

Lower Thames Crossing

6.3 Environmental Statement Appendices

Appendix 10.3 - Site Walkover Factual Report

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Lower Thames Crossing

Appendix 10.3 - Site Walkover Factual Report

List of contents

	Page number
1 Appendix 10.3 Site Walkover Factual Report.....	1
1.1 Site walkover survey	1
1.2 Nitrogen deposition area walkover survey	1
Annexes.....	54
Annex A Low Street Pit Potential Local Geological Site	55
Annex B Walkover survey photographs	82
Annex C Historical maps and photographs	86
Annex D River Terrace formation (after Bridgland, 1994)	91
Figures.....	93

List of plates

	Page number
Plate A.1 Site location.....	59
Plate A.2 Site setting.....	60
Plate A.3 Geological map extract.....	64
Plate A.4 Marine isotope record.....	68
Plate A.5 Idealised terrace sequence in Lower Thames.....	71
Plate A.6 Current terrace distribution in the northern Lower Thames Valley.....	72
Plate A.7 Proposed construction at Low Street Pit.....	78
Plate B.1 Pond in east of site.....	82
Plate B.2 North-east area of site.....	82
Plate B.3 Bank to south of site.....	83
Plate B.4 Ditch in base of quarry.....	83
Plate B.5 Eastern quarry slope.....	84
Plate B.6 Eastern quarry slope material.....	84
Plate B.7 Area of vegetation dieback.....	85
Plate C.1 Extract from Ordnance Survey 1:10,560 sheet dated 1865.....	86
Plate C.2 Extract from Ordnance Survey 1:10,560 sheet dated 1895.....	86
Plate C.3 Extract from Ordnance Survey 1:10,560 sheet dated 1898.....	87
Plate C.4 Extract from Ordnance Survey 1:10,560 sheet dated 1921.....	87
Plate C.5 Extract from Ordnance Survey 1:10,560 sheet dated 1923.....	88
Plate C.6 Extract from Ordnance Survey 1:10,560 sheet dated 1938.....	88
Plate C.7 Extract from Ordnance Survey 1:10,560 sheet dated 1955.....	89
Plate C.8 Extract from Ordnance Survey 1:10,000 sheet dated 1967.....	89
Plate C.9 Extract from Ordnance Survey 1:10,000 sheet dated 1973.....	90
Plate C.10 Extract from Ordnance Survey 1:10,000 sheet dated 1991.....	90
Plate D.1 River Terrace Formation.....	92

List of tables

	Page number
Table 1.1 Site walkover south of the River Thames.....	3
Table 1.2 Tunnel South Portal to North Portal.....	12
Table 1.3 North of the River Thames.....	30
Table A.1 Geoconservation criteria.....	75

List of figures

Figure 1 Digital Terrain Model

Figure 2 Site layout and walkover survey

Figure 3 Geology and site investigation

Figure 4 Proposed restricted area

1 Appendix 10.3 - Site Walkover Factual Report

1.1 Site walkover survey




- 1.1.1 The key observations and photographs taken during the site walkover surveys are summarised in Table 1.1 below. Site walkovers were carried out in July 2017, October 2017, September 2018, August 2020 and May 2022. The findings of the walkover survey were used to inform the Preliminary Risk Assessment Report (Application Document 6.3, Appendix 10.6) and subsequent ground investigation work completed in 2018, 2019 and 2020.
- 1.1.2 An additional walkover was carried out in August 2020 to survey the Local Geological Sites (LGS) identified within Table 10.10 of Chapter 10: Geology and Soils (Application Document 6.1). A technical note presenting the findings of the survey is presented in Annex A.
- 1.1.3 The locations of area surveyed as part of the geology walkover are presented in Figure 10.1 (Application Document 6.2) using an identification (ID) number which is in the table below.
- 1.1.4 The ID number relates to a general area visited. Within these areas, a separate number of locations were surveyed noting field observations (e.g. area 1, location 2 – so the ID is 1.2).
- 1.1.5 A description of the areas and sites visited during the walkover survey is provided below, and has been split into the following areas of the Project:
- South of River Thames: Project route/A2 junction to Gravesend link
 - Tunnel: South Portal to North Portal
 - North of River Thames: Tilbury to M25 junction 29
- 1.1.6 It is noted that some of the features detailed in the table below have changed since the original walkover surveys were carried out, e.g. Tilbury Power Station has now been demolished. Where there has been a change, it is detailed within the tables below and, if appropriate, highlighted in the baseline or conceptual site model reporting.





1.2 Nitrogen deposition area walkover survey

- 1.2.1 Compensation measures have been designed to offset significant effects of nitrogen deposition once the Project is operational, by planting new compensatory habitats and enhancing existing ones.
- 1.2.2 Eight Nitrogen Deposition Areas (NDA) have been identified for the provision of compensatory habitat planting for the Project. These have been considered separately in a standalone Preliminary Risk Assessment Report which provides a desk study and overview of the ground conditions observed at the proposed compensatory tree planting sites, presented as Annex D of the Preliminary Risk Assessment Report (Appendix 10.6, Application Document 6.3).




- 1.2.3 Walkover surveys were carried out in May 2022 to survey Nitrogen Deposition Areas as part of this assessment and are summarised in Annex D of the Preliminary Risk Assessment Report (Appendix 10.6, Application Document 6.3).
- 1.2.4 The following sites were visited as part of the Nitrogen Deposition area walkover survey carried out in May 2022:
- a. Bluebell Hill
 - b. Henhurst Hill
 - c. Court Wood
 - d. Fenn Wood
 - e. Hoford Road
 - f. Hole Farm
 - g. Buckingham Hill
 - h. Hole Farm East
- 1.1.2 The Burham and Buckingham Hill Nitrogen Deposition sites were not visited during the May 2022 survey due to land access restrictions.

Table 1.1 Site walkover south of the River Thames

Area name	Site/location description	Photographs	ID
<p>A2 Trunk Road and surroundings (Area 1)</p>	<p>Singlewell infrastructure maintenance is on the HS1 between Church Road and the A2. The depot appears to be used for the maintenance of trains. Materials (such as large cable reels, scrap metal, scaffolding poles, railway sleepers and plastic piping) and waste storage were noted along with electricity transformers and potential tank-like structures.</p>	 <p>Photo taken from public footpath (bridge over the high-speed rail line), looking east.</p>	<p>1.1</p>
	<p>Fly-tipped waste noted in hedge by public footpath comprising construction waste, insulation, plastic, foam and polystyrene.</p>	 <p>Fly-tipping viewed from public road, looking north.</p>	<p>1.2</p>
	<p>Highway maintenance depot between Henhurst Road and the A2. Storage of vehicles and materials (such as aggregate and scaffolding poles) were noted.</p>	 <p>Viewed from public footpath, looking north.</p>	<p>1.3</p>



Area name	Site/location description	Photographs	ID
<p>A2 Trunk Road and surroundings (Area 1)</p>	<p>Fly-tipping of discarded concrete rings and made ground (presence of man-made material) was noted immediately north of the A2.</p>	  <p>Precast concrete drainage piping.</p>   <p>Fly-tipping (plastic tubing and metal) was noted in a ditch at the southern end of the former Gravesend airport.</p> <p>Fly-tipping was also noted at two locations along a footpath that runs through Claylane Wood towards the A2.</p>	<p>1.4</p>



Area name	Site/location description	Photographs	ID
A2 Trunk Road and surroundings (Area 1)	Between A2 Trunk Road and Thong Lane, is an old road believed to be associated with the former Gravesend Airport. It extends south-east from Riverview Park Housing estate towards the A2.	 <p data-bbox="742 609 1305 676">Old road believed to be associated with the former Gravesend Airport.</p>	1.5
	Evidence of buried services, including gas main (high-pressure) marker posts located along the old road and adjacent to Claylane Wood, and covered manholes suspected to be associated with the existing sewerage system.	 <p data-bbox="742 1043 1353 1077">Gas main markers.</p>  <p data-bbox="742 1429 1343 1462">Covered manholes.</p>  <p data-bbox="742 1917 1332 1984">The southern section of the airport is now agricultural fields.</p>	1.6

Area name	Site/location description	Photographs	ID
<p>A2 Trunk Road and surroundings (Area 1)</p>	<p>Former petrol filling station adjacent to north of A2.</p>	<p>Seen from the former Gravesend Airport land to the north. The former petrol station appeared overgrown, with all visible above ground infrastructure removed.</p>  <p>Former petrol station, viewed from the north. Current Esso Petrol station is in the background.</p>	<p>1.7</p>
	<p>Shorne Woods Country Park. The site is now a country park which comprises predominantly woodland with ponds, a visitor centre and car park. The land was previously used as a quarry, which included clay pits and associated infrastructure. It is understood that the former clay pits are now ponds. No visible evidence of the former clay mining infrastructure was seen.</p>	 <p>Former clay pit, now a pond.</p>  <p>Typical woodland and footpaths at Shorne Woods Country Park.</p>	<p>1.8</p>

Area name	Site/location description	Photographs	ID
<p>A2 Trunk Road and surroundings (Area 1)</p>	<p>Esso Petrol Station adjacent to south of A2.</p> <p>Operational fuel station. Most of the site is covered by hardstanding, which is in good condition.</p> <p>Refuelling points for the below-ground tanks were noted on the southern side of the forecourt. Interceptor drains were present, along with a spill kit and fire extinguisher.</p> <p>Broken tarmac with standing water was seen near the southern boundary of the fuel station.</p>	 <p>Fuel station forecourt.</p>  <p>Refuelling points, oil interceptor drains, spill kit and fire extinguishers.</p>  <p>Broken hardstanding near the site's southern boundary.</p>	<p>1.9</p>

Area name	Site/location description	Photographs	ID
<p>Hartshill Nursery and Baylis Landscape Contractors Ltd on the eastern side of Thong Lane (Area 2)</p>	<p>The northern part of the site comprises a soil and waste storage area, including a large stockpile of soil (mixed with concrete, brick, wood and plastic), waste plastic, wooden pallets, disused machinery, gas canisters, bricks, sand, ceramics and empty fuel/chemical drums.</p>	 <p>Soil/waste stockpile in northern part of the site</p>  <p>Used fuel/chemical drum in the northern part of the site.</p>	<p>2.1</p>
	<p>Site office in the central area. Anecdotal evidence from Baylis Landscapes indicates that there was a quarry in this area which was filled in after WWII. During piling for the foundations of the office, the edges of the quarry were not encountered.</p>	 <p>Site office viewed from the north-east.</p>	<p>2.2</p>

Area name	Site/location description	Photographs	ID
	<p>The southern part of the site comprises vehicle storage (not on hardstanding) and a workshop for vehicle and equipment maintenance.</p>	 <p>Vehicle storage area viewed from the north-west.</p>	2.3
	<p>Red and white diesel storage tanks (5,400 and 1,500 litres) were sited on hardstanding. A stained metal oil can was noted adjacent to the tanks (possibly used for topping up vehicles). There was evidence of oil staining on the hardstanding floor and an oil-stained blanket (possibly used to mop up spills).</p>	 <p>Fuel tanks viewed from the south.</p>	2.4
	<p>Waste skips noted for general waste and recyclables. Scattered waste (such as artificial turf and plastic) was noted outside the skips.</p>	 <p>Skips viewed from the north.</p>	2.5

Area name	Site/location description	Photographs	ID
<p>Former quarries on the western side of Thong Lane (Area 3)</p>	<p>No evidence was identified of the two former quarries identified from historical mapping. The land is arable farmland with a small area of scrub woodland in the northern corner of the field.</p>	 <p>Viewed from side of public road (Thong Lane), looking north.</p>	<p>3.1</p>
<p>Southern Valley Golf Club on the eastern side of Thong Lane (Area 4)</p>	<p>The golf course comprises landscaped areas, electricity pylons and overhead power lines, a public footpath and existing boreholes that irrigate the site. According to anecdotal evidence, made ground and fill associated with the construction of Bluewater Shopping Centre was used to form the landscaped mounds.</p>	 <p>Southern end of the golf course, looking north-east.</p>	<p>4.1</p>









Area name	Site/location description	Photographs	ID
<p>Southern Valley Golf Club on the eastern side of Thong Lane (Area 4)</p>	<p>According to anecdotal evidence, the north-eastern side of the golf course was an airfield during WWII, but all ordnance was cleared when the site was developed into a golf course circa 1990. No evidence of the former airfield was apparent apart from a relatively level area that used to be the runway. There is a gas tank and waste storage compound to the north-west of the clubhouse.</p>	 <p>Location of former airfield, looking south-west.</p>	<p>4.2</p>



Table 1.2 Tunnel South Portal to North Portal

Area name	Site/location description	Photographs	ID
<p>Lower Higham Road (Area 5)</p>	<p>Pile of fly-tipped construction waste was noted in a layby on the northern side of Lower Higham Road (including tarmac, plastic pipe, tiles, soil etc).</p> <p>During the September 2018 survey, fly-tipped waste (wood, plastