drawing No. B030-00676-05**.

Hydrogeological Risk Screening

- 2.3.8 Schedule 22 from The Environmental Permitted (England and Wales) Regulations 2016 covers all aspects in relation to groundwater activities. The regulations provide a consolidated system of environmental permitting relating to the relevant functions, granting of an environmental permit as well as the groundwater activities for which a permit may be granted.
- 2.3.9 The landfill operations at Stanway constitute a Groundwater Activity under Schedule 22 of EPR2016 on the basis that it has the potential to lead to the direct and indirect discharge of pollutants to groundwater.

Final Landform and After-use

- 2.3.10 The proposed restored landform for the site has been achieved through balancing the permitted terrestrial based restoration scheme for Stanway Quarry together with minimising the requirement for the importation of inert materials to achieve an appropriate restored landform.
- 2.3.11 The final landform will include 1 in 3 slopes from the surrounding surface at c. 35mAOD to a restored quarry levels of between 22-24mAOD, as shown in **Drawing No. B030-00676-11**. These restoration levels will sit above assessed rebounded groundwater levels following the cessation of groundwater management activities at the quarry.
- 2.3.12 The restoration scheme will provide a landscape to create new habitats for sustainable long-term biodiversity within the site and local area. Full consideration has been given to the need to retain protected, rare and priority species on site and the creation of priority habitats. The landform will be designed to enhance local landscape character where land use includes:
- species rich grassland
 - hedgerows
 - woodland blocks
 - Scrubland
 - Orchard
 - Acid and neutral grassland
 - Lakes and aquatic marginal vegetation
 - Amenity access/permissive rights of way
 - Reptile habitat/translocation areas and;
 - Jersey Cudweed protection area

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3.0 PATHWAY AND RECEPTOR

3.1 Geology

3.1.1 The geology of the proposed FWFF extension area and Stanway Quarry is taken from:

- the British Geological Survey (BGS) 1:50,000 scale Sheet 223 Braintree solid and drift edition, the Institute of Geological Sciences Report number 74/6 entitled “The sand and gravel resources of the country west of Colchester, Essex. Description of 1:25,000 resource sheet TL 92”;
- the report of a collaborative study by Cambridge University and Tarmac entitled “Reconstruction of the depositional palaeoenvironment of sand and gravel deposits at Stanway Quarry, Colchester and it’s implication for further development of the quarry”;
- a mineral proving site investigation report entitled “Report on geological exploration at Fiveways Fruit Farm Stanway Colchester April/May 1995” prepared by Tarmac; and
- the logs of historical boreholes drilled at and in the vicinity of the site (available from BGS Onshore Viewer)

3.1.2 Copies of the logs of groundwater monitoring boreholes and mineral proving site investigation boreholes drilled in the vicinity of the Stanway Quarry are presented at **Appendix ESSD3**.

3.1.3 The quarry is located within superficial deposits which comprise generally glacially derived sand and gravel of the Lowestoft Formation which is underlain by fluvial sand and gravels of the Kesgrave Catchment Subgroup which formerly were known as the Kesgrave Sands and Gravels. Prior to mineral extraction other areas of the application site were underlain by superficial deposits comprising the Lowestoft Formation and the Kesgrave Sands and Gravels. The superficial deposits at the application site are underlain in turn by bedrock comprising the London Clay Formation which is part of the Thames Group, the Lambeth Group and the Thanet Formation which in this area together comprise the former Lower London Tertiaries of previous classifications and strata formerly classified as Upper Chalk which now comprise part of the White Chalk Subgroup. The London Clay Formation comprises generally stiff dark grey clay, the Thanet Formation and Lambeth Group comprise silty sand, glauconitic sand and mottled clay and the White Chalk Subgroup comprises a white fine-grained limestone. The bedrock strata in the vicinity of the application site dip gently to the south east. The regional geology in the vicinity of the application site is presented on **Drawing No. B030-00676-09**.

3.1.4 The Kesgrave Catchment Subgroup crops out to the south and south east of the application site in the sides of the valley of the Roman River and the valley of a small north bank tributary of the Roman River to the south generally of Maldon Road. Head deposits are recorded in the base and sides and Alluvium is recorded in the base of the valleys. To the west of Abbotstone Quarry and Bellhouse Quarry on the far side of the Roman River the BGS map shows diamicton of the Lowestoft Formation overlying sand and gravel of the Lowestoft Formation. The diamicton which comprises a mixture of different sized particles in a fine-grained matrix formerly was known as Boulder Clay.

3.1.5 The superficial deposits in the vicinity of the quarry are described in detail in the mineral assessment report prepared by Tarmac entitled “Report on geological exploration at Fiveways Fruit Farm Stanway Colchester April/May 1995” with additional information available from the logs of historical boreholes drilled at and in the vicinity of the site. A summary of the units proved within the vicinity of the quarry based on the logs of the site investigation boreholes drilled at and in the vicinity of the quarry area is presented in **Table ESSD4**. Based on this information the superficial deposits comprise several sand units with varying percentages of secondary components comprising mainly gravel and/or silt. For the purpose of this chapter the superficial deposits of the Lowestoft Formation and the Kesgrave Catchment Subgroup are considered together as a composite unit of sand and gravel. The total thickness of the sand and gravel deposits proven in the vicinity of the site varied between approximately 12m and 23.2m. In general, the sand and gravel deposits were thinner in the west and south of the quarry.

Based on the interpretive cross sections prepared by Tarmac the superficial deposits are least thick in the area of a valley feature in the west of the proposed FWFF extension area which, based on the report prepared by Tarmac, comprises an ancient river channel which eroded the top part of the mineral.

- 3.1.6 The geology within the vicinity of the site is shown on **Drawing No. B030-00676-09**. A summary of the stratigraphy present within vicinity of the quarry is provided in **Table ESSD4**.

Table ESSD4: Summary of geology in the vicinity of Stanway Quarry

	Unit	General Description	Thickness (m)
Topsoil	-	Pale grey gravelly silty topsoil	0.1-0.5
Glacial sands and gravels (Lowerstoft Formation)	Upper Gravel	Dark orange-brown silty sands with 30% gravel	0.5-4.0
	Fill Sands	Dark orange-brown and orange-brown slightly silty sands with occasional thin bands of gravel	0-2.0
	Middle Gravel	Orange-brown slightly silty sands with 40% gravel	1.0-6.0 ¹
Kesgrave Sands & Gravels ² [Kesgrave Catchment Sub-Group]	Pale Sand	Pale Brown and Yellow-brown clean sands. Gravel averages ~15%	1-8
	Lower Gravel	Brown clean fine/medium to medium grained sands with 40% gravel	1-7
Bedrock	London Clay Formation	Dark blue-grey, grey brown or occasionally red brown stiff silty clay	(29-35) ³
	Thanet Formation and Lambeth Group (Undifferentiated)	Predominantly dark brown and brown clays, some silty or sandy, interbedded with some sands and gravels, minor limestone and lignites and occasional sandstone and conglomerate	(26) ³
	White Chalk Subgroup	Chalk with flints and discrete marl seams, nodular chalk, sponge-rich- and flint seams throughout	(+78m) ³

Geological summary for superficial deposits principally prepared from mineral proving site investigation report entitled "Report on geological exploration at Fiveways Fruit Farm Stanway Colchester April/May 1995" prepared by Tarmac. Summary of bedrock units prepared from a log from adjacent Bellhouse quarry (BH09) and a historical exploratory log available via BGS Onshore Viewer

- ¹ - It is stated in the Tarmac report that the junction between the glacial sands and gravels and the Kesgrave Sands and Gravels is gradational and difficult to establish. It is assumed that the boundary is a point within the Middle Gravel where the appearance of quartzite in the gravel fraction becomes marked.
- ² - The thickness of the Middle Gravel is not reported in the table presented in the report prepared by Tarmac. It is reported in the text of the report that the middle gravel was present in all the boreholes at the site and varied in thickness between 1.0m and 6.0m.
- ³ - thickness have not been proven via on-site investigations and are therefore interpreted from a borehole log from the adjacent Bellhouse quarry (BH09) and a historical exploratory log installed in 1936 (BGS Ref.: TL92SE166) located approximately 650m north of the quarry – as viewed via BGS Onshore Viewer.

- 3.1.7 The London Clay Formation was proved at the base of the superficial drift deposits at the FWFF northern extension area and is visible in places on the floor of the application site. The London Clay Formation at the FWFF extension area comprises dark grey occasionally brown or red brown silty clay. The London Clay Formation in the floor of the landfill comprises a dark grey mudstone. The full thickness of the London Clay Formation has not been proved at site itself but a full thickness of approximately 29m was proved in borehole BE06 located approximately 640m to the west of the quarry, in the vicinity of the adjacent Bellhouse Quarry. The thickness of the London Clay has also be proven to be c. 35m at a historical borehole drilled c. 650m northwest of the landfill. It is reported in the collaborative study report prepared by Cambridge University and Tarmac that the surface of the London Clay Formation is undulating and contains depressions and channel features which are filled with sand and gravel.

- 3.1.8 The Lambeth Group, Thanet Formation and the White Chalk Subgroup underlying the London Clay Formation have not be proved in the boreholes drilled with the quarry footprint. In borehole BE06 to the west of the quarry, the Lambeth Group and Thanet Formation comprise sandy clay and sandy, fissured micaceous clay respectively. In the borehole the combined thickness of the Lambeth Group and Thanet Formation is

approximately 29m. In borehole BE06 approximately 10m of a very weak, white to cream chalk comprising the White Chalk Subgroup was also proven. The full thickness of the White Chalk Subgroup was not proved in the borehole. Based on the BGS map the thickness of chalk strata proved in boreholes in the area of the application site is at least 115m. The elevation level of the top of the chalk proved in borehole BE06 is approximately 34.43m below Ordnance Datum which is approximately 73m below ground level (mbgl).

3.2 Hydrology

- 3.2.1 The hydrology of the quarry is taken from Ordnance Survey topographical maps, water quality monitoring undertaken in the vicinity of the application site, information provided by the Environment Agency and information provided by Tarmac regarding their water management scheme in the current extraction area in the application site. The main hydrological features in the vicinity of the proposed quarry are shown on **Drawing No. B030-00676-10**.
- 3.2.2 The application site is located in the catchment of the Roman River which rises approximately 8km west of the quarry from where it flows generally southeast then east passing approximately 650m to the south of the landfill footprint. The Roman River has a confluence with the River Colne approximately 8km to the east of the quarry. Only lagoons and connecting drains associated with surface and ground water management operations are present within the landfill footprint and wider quarry. The watercourse closest to the landfill is an unnamed drain located on the north bank of the Roman River in the vicinity of Colchester Zoo which is the outfall from a pond immediately south of the quarry called Heckford Lodge Pond. It is possible that in the vicinity of the Roman River there may be limited continuity locally between groundwater in the superficial deposits and surface water in the unnamed north bank tributaries of the river.
- 3.2.3 There are several areas of open water associated with current quarrying operations at Stanway Quarry. Surface water runoff and groundwater accumulating in the western most section of the quarry drains to a ditch along the base of parts of the northern and eastern quarry faces to a sump in the north of the proposed landfill footprint or drains to a lagoon located in the east of the quarry. Water from the sump in the north is pumped to an unlined settlement lagoon in the northwest of the quarry where it passes through a series of lagoons in the west and southwest of the quarry before being pumped to the lagoon in the east of the Stanway Quarry, or discharged from the lagoon in the south west of Stanway Quarry called Policeman's Lagoon via a piped outlet which passes under Colchester Zoo to outfall to the Roman River. Water in the lagoon in the east of Stanway Quarry is pumped to another lagoon in the northeast of the quarry and is used on site as process water consistent with an abstraction licence or is pumped into one of the lagoons in the south west of Stanway Quarry then to the Roman River via Policeman's Lagoon and the pipe which passes under Colchester Zoo.
- 3.2.4 The sand and gravel deposits in Stanway Quarry generally have been removed and it is understood that the areas of open water in Stanway Quarry are supported on the underlying London Clay Formation. It is understood that in the west of Stanway Quarry some lagoons are excavated into the sand and gravel deposits. It is understood that a large pond located approximately 250m west of the northern FFFF quarry extension area to the west of Warren Lane, on restored land at Bellhouse Quarry, comprises an attenuation pond for surface water runoff from the landfill. It is understood from Tarmac that the outfall from the large pond is culverted and flows under Warren Lane to the northwest of Stanway Quarry from where it is pumped through a buried pipe through the western side of Stanway Quarry to outfall to Heckford Lodge Pond. It is likely that the water feature is lined and is not in continuity with the groundwater in the sand and gravel deposits. There is also a large pond approximately 500m to the northwest of the quarry associated with a former mineral extraction restored to residential housing.
- 3.2.5 There is a total of 7 licenced discharges to surface water within 1km of the landfill. Summary details are presented in **Table ESSD5**. Two consented discharges relate to Tarmac's quarry/mineral activities that discharge to the Roman River; one for Stanway Quarry in respect of the pipe from Policemans Lagoon which passes under Colchester Zoo to a point on a tributary of the Roman River located approximately 300m to the

south-southwest of the quarry (**Drawing No. B030-00676-10**), and the other for Bellhouse Quarry to the Roman River approximately 950m to the west and upstream of the landfill. The Environmental Permits (formerly Consents to Discharge) in respect of Stanway Quarry and Bellhouse Quarry refer to the discharge of treated trade effluent arising from the prevention of interference with mining or quarrying. In addition to the two discharge consents held by Tarmac there are 5 other consented discharges to the Roman River or tributaries of the Roman River within 1km of the landfill.

Table ESSD5: Summary of active Discharge Consents to surface water within 1km of the site

Location	Details
Colchester Zoo Maldon Road, Stanway, Colchester CO3 0SL Distance 232m S NGR: 594950,221850	Operator: Colchester Zoo Ltd Property Type: Domestic Property (Single) Catchment Area: Roman River/Abberton Reservoir Ref: Prenf10265 Discharge Type: Sewage Discharges – Final/Treated Effluent – Not Water Company Discharge Environment: Freshwater Stream/River Receiving Water: Roman River Status: Post National Rivers Authority Legislation where issue date >31/08/1989
Tarmac Southern Limited Bellhouse Quarry, Warren Lane, Stanway, Colchester, Essex, CO3 5NH Distance: 292 S NGR: 594890, 221770	Operator: Tarmac Trading Limited Property Type: Manufacture of Other Building Materials Catchment Area: Roman River/Abberton Reservoir Ref: Prenf08537 Discharge Type: Trade Discharge – Process Water Discharge Environment: Freshwater Stream/River Receiving Water: Roman River Status: Varied under EPR2010
Road Improvements /Construction Off Maldon Road, Stanway, Colchester Distance: 408 E NGR: 596230, 222360	Operator: Anglian Water Services Limited Property Type: Sewerage Network – Sewers – Water Company Catchment Area: Not Given Ref: Aw2nfe03578 Discharge Type: Discharge of Other Matter- Surface Water Discharge Environment: Freshwater Stream/River Receiving Water: Trib Roman River Status: Pre National Rivers Authority Legislation where issue date <01/09/1989
Road Improvements /Construction Off Maldon Road, Stanway, Colchester Distance: 408 E NGR: 596230, 222360	Operator: Essex Country Council (Highways Dept.) Property Type: Sewerage Network – Sewers – Water Company Catchment Area: Not Given Ref: Aw2nfe03578 Discharge Type: Discharge of Other Matter- Surface Water Discharge Environment: Freshwater Stream/River Receiving Water: Trib Roman River Status: Pre National Rivers Authority Legislation where issue date <01/09/1989
Cattle Yard at Hill Farm, Copford, Colchester Distance: ~750m W NGR: 594200, 222100	Operator: Abbotstone Agri Prop Property Type: Mixed Farming Catchment Area: Not Supplied Ref: Pr2nfe09468 Discharge Type: Agricultural effluents Discharge Environment: Freshwater Stream/ River Receiving Water: Trib Roman Rover Status: Pre National Rivers Authority Legislation where issue date <01/09/1989
Tarmac Southern Limited Bellhouse Quarry, Warren Lane, Stanway, Colchester, Essex, CO35NH Distance: ~950m, W NGR: 593970, 222600	Operator: Tarmac Trading limited Property Type: Manufacture of Other Building Materials Catchment Area: Not Supplied Ref: Prenf15284 Discharge Type: Trade Discharge – Mineral Workings Discharge Environment: Freshwater Stream/River Receiving Water: Roman River Status: Varied under EPR 2010
Baymil Cottages, Birch, Colchester Distance: 897m SE NGR: 595800, 221400	Operator: Anglian Water Services Limited Property Type: Sewage Disposal Works - Other Catchment Area: Not Given Ref: Aw2nfe16172 Discharge Type: Unknown Discharge Environment: Freshwater Stream/River Receiving Water: Roman River Status: Pre National Rivers Authority Legislation where issue date <01/09/1989

Table ESSD6: Statistical summary of surface water quality within the vicinity of Stanway Quarry (October 2016 to February 2018)

Statistic	Arsenic (ug/l)	Cadmium (ug/l)	Chloride (mg/l)	Chromium (ug/l)	Copper (ug/l)	Fluoride (mg/l)	Lead (ug/l)	Mercury (ug/l)	Molybdenum (ug/l)	Nickel (ug/l)	PAH (Total) (ug/l)	Phenols (Mono) (mg/l)	Selenium (ug/l)	Sulphate (mg/l)	Zinc (ug/l)
SW1															
Min	0.4	<0.02	67	<1	<0.5	0.13	<0.3	<0.05	<1	1	<0.01	<0.02	<0.5	76	3
Mean	0.84	0.03	86.69	<1	3.14	0.21	0.26	0.03	<1	3.00	0.26	-	0.63	89.50	5.73
Max	1.4	0.05	100	0.5	4.3	0.26	0.5	0.025	1	4	2.6	<0.02	1	100	10
Stdev	0.25	0.01	9.56	0.00	1.03	0.04	0.15	0.00	0.24	0.95	0.72	-	0.23	7.75	1.85
SW2															
Min	0.6	<0.02	59	<1	<0.5	0.14	<0.3	<0.05	<1	2	<0.01	<0.02	<0.5	69	<2
Mean	0.84	0.03	87.09	0.50	3.41	0.21	<0.3	<0.05	0.82	3.36	0.32	-	0.60	87.58	6.17
Max	1.3	0.05	100	0.5	6.3	0.28	0.5	0.025	2	6	2.9	<0.02	1.3	99	11
Stdev	0.22	0.02	11.39	0.00	1.58	0.05	0.13	0.00	0.46	1.50	0.86	-	0.34	9.95	2.92
SW3															
Min	0.4	<0.02	68	<1	<0.5	0.12	<0.3	<0.05	<1	2	<0.01	<0.02	<0.5	78	4
Mean	0.76	0.03	83.38	0.56	3.44	0.20	<0.3	<0.05	<1	2.86	0.33	-	0.80	90.14	5.40
Max	0.9	0.05	96	1	4.8	0.23	0.6	0.025	1	4	2.5	<0.02	1.9	98	6
Stdev	0.18	0.01	9.04	0.18	0.73	0.04	0.17	0.00	0.23	0.69	0.88	-	0.53	6.57	0.89
SW4															
Min	0.6	<0.02	59	<1	<0.5	0.13	<0.3	<0.05	<1	2	<0.01	<0.02	<0.5	74	3
Mean	0.87	0.03	84.55	<1	3.26	0.19	0.33	<0.05	<1	3.64	0.06	-	0.58	87.45	5.18
Max	1.2	0.08	98	0.5	6.9	0.26	0.8	0.025	2	7	0.43	<0.02	1.3	97	9
Stdev	0.21	0.02	10.13	0.00	1.62	0.04	0.24	0.00	0.60	1.86	0.12	-	0.40	7.27	1.83

- 3.2.6 Based on the information presented on the Environment Agency website under the Water Framework Directive classification the ecological quality of the Roman River is currently 'moderate', whilst chemical quality is currently 'good'¹ (although specific pollutant concentrations have not been assessed).
- 3.2.7 Background water quality monitoring has been carried out in support of this application between October and December 2016 and between May 2017 to February 2018. A statistical summary of the monitoring data is presented in **Table ESSD6**, with full datasets and timeseries charts presented **Appendix ESSD5**.
- 3.2.8 There are 5 licensed surface water abstractions within 2km of the quarry, details of which are summarised in **Table ESSD7**. The details of the licensed surface water abstractions are presented in **Appendices ESSD1 and 4**. The approximate locations of the surface water abstractions are shown on **Drawing No. B030-00676-10**. There is a licensed abstraction for spray irrigation from a stretch of the Roman River in the vicinity of Stanway Quarry. Part of the relevant stretch of the Roman River is downstream of the discharge from Stanway Quarry.

Table ESSD7: Details of licensed surface water abstraction within 2km of the site

Location	Details
Roman River, Stanway Hall Farm Distance: 361m SW NGR: 594600, 221700	Operator: R Davidson & Son License No: 8/37/24/*S/0040 Abstraction: General Agriculture: Spray Irrigation- Direct Abstraction Type Water may be abstracted from a river or stream reach, or row of wellpoints Source: Surface
Roman River, Stanway Hall Farm, Stanway Distance: 953m SE NGR: 595600, 221300	Operator: R Davidson & Son License No: 8/37/24/*s/040 Abstraction: Spray Irrigation Abstraction type: Not Supplied Source: Stream
Catchpit Fed By Trib Roman River Distance: 1139m, W NGR: 593600,221800	Operator: Birch Farms License No: 8/37/24/*S/0034 Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction type: water may be abstracted from a single point Source: Surface
Copford Hall, Colchester Distance: 1376m, E NGR: 593500,222800	Operator: F M Mallinson License No: 8/37/24/*S/0013 Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction type: Water may be abstracted from a river or stream reach, or a row of wellpoints Source: Surface
Birch Hall Lake, Birch Environment Agency, Anglian Distances: 1646m, S NGR: 594900,220400	Operator: Trustees Of The Round 1969 Settlement License No: 8/37/24/*S/0029 Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction type: water may be abstracted from a single point Source: Surface
Trib Roman Riverat Birch Distances: 1838m, S NGR: 594800,220200	Operator: Birch Farms License No: 8/37/24/*S/0060 Abstraction: General Agriculture: Spray Irrigation - Storage Abstraction type: water may be abstracted from a single point Source: Surface

- 3.2.9 There are no water dependent Sites of Special Scientific Interest within approximately 2km of the application site. The Roman River is designated as a European eel migratory route (**Appendix ESSD6**)

Flood Risk

- 3.2.10 The entire site is within Flood Zone 1, in which there are no watercourses within the immediate vicinity of the quarry and there are no historical (including geological) indicators of flooding having impacts the site. The site has therefore been deemed as not at risk of fluvial or coastal flooding.

¹ Ecological and chemical status' quoted are based on the results from the second cycle in 2016.

- 3.2.11 Surface and ground waters within the quarry are appropriately managed within the confines of the quarry and discharged to surrounding surface water course under appropriate regulatory consent.

3.3 Hydrogeology

Overview

- 3.3.1 The hydrogeology of the application site is taken from the results of groundwater monitoring undertaken by Tarmac around the periphery of the quarry, the British Geological Survey (formerly the Institute of Geological Sciences) and the former Anglian Water Authority 1:125,000 scale hydrogeological map of southern East Anglia, information provided by the Environment Agency, and historical groundwater level and groundwater quality monitoring undertaken by Cory Environmental and Essex County Council in the vicinity of the application site between July 2004 and January 2013, additional
- 3.3.2 The sand and gravel in the superficial deposits has a moderate to high inter-granular hydraulic conductivity. The London Clay Formation has a low hydraulic conductivity, the Lambeth Group and Thanet Formation have a low to moderate hydraulic conductivity and the White Chalk Subgroup has a low primary hydraulic conductivity and a moderate to high secondary hydraulic conductivity imparted by fissures, fractures and solution features. The London Clay Formation underlying the sand and gravel in the superficial deposits supports groundwater in the overlying sand and gravel. The sand and gravel in the superficial deposits, the Lambeth Group and the Thanet Formation are classified by the Environment Agency as Secondary A Aquifers. The London Clay Formation is classified as unproductive strata. The White Chalk Subgroup is classified as a Principal Aquifer.

Groundwater Levels

- 3.3.3 The sand and gravel in the vicinity of the quarry is water bearing. Groundwater level monitoring carried out around the periphery of the quarry between October 2016 to February 2018. A statistical summary of the monitored groundwater levels is presented in **Table ESSD8**, with full datasets and hydrographs presented in **Appendix ESSD7**.

Table ESSD8: Statistical summary of monitored groundwater levels within the sand and gravel aquifer around Stanway Quarry (mAOD)

BH ID	BE8A	GR7	GR8	SQ1	SQ2	SQ3
Min	17.13	20.62	20.98	17.69	19.24	17.94
Mean	17.70	21.91	21.21	18.24	19.36	18.04
Max	17.85	22.39	21.53	18.75	19.56	18.45

- 3.3.4 The data indicates that groundwater within the sands and gravels immediately surrounding the site are currently suppressed as result of the quarry activities, with levels to the north of the quarry currently at an elevation around between c. 18 and 19.5mAOD, and between c. 17.5 to 18.5mAOD to south of the quarry. Levels in GR8 located to the northwest of the quarry are elevated at c. 21mAOD. The highest groundwater levels of c. 22mAOD are recorded in borehole GR7. However, this borehole is located within the western extents of the quarry, located adjacent to flooded lagoons associated with ongoing surface and groundwater management operations at the quarry, which are understood to be constructed in sand and gravel deposits. Levels in GR7 are therefore likely to be influenced by the water levels within the lagoons.
- 3.3.5 Prior to the commencement of quarrying at Colchester Quarry it is considered likely that groundwater in the sand and gravel discharged to a former valley in the west quarry thence to the Roman River or directly to the valley of the Roman River through springs located close to the interface between the sand and gravel and the London Clay Formation in the valley of the Roman River. It is likely that the current groundwater flow direction is influenced significantly by the groundwater management in the current extraction areas in the application site and the topography of the top of the London Clay Formation which supports groundwater in the sand and gravel superficial deposits. It is

considered that currently the direction of groundwater flow is towards the quarry void. It is possible that there is a component of groundwater flow locally to the south and southeast east towards springs in the valley of the Roman River and an unnamed north bank tributary of the Roman River. Because the sand and gravel aquifer is absent in the base of the valley of the Roman River and superficial deposits in the vicinity of the river comprise Head and Alluvium or are absent it is considered that there will be limited continuity between groundwater in the sand and gravel and surface water in the Roman River.

- 3.3.6 The London Clay Formation is not water bearing in the vicinity of the application site. It is likely that the Lambeth Group and Thanet Formation are water bearing. Groundwater in the Thanet Formation is monitored by Cory Environmental in borehole BE7B located approximately 260m west of the quarry. Based on groundwater level monitoring undertaken between May 2005 and December 2012 the groundwater level in the Thanet Formation monitored in borehole BE7B typically is approximately 9.0mAOD which is within the London Clay Formation hence groundwater levels in the Thanet Formation are confined by the overlying London Clay Formation.
- 3.3.7 The White Chalk Subgroup is water bearing and is monitored by Cory Environmental at borehole BE6 with a response zone in the White Chalk Subgroup approximately 640m to the west of the quarry. Groundwater level monitoring data has been assessed for borehole BE06 for the period May 2005 to December 2012. Since early 2009 the groundwater level in the borehole typically has been approximately 9.4mAOD. Based on historical groundwater level data presented on the hydrogeological map the potentiometric level of the groundwater in the chalk in the vicinity of the application site is between approximately 3m AOD and 4m AOD which is approximately 30mbgl. The groundwater in the chalk is confined by the overlying London Clay Formation. It is shown on the hydrogeological map that the regional groundwater flow direction in the chalk generally is to the east or south east in the vicinity of application site. It is likely that there is continuity between groundwater in the Lambeth Group, Thanet Formation and White Chalk Subgroup.
- 3.3.8 The level to which the groundwater around the Stanway Quarry area of the application site could recover was reviewed in 2012 and a copy of the report in which the results of the review are presented is provided at **Appendix ESSD8**. Based on the review it is anticipated that in the vicinity of Stanway Quarry the potential recovered groundwater levels will be between approximately 21mAOD and 24mAOD. It is likely that the groundwater levels will be highest to the north of the quarry and will be lower round the eastern, western and southern boundaries of the quarry.

Groundwater Quality

- 3.3.9 Historically, groundwater quality in the sand and gravel deposits has been monitored in groundwater monitoring boreholes BE8, BE9, GR7, GR8 and BH09, although BE8 and BE9 have been lost in recent years. Additional groundwater monitoring boreholes SQ1, SQ2, SQ3 were installed within the sand and gravel deposits in October 2016, with replacement well BE8A installed south of Maldon Road in April 2017. All these boreholes are currently considered to be upgradient of the quarry whilst groundwater management practices in place. When such practices cease, and groundwater levels rebound to natural levels, SQ3 and BE8A are likely to become down-hydraulic gradient of the landfill. Groundwater quality within these monitoring boreholes have been monitored monthly from October to December 2016 and then again from May 2017 onwards. No replacement has been installed for BE9 as this area is currently inaccessible due to quarry activities and the presence of Gyrmes Dyke SAM to the immediate east of the quarry. A statistical summary of groundwater quality within the sand and gravel aquifer around the quarry between October 2016 to February 2018 is presented in **Table ESSD9**. Full datasets and time-series charts are presented in **Appendix ESSD9**.
- 3.3.10 The results show that there is significant variation of groundwater quality around the site, the most noteworthy being the variation of the chloride and sulphate, whereby chloride concentrations in SQ3 are notably lower in than the rest of the site, and sulphate concentrations in SQ2 and SQ3 significantly higher than rest of the site. Similarly, there

were notable peaks in concentrations of cadmium, copper, molybdenum, nickel and fluoride concentration during the autumn of 2017 within GR7. There are also some notable increasing trends throughout the monitoring period for several substances at various boreholes - including barium in BE8A and SQ2; nickel in GR7 and SQ2; chloride in BE8, GR7 and SQ; fluoride in GR7 and SQ3, sulphate in SQ2. The variations observed in SQ2 and SQ3 may be due to the recent installation of these monitoring boreholes, with SQ2 potential influenced by changing redox or conditions within the aquifer as quarry operations extend northwards into the eastern extents of the northern extension area. However, a full understanding of the redox conditions within the boreholes has not been established as part of the background monitoring works. There are also numerous historical and licensed landfill sites located to the west and north of the quarry that could be impacting on groundwater quality along the northern and western edges of the site.

Aquifer Physical Characteristics

- 3.3.11 The sand and gravel in the superficial deposits has a moderate to high inter-granular hydraulic conductivity, with values of between 5.79×10^{-5} and 6.24×10^{-4} m/s within the local study carried out by Hafren (2001).

Table ESSD9: Statistical summary of groundwater quality within sand and gravel aquifer at Stanway Quarry (October 2016 to February 2018)

Statistic	Arsenic (ug/l)	Cadmium (ug/l)	Chloride (mg/l)	Chromium (ug/l)	Copper (ug/l)	Fluoride (mg/l)	Lead (ug/l)	Mercury (ug/l)	Molybdenum (ug/l)	Nickel (ug/l)	PAH (Total) (ug/l)	Phenols (Mono) (mg/l)	Selenium (ug/l)	Sulphate (mg/l)	Zinc (ug/l)
BE8A															
Min	<0.2	0.07	70	<0.1	0.8	<0.05	<0.3	<0.05	<1	4	<0.01	<0.01	<0.5	53	4
Mean	0.34	0.11	88.0	-	1.14	<0.05	<0.3	<0.05	<1	4.3	0.43	-	<0.5	55.8	12.2
Max	0.7	0.19	120	<0.1	1.6	0.05	0.3	0.06	1	5	3.1	<0.01	0.5	59	39
Stdev	0.17	0.04	15.3	-	0.33	0.01	0.07	0.01	0.17	0.5	1.03	-	0.13	2.3	11.3
GR7															
Min	0.6	<0.02	92	<0.1	3.2	<0.05	<0.3	<0.05	<1	2	<0.01	<0.01	<0.5	81	5
Mean	0.71	0.15	107.7	-	5.00	0.07	<0.3	-	2.40	12.2	0.33	-	-	89.7	12.0
Max	0.8	0.41	120	<0.1	6.5	0.19	0.5	<0.05	7	33	3.2	<0.01	<0.5	99	17
Stdev	0.09	0.16	10.5	-	1.32	0.05	0.12	-	2.39	11.1	1.01	-	-	6.2	4.5
GR8															
Min	0.6	0.04	86	<0.1	1.4	<0.05	<0.3	<0.05	<1	2	<0.01	<0.01	<0.5	79	5
Mean	0.75	0.08	119.5	-	2.19	<0.05	<0.3	-	<1	2.1	0.31	-	-	96.2	8.3
Max	0.9	0.18	140	<0.1	3.1	0.08	0.4	<0.05	1	3	3.2	<0.01	<0.5	110	13
Stdev	0.09	0.04	15.2	-	0.49	0.02	0.08	-	0.19	0.3	0.92	-	-	8.2	2.6
SQ1															
Min	0.3	0.04	60	<0.1	0.7	<0.05	<0.3	<0.05	<1	6	<0.01	<0.01	<0.5	74	8
Mean	0.34	0.08	65.5	-	1.25	<0.05	<0.3	-	<1	7.7	0.23	-	0.61	87.3	16.8
Max	0.4	0.2	77	<0.1	2.4	0.025	<0.3	<0.05	1	11	2.2	<0.01	0.7	95	56
Stdev	0.05	0.05	4.9	-	0.50	0.00	0.00	-	0.20	1.9	0.66	-	0.07	7.3	14.4
SQ2															
Min	0.6	0.09	74	<0.1	2.1	<0.05	<0.3	<0.05	<1	7	<0.01	<0.01	<0.5	130	7
Mean	0.69	0.19	114.6	-	2.52	<0.05	<0.3	0.06	<1	13.9	0.38	-	-	197.5	12.5
Max	0.8	0.34	150	<0.1	3	0.025	0.4	0.12	3	26	4	<0.01	<0.5	320	26
Stdev	0.09	0.07	31.0	-	0.32	0.00	0.10	0.04	0.72	6.6	1.15	-	-	62.4	5.9
SQ3															
Min	0.5	0.03	14	<0.1	<0.5	<0.05	<0.3	<0.05	<1	7	<0.01	<0.01	1.6	200	7

Statistic	Arsenic (ug/l)	Cadmium (ug/l)	Chloride (mg/l)	Chromium (ug/l)	Copper (ug/l)	Fluoride (mg/l)	Lead (ug/l)	Mercury (ug/l)	Molybdenum (ug/l)	Nickel (ug/l)	PAH (Total) (ug/l)	Phenols (Mono) (mg/l)	Selenium (ug/l)	Sulphate (mg/l)	Zinc (ug/l)
Mean	0.75	0.07	19.6	-	0.82	<0.05	<0.3	-	-	10.5	0.47	-	2.14	224.5	13.0
Max	1.4	0.14	33	<0.1	1.4	0.11	0.9	<0.05	<1	14	3.7	<0.01	3.1	270	24
Stdev	0.28	0.03	5.5	-	0.30	0.03	0.24	-	-	2.3	1.08	-	0.45	21.6	5.3

Licensed Abstractions & Private Water Supplies

- 3.3.12 The application site is not located in a groundwater Source Protection Zone. The quantitative status of the sand and gravel aquifer is classified by the Environment Agency as good. There are eight licensed groundwater abstractions, three deregulated groundwater abstractions and two private groundwater abstractions within 2km of the of the landfill. Details of the active licensed groundwater abstractions are presented in **Table ESSD10** and **Appendix ESSD1**, with details of the deregulated and private groundwater abstractions are presented in **Appendix ESSD4**. The approximate locations of these groundwater abstractions are shown on **Drawing No. B030-00676-10**.
- 3.3.13 The groundwater abstraction location closest to the landfill is the abstraction from the glacial sand and gravel associated with the current mineral extraction at Stanway Quarry and is used for mineral washing and mineral processing at the quarry. The next groundwater abstraction closest to the landfill is located to the north of the quarry, is from the chalk and is used for spray irrigation. There are two wells associated with residential properties shown in the vicinity of Stanway Green to the northeast of the landfill on the Ordnance Survey 1:10,000 scale map. The well closest to the quarry area is approximately 200m northeast of the proposed landfill void. The wells are not listed as licensed or private groundwater abstractions. Groundwater levels are managed as necessary in parts of Bellhouse Quarry. During periods that groundwater levels are managed actively the groundwater was discharged to a lagoon on the site thence to the Roman River or directly to the Roman River. The water abstracted from Bellhouse Quarry is not used at the quarry.

Table ESSD10: Details of licensed groundwater abstraction within 2km of the site

Location	Details
Gravel Pit at Stanway Distance: On-site NGR: 594970, 222630	Operator: Lafarge Tarmac Trading Limited License No:8/37/24*G/0080 Abstraction: Extractive: Mineral Washing Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Hill Farm, Copford Distance: 922m W NGR: 593800,222200	Operator: J A Bird License No: 8/37/24/*G/0012 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater

Discharge Consents

- 3.3.14 There are currently 3 licensed discharges to land/soakaway within 1km of the site. Summary details are provided in **Table ESSD11**. Further information is presented in **Appendix ESSD1**.

Table ESSD11: Summary of active Discharge Consents to groundwater/land within 1km of the site

Location	Details
Fiveways Fruit Farms Fiveways, Stanway, Colchester, Essex, CO3 5QR Distance 45m N NGR: 595360, 223100	Operator: Julian Mead Property Type: Horticulture Est. Nursey Gardens Catchment Area: Catchment 29 Unknown Detail Ref: Gwelf50604 Discharge Type: Trade Discharge – Agricultural and Surface onto Land Discharge Environment: Onto Land Receiving Water: Groundwater Status: Deemed Groundwater Regulations Authorisation
Farmworkers Cottage Stanway Hall Farm, Maldon Rd, Stanway, Essex Distance 50m E NGR: 595200,222200	Operator: Mr W. Wallace Property Type: Sewage Disposal Works 0 Other Catchment Area: Not Supplied Ref: Pr2lf672 Discharge Type: Unknown Discharge Environment: Land/Soakaway Receiving Water: Soakaway into Land Status: Pre-National Rivers Authority Legislation where issue date <01/09/1989

Location	Details
The Bungalow, Heckfordbridge Maldon Road, Heckfordbridge, Colchester, Essex, CO3 0SN Distance 68m SW NGR: 594667,222003	Operator: Mr M White Property Type: Domestic Property (single) Catchment Area: Roman River / Abberton Reservoir Ref: Pr2lfs13967 Discharge Type: Sewage Discharges – Final/Treated Effluent – Not Water Company Discharge Environment: Land/Soakaway Receiving Water: Status:

3.4 Man-Made Subsurface Pathways

3.4.1 Other than the monitoring boreholes associated with the quarry and neighbouring Bellhouse Quarry landfill, and abstraction boreholes/wells previously discussed, other man-made pathways in the vicinity of the site are likely to include buried utility and service conduits either beneath the local road networks or within neighbouring fields. Specific details of any such conduits have not been identified due to the associated risk with the inert waste deposits. A culverted section of a tributary to the Roman River is also known to exist beneath Colchester Zoo to the southwest of the landfill.

3.5 Receptors and Compliance Points

Controlled Waters

3.5.1 Potential receptors of waterborne contaminants from Stanway Quarry landfill are:

- Groundwater Resources
- Surface water bodies
- Abstraction points

Groundwater

3.5.2 The groundwater within the superficial sand and gravels forms the primary receptor to potential pollutants that may be released as a consequence of the landfill operations. For both hazardous substances and non-hazardous pollutants, the point of compliance will be edge of the site. The River Roman River and associated tributaries to the southwest and south east constitute the only existing secondary groundwater receptors, although it is feasible that additional abstractions may be permitted from the superficial sand and gravel aquifer in the future.

3.5.3 Whilst groundwater is also present within the undifferentiated Thanet Formation and Lambeth Group, and the underlying white chalk subgroup, the presence of around 29m of low permeability London Clay between the base of the landfilled deposits and the bedrock aquifer will provide significant level of attenuation. The potential risk to this aquifer is considered to be significantly lower than that of the superficial aquifer. Assessment of the risk to the superficial aquifer will therefore provide an appropriate level of assurance that there will be no significant risk to the bedrock aquifer.

Surface Water

3.5.4 Surface and ground waters managed within the quarry will be discharged from the A network of balancing/settlement points and lagoons to a tributary of the Roman River located to the southwest of the landfill.

3.5.5 Groundwater within the superficial sand and gravel aquifer also discharges via a spring located at the boundary between the base of the Kesgrave Formation and upper boundary of the London Clay located approximately 800m south of the landfill. This geological boundary also extends around the edge of the tributary to the southwest of the landfill. Groundwater is also therefore likely to contribute to baseflow to this tributary.

Amenity (Nuisance and Health Issues)

- 3.5.6 There are no RAMSAR sites, Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Site of Special Scientific Interest (SSSIs) or national nature Reserves (NNRs) located within 2km of the landfill facility. The nearest Local Nature Reserves, Lexden Park is located a little under 2km to the northeast of the site and comprised mainly species rich acid grassland meadow habitats with areas of deciduous woodland.
- 3.5.7 Details of all human, natural and cultural receptors located with 500m of the operational extents of the landfill facility are presented in **Table ESSD1**. In summary the nearest human receptors include users of the public rights of ways located adjacent to the western and eastern boundaries of the site together with residential properties within 50m of the landfill boundary located along Maldon Road to the south and at Furzehill to the northwest.
- 3.5.8 A Local Wildlife Site (LWS) designation is associated with the northern and eastern extents of the landfill and wider quarry footprints. These areas have been designated for their “*open mosaic habitats on previously development land*” associated with the quarry operations. Whilst the landfill and wider quarry restoration activities will impact directly on these habitats, the restoration proposals will ultimately result in net improvement and increase in the habitat created by the restoration scheme, as approved by Essex County Council under Planning Permission Ref.:ESS/23/14/COL (**Appendix ESSD10**). Similar habitats are also associated with the Stanway Pits LWS located approximately 400m to the northwest of the landfill. To the immediate west of the Stanway Pits LWS is the Tye Grove LWS, designated for its lowland mixed deciduous and ancient woodland habitats.
- 3.5.9 Gryme’s Dyke located along the quarries eastern boundary and Oliver’s Thicks/Butcher’s Woods are located approximately 175m to the southeast of the landfill are also designated as LWSs for their lowland mixed deciduous woodland, dry acid grassland, ancient and species-rich hedgerows and green lanes and urban habitats.
- 3.5.10 Operational activities on the landfill will not result in any significant emissions to air, therefore there is no need to consider any other sites up to a radius of 10km beyond those identified above.
- 3.5.11 The locations of all LWS are shown in **Appendix ESSD6**.

4.0 POLLUTION CONTROL MEASURES

4.1 Site Engineering

Groundwater Management System

- 4.1.1 Dewatering operations associated with the ongoing sand and gravel extraction activities at the site will continue throughout the duration of restoration activities.

Basal and Side-Sloped Engineering

Geological Barrier

- 4.1.2 The London Clay Formation comprising dark grey mudstones has been proven at the base of the superficial drift deposits and is currently exposed on the floor of the quarry. The full thickness of the London Clay Formation has not been proved beneath the quarry, although full thicknesses of between 29 and 35m has been proven in boreholes BE05, BE06, BH09 in the vicinity of the adjacent Bell house Quarry landfill and in a historical borehole to the north of the site.
- 4.1.3 The permeability of the London Clay Formation can vary depending on the effective stresses offered by the depth of cover and prevalence of fissuring. Where the effective stress is high the permeability is usually quoted as being around 10^{-11} m/s (EA & ESI, 2010), although values ranging from 10^{-11} to 10^{-8} m/s have been published by Hight (2003). It is considered that this substantial thickness of clay and mudstone form a natural geological barrier that meets the requirement set out under Annex I of the Landfill Directive in order to protect to the underlying aquifer group comprising the Lambeth Group, Thanet Sand Formation and White Chalk Sub-group.
- 4.1.4 The sidewalls of the quarry comprise exposed sand and gravels of both the Lowestoft Formation and the Kesgrave Catchment Subgroup (formerly the Kesgrave Sands and Gravels). These natural physical characteristics of these deposits are not considered to provide the necessary attenuation requirements specified under Annex I to the Landfill Directive. It is therefore proposed to construct an Artificial Established Geological Barrier (AEGB) over the sidewalls of the propose landfill area utilising site-won London Clay. This AEGB is proposed to be constructed from London Clay excavated from the basal area within the landfill footprint, with maximum permeability of 1×10^{-9} m/s. Due to stability factors and construction techniques the thickness of the AEGB over sidewalls comprising exposed sand and gravels will be a minimum of 3m. The thickness of the AEGB over the side wall (bund) formed from restoration materials within the northern extension area will be reduced to 0.5m. AEGB details are presented in **Drawing No. B030-00676-06**.

Capping

- 4.1.5 An engineered cap is not required for the Stanway Quarry landfill facility since the only waste to be accepted is inert. The Hydrogeological Risk Assessment (*Document Reference: TA1026/06*) demonstrates that there will be no adverse environmental impacts from the deposition of inert waste in the site without an engineered cap.
- 4.1.6 During the restoration phase, the final top layer will consist of soils and restoration planting.

4.2 Restoration Profile

- 4.2.1 The restoration profile is presented in **Drawing No. B030-00676-11**. Restoration of the quarry will involve infilling approximately half of the overall quarry void. The restored profile will fall at gradients of 1:3 from approximately 34-36mAOD around the southern and western perimeters of the landfill facility to a restoration platform of between 23-24mAOD. The northern and western margins of the restored landfill area will also merge with adjacent restored areas of the wider quarry. A lake with wetland habitats and aquatic margins will be created across a large section of the northern area of the

landfill footprint, in which water levels will be controlled to the predicted groundwater rebound level within the surrounding natural sand and gravel aquifer.

- 4.2.2 A full list of inert wastes to be used to restoration of landfill footprint area of the quarry is presented in **Appendix ESSD2**. Due to the inert nature of the proposed wastes to be disposed of at the facility, and the use of appropriate compaction techniques, the likelihood of any physical settlement of the final restored profile will be minimal (i.e. less than 1%).

4.3 Water Management

- 4.3.1 During infilling within the footprint of the landfill surface waters draining from unfilled and waste filled areas will continue to be managed within a network of balancing/attenuation lagoons excavated within the London Clay with subsequent discharge to the tributary of the Roman River located to the southwest of the quarry.

- 4.3.2 Groundwater will also continue to be managed at the quarry during restoration. Groundwater draining from the sand and gravels will continue to be collected within the existing balancing/attenuation lagoons network pending discharge to the tributary to Roman River, or to support ongoing mineral processing operations and emissions management requirements.

4.4 Post Closure Controls (Aftercare)

Proposed after-use of the site

- 4.4.1 The restoration scheme for the whole of Stanway Quarry is to create a variety of land uses comprising fruit farm production, lakes, agricultural land, species rich grassland, woodland and nature conservation areas, with a series of permissive paths across the restored site to link with existing rights of way.

Post-Closure Management of the Site

- 4.4.2 When final levels are achieved a series of monitoring wells will be retro drilled within the waste deposits in areas where the waste thicknesses exceed 4m, as indicatively shown in **Drawing No. B030-00676-08**. The wells will be used to monitor the waste deposits for the purposes of demonstrating that the waste materials are stable, both physically and chemically, to enable subsequent surrender of the permit. Monitoring for gas will be carried out quarterly for a minimum of two years after closure of the site to support subsequent surrender of the Environmental Permit. Full details are presented in the Section 8.0 of the Management Plan (*Doc. Ref.: TA1026_05*) submitted in support of this application. In areas where waste thicknesses are less than 4m spike tests will be performed.

Conditions when Permit Surrender is Acceptable

- 4.4.3 Permit surrender will be considered when the site has reached final levels and it has been demonstrated that the deposits are stable and do not present a risk to the environment or human health. This will be determined by appropriate monitoring and surveying of the waste deposits for a minimum period of two-years after closure. Full details of the proposed monitoring and survey requirements after closure are presented in the Section 8.0 of the Management Plan (*Doc. Ref.: TA1026_05*) that supports this application. If after two years, the waste is assessed as stable, and in-waste gas concentration meets the criterion as set out in the relevant guidance and the Risk Assessments, then an application for surrender of the permit can be made.

5.0 MONITORING

5.1 Weather

5.1.1 Regional climate data has been sourced from the recording station located at Wattisham Airfield, which is located approximately 40km north of Stanway Quarry.

5.1.2 Average monthly and annual rainfall depths and rainfall days are presented in **Table ESSD12**. The average annual mean rainfall for this area is 613.7mm. In comparison, the average potential evaporation totals for MORECS square 153, which includes Stanway Quarry, is approximately 675mm/yr, resulting an estimated average Soil Moisture Deficit (SMD) of approximately 50mm/yr.

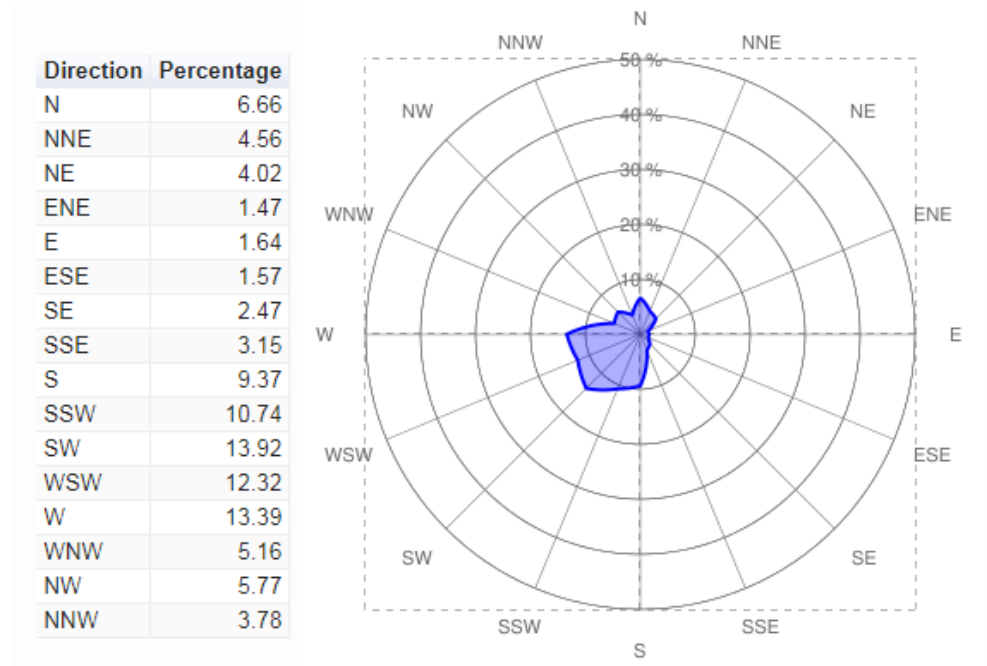
Table ESSD12: Average rainfall and days of rainfall (>1mm) at Wattisham (1981-2010)

Month	Rainfall (mm)	Days of rainfall >= 1 mm (days)
Jan	49.2	11.2
Feb	40.7	9.5
Mar	44.4	10.4
Apr	41.1	9.3
May	50.9	8.7
Jun	52.6	9.1
Jul	50.1	8.7
Aug	56.2	8.4
Sep	51.9	8.8
Oct	64.8	10.1
Nov	59.9	10.9
Dec	52.0	10.6
Annual	613.7	115.8

Source: www.metoffice.gov.uk

5.1.3 The predominant wind direction is from the southwestern quadrant with the prevailing winds from the west-southwest, with significant contributions from also the west and south. Wind from the north-western quarter occurring relatively less frequently, with winds from the south-eastern and north-western, occurring very infrequently.

Figure ESSD1: Wind direction data and wind rose for Wattisham Airfield meteorological recording station between 2000-2010 (inclusive (Source: RenSMART)



5.2 Gas Monitoring Infrastructure

5.2.1 There are currently 6 boreholes monitored around the periphery of the landfill and quarry: GR7, GR8, SQ1, SQ2, SQ3 and BE8A. The locations of these boreholes are presented in **Drawing No. B030-00676-08**.

5.3 Gas Monitoring

5.3.1 Initial baseline ground gas monitoring carried out from September 2016 to February 2018 (**refer to Appendix ESSD11**) has demonstrated that methane is regularly detected around the periphery of the site, with mean concentrations of around 0.1%v/v and maximum concentrations of up to 0.3%v/v recorded in most boreholes. There is no significant variation in background methane concentrations around the quarry.

5.3.2 Carbon dioxide was continuously detected in all monitoring boreholes around the edge of Stanway Quarry. The highest concentration of 8.2%v/v was recorded in GR7, which is located within the western extent of the quarry approximately 100m from the edge Bellhouse Quarry Landfill. the mean concentration at GR7 during the monitoring period was 2.86%v/v. In comparison, the mean and maximum recorded concentrations in GR8, which is located adjacent to the Bellhouse Quarry Landfill, were notably lower at 0.39%v/v and 1%v/v respectively. Mean and maximum carbon dioxide concentrations along the northern boundary of the quarry were recorded at approximately 1.8%v/v and 4.4%v/v respectively in SQ1 and approximately 2.3%v/v and 5.1%v/v in SQ2. To the south of quarry respective mean and maximum recorded concentrations of approximately 1.4%v/v and 3.1%v/v were recorded in SQ3, and approximately 2.1%v/v and 3.5%v/v in BE8A. this monitoring data indicates a notable background concentration of methane and carbon dioxide. Higher mean concentrations to the north and south of the quarry than along the western edge of the quarry, at its boundary with the adjacent Bellhouse landfill facility would suggest that these are natural baseline ground gas concentrations for the superficial sand and gravel strata.

5.3.3 Only inert wastes will be deposited at the site in which the potential to produce landfill gas will be negligible. Consequently, it is not proposed to undertake gas monitoring during the active period of infilling of the site.

5.3.4 Once final levels are achieved in each phase a series of in-waste monitoring boreholes will be installed within the wastes mass at a density of 2 per hectare where waste deposits exceed depths of 4m. These will be monitored quarterly for a period of 2 years post-closure to support the subsequent surrender of the permit. The proposed positions of these boreholes are present in **Drawing No. B030-00676-08**.

6.0 SITE CONDITION REPORT

6.1 Scope and Objectives

6.1.1 The Site Condition Report assess the baseline environment of the operational areas of Stanway Quarry Landfill site that will not receive permanent deposits of waste.

6.1.2 The Site Condition Report has been compiled in accordance with Environment Agency's Templates: Conceptual Site Model, Environmental Setting and Site Design Report, Version 1, 14/10/2016, and H5 Guidance. Information has been gathered from a number of sources including existing site investigation reports, desk study analysis and observations made by Sirius.

6.1.3 The purpose of this initial Site Condition Report is to provide a factual statement of the condition of the site at the time of issue of the Environmental Permit. The Site Condition Report must describe the nature and distribution of potentially polluting substances in the ground and groundwater at the site prior to the commencement of operations under the Environmental Permit, and those handled during the course of the permitted operations. The potentially polluting substances of interest are those which are to be handled at the site under the Permit, and include raw materials, waste materials and by-products that are generated by the process.

6.1.4 The proposed development comprises the restoration of a large section of Stanway Quarry through landfilling within inert wastes. However, this section of the ESSD focuses on the condition of the areas of the site which will not be subject to the permanent deposit of wastes, which for this site will be restricted to a section of the internal access road and the existing weighbridge and reception area. The waste that will be disposed at the site will be inert in nature and as such should it should present little chance of pollution or contamination. Notwithstanding this, the proposed development is described in section 2.1.2 which allows derivation of the types of contaminants to be considered.

6.2 Condition of the Land at Permit Issue

Sources of Information

6.2.1 The base information this report has been determined from a review of available published information, including:

- Landmark Envirocheck Report (**Appendix ESSD1**)
- BGS 1:50,000 scale geology maps
- Environment Agency web-based data

Development History

6.2.2 A full description of the development history of the quarry and surrounding areas is provided in **Section 2.0**. In summary, the development history of the access road and reception area consists of open pastured surrounded with woodland plantations until the commencement of quarry activities in the 1970's. Since then these areas have supported the wider quarry operations, including infrastructure such as overhead conveyors, access roads, weighbridges and storage facilities. To the northeast of reception area is the main mineral processing facility, which occupies an area in which mineral extraction has been completed. Mineral extraction is currently ongoing in the northernmost area of the site.

6.2.3 Beyond the boundary of Stanway Quarry the development history has been limited to the mineral extraction and subsequent landfilling activities at the adjacent Bellhouse Quarry Landfill facility located approximately 275m west of the reception area. To the south of the quarry Stanway Hall has been present since the 19th Century, with the development of Colchester Zoo to its immediate south and west also commencing from the 1970's.

Geology

- 6.2.4 A detailed description of the regional and local geology and hydrogeology is present in **Section 3.1**. In summary, the site reception area is underlain by London Clay Formation comprising clay, silt and sand. The quaternary superficial sand and gravels that formerly overlaid the London Clay within the reception area have been fully exploited. Beneath the London Clay, at a depth of between approximately 29-35m lie the undifferentiated Lambeth Group and Thanet Sand Formation units, which overlay the White Chalk Subgroup.

Hydrogeology

- 6.2.5 The detailed description of the regional and local hydrogeology is presented in **Section 3.3**. To summarise, London Clay formation classified as unproductive strata which overlies the underlying the undifferentiated Lambeth Group and Thanet Sand Formation which are classified as Secondary A aquifers regionally. The underlying chalk is classified regionally as a Principal Aquifer.
- 6.2.6 There is currently a total of eight licensed abstraction points within 2km the landfill, details of which are presented in **Appendix ESSD1** and summarised in **Table ESSD5**. A further two private supplies and three deregulated abstraction are also present within 2Km of the landfill, details of which are presented in **Appendix ESSD4**.

Hydrology

- 6.2.7 A comprehensive description of the hydrological setting of Stanway Quarry is presented in **Section 3.2**.
- 6.2.8 In summary, the site is located in the catchment of the Roman River which rises approximately 8km west of the site generally flowing southeast to within 650m of the quarries southern boundary. The Roman River has a confluence with the River Colne approximately 8km to the east of the site. A tributary to the Roman River into which managed surface and ground waters from the site are discharged flows south from the south-western edge of the quarry. Another tributary flows south from the along the north bank of the Roman River Valley approximately 350m to the southeast of the quarry.
- 6.2.9 The site is located in Flood Zone 1, with an area designated to Flood Zone 3 located 290m south of the site associated with the Roman River.
- 6.2.10 There are several areas of open water associated with current quarrying operations at the site. Surface water runoff drains to a ditch along the base of parts of the northern and eastern quarry faces then to a sump in the north of the quarry or drains to a lagoon located in the east of the quarry. There is a total of 12 active discharge consents within 1km of the landfill, summary details of which are summarised in **Table ESSD11**.
- 6.2.11 There are currently seven licensed abstraction within 500m of the site as detailed in **Tables ESSD7 & ESSD10**

Natural Hazards

- 6.2.12 The Landmark Information Group Service was contacted to identify the potential natural hazards at the site. A summer of the ratings associated with each potential hazard on site and to distance of 250m from the site boundary is provided in **Table ESSD13**.

Table ESSD13: Natural Hazard Rating Summary within 250m of the site

Hazard Type	Hazard Rating
Instability due to Coal Mining	No Hazard
Shrink Swell	Very Low to Moderate
Landslides	Very Low to Moderate
Ground Dissolution Stability	No Hazard
Compressible Ground	No Hazard to Moderate

Hazard Type	Hazard Rating
Collapsible Ground	No Hazard to Very low
Running Sand	No Hazard to Low
Radon Potential	The property is in a lower probability radon area, as less than 1% of homes are above the action level.

Mineral Sites and Hazardous Facilities

- 6.2.13 There is a total of 23 mineral sites recorded by the BGS within 1km of the site. Six of these records relate to Stanway Quarry; five relate to the adjacent Bellhouse Farm Quarry landfill complex; one relates Heckfordbridge Gravel Pit located within western extents of Colchester Zoo, approximately 450m southwest of the landfill; nine relate to a cluster of gravel pits to the north, and northwest and northeast of Stanway Quarry, under the names of Warren Lane Pit/Gravel pit, Stanway Pit, and Fiveways Pit; and one relates to Colchester Quarry approximately 650m northeast of the site, on the outskirts of the suburbs of Shrub End. All records relate to opencast quarrying of the superficial sand and gravel reserves, in which only Stanway Quarry remains operational.
- 6.2.14 There are no registered facilities handling hazardous substances located within 1km of the site.

Environmental Regulatory Authorisations

- 6.2.15 There are a total of five records Local Authority Pollution Prevention and Controls authorisations within 500m of landfill, each of which are held by Tarmac relating to mineral processing/coating activities at Stanway Quarry or the adjacent Bellhouse Quarry. Details are present in **Appendix ESSD1**, with summary details presented in **Table ESSD14**. One of these authorisations is no longer active.

Table ESSD14: Local Authority Pollution Prevention and Controls authorisation within 500m of site

Location	Details
Colchester Quarry, Warren Lane, Stanway, Colchester, CO3 9NN Distance: Adjacent, NE NGR: 595435, 222693	Name: Tarmac Southern Ltd Topmix Permit Reference: APA 1/03 MAU 1802 Dated: 31 st January 2006 Description: PG3/15 Mineral drying and road stone coating processes Status: Authorised
Colchester Quarry, Warren Lane, Stanway, Colchester, CO3 9NN Distance: Adjacent, NE NGR: 595147,222375	Name: Tarmac Ltd Permit Reference: Not Supplied Dated: 31 st March 2004 Description: PG3/15 Mineral drying and roadstone coating process Status: Authorised
Colchester Quarry, Warren Lane, Stanway, Colchester, CO3 9NN Distance: 245m W NGR: 594502,222222	Name: Tarmac Southern Ltd Topmix Permit Reference: APA 1/04 MAU2546 Dated: 19 th March 1993 Description: PG3/1 Blending, packing, loading and use of bulk cement Status: Authorised
Bellhouse Pit, Warren Lane, Stanway, Colchester, Essex, CO3 5NH Distance: 273m W NGR: 594497, 222313	Name: Pioneer Concrete (UK) Ltd Permit Reference: Apa 3/91 Dated: 30 th December 1992 Description: PG3/1 Blending, packing, loading and use of bulk cement Status: Authorisation Revoked
Bellhouse Works, Warrne Lane, Stanway, Colchester, Essex, CO3 0NN Distance: 247m W NGR: 594497, 222316	Name: Tarmac Southern Ltd Permit Reference: APA 4/91 MAU 720 Dated: 19 th March 1993 Description: PG3/15 Mineral drying and road stone coating processes Status: Authorised

- 6.2.16 There are also three records within 1km of the site relating to historical landfill sites, three relating to licensed waste management facilities, and two relating to Local Authority Recorded Landfill Sites. Details are presented **Appendix ESSD1** and summarised in **Table ESSD15**.

Table ESSD15: Summary of waste facilities within 1km of the reception area

Location	Details
Historical Landfill Sites	
Warren Lane, Stanway Distance: ~150m; W NGR: 594921, 222367	Licence Holder: Exwaste Limited Name: Bellhouse Quarry Provider Reference: EAHL03413 First Input Date: 31 st December 1979 Last Input Date: Not Supplied Specified Waste type: Deposited Waste included Inert, Industrial, Commercial and Household Waste
Stanway Distance: 4m W NGR: 594792, 222337	Licence Holder: Essex County Council Name: Bellhouse Pit Provider Reference: EAHL01205 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste type: Not Supplied
Licensed Waste Management Facilities	
Bell House, Warren Lane, Stanway, Colchester, Essex, CO3 5NN Distance: ~300m W NGR: 594801, 222368	Name: Bellhouse Quarry Licence Number: 70321 Licence Holder: Essex County Council Authority: Environment Agency- Anglian Region, Eastern Area Site Category: Household, Commercial, and Industrial Waste Landfills Licence Status: Closure Issued: Not Supplied
Bell House, Warren Lane, Stanway, Colchester, Essex, CO3 5NN Distance: ~300m W NGR: 594801, 222364	Name: Bellhouse Landfill Licence Number: 711116 Licence Holder: Cory Environmental Limited Authority: Environment Agency- Anglian Region, Eastern Area Site Category: Household, Commercial, and Industrial Waste Landfills Licence Status: PPC Issued: Not Supplied
Colchester Recycling, Warren Lane, Stanway, Colchester, Essex, CO3 0NN Distance: Adjacent; W NGR: 594952, 222484	Name: Lafarge Tarmac Trading Limited Licence Number: 103924 Authority: Environment Agency – Anglian Region, Eastern Area Site Category: Inert & Excavation WTS with treatment Licence Status: Modified Issued: 15 th March 2012 Last Modified: 25 th November 2013
Local Authority Recorded Landfill Site	
Stanway Quarry Distance: ~150m; W NGR: 594879, 222384	Reference: 13/421/19 Authority: Essex County Council Last reported status: Not Supplied Types of Waste: Not Supplied Date of Closure: Not Supplied
Stanway Quarry Distance: 500m NW NGR: 594627, 222817	Reference: 13/421/18 Authority: Essex County Council Last reported status: Not Supplied Types of Waste: Not Supplied Date of Closure: Not Supplied

Contemporary Trades

- 6.2.17 There are currently only 1 active contemporary trade directory entries within 1km of the site as detailed in **Table ESSD16**, all other contemporary trade directory entries are either inactive or obsolete.

Table ESSD16: Summary of active contemporary trade directory entries within 1km of the site.

Location	Details
Bellhouse Quarry, Warren Lane, Stanway, Colchester, CO3 0NN Distance: 0m W NGR: 594759, 222253	Name: Ace Minimix Classification: Concrete & Mortar Ready Mixed Status: Active Positional Accuracy: Manually positioned to the road within the address or location

History of Incidents

- 6.2.18 Landmark Information Services were commissioned to conduct a search of all records relating to pollution incidents to controlled waters which have within 1km of the site boundary. The search identified 2 incidents between 250 and 500m of the site. Details of these incidents are contained within **Table ESSD17**.

Table ESSD17: Pollution Incidents within 500m of the site

Location	Details
Kelvedon District Distance: 295m NW NGR: 594600, 222700	Property Type: Landfill/Waste Disposal Authority: Environment Agency, Anglian Region Pollutant: Miscellaneous – Tip Leachate Incident Date: 20 th October 1997 Incident Reference: 3288 Receiving Water: Into and/or watercourse Cause of Incident: Vandalism Incident Severity: Category 3 – minor incident
Kelvedon District Distance: 492m NW NGR: 594500, 223000	Property Type: Landfill/Waste Disposal Authority: Environment Agency, Anglian Region Pollutant: Oils – Other oil Incident Date: 25 th January 1994 Incident Reference: 1937 Receiving Water: Freshwater Stream/River Cause of Incident: Poor Operational Practice Incident Severity: Category 3 – minor incident

6.3 Permitted Activities

The area under the consideration of this SCR will not be subject to any specified waste management activities and will serve as the primary access and reception (weighbridge) area to the main landfill area.

Potential Contaminants

Potential polluting substances that may present a risk to the condition of the land within the site reception area are limited to oils and fuels from onsite storage (bundled/doubled skinned tanks) and leaks from vehicles, and spillages of waste materials from delivery vehicles. The

6.4 Conclusions

6.4.1 The development history of the quarry areas has largely been associated with the extraction and processing of sand and gravel, together with some low-risk waste related activities. Beyond the site boundary several there are several operational and closed landfills. This includes the operational and closed landfills of the adjacent Bellhouse Quarry, in which non-hazardous biodegradable wastes are authorised for deposit.

6.4.2 Future use of the site access and reception area within the permitted boundary of the inert landfill facility presents a limited risk from the future contamination of the land from leaks and spills of low-risk wastes, oils and fuels. Appropriate measures will be implemented to adequately manage any such spills and leaks, and appropriate investigations to be undertaken to determine if the condition of the land has been significantly affected by any such incidents. Ongoing monitoring of groundwater between the site and adjacent Bellhouse Quarry landfill facilities will also be carried out during the life of the landfill operations to identify any potential future increasing trends in pollutant concentrations.

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REFERENCES

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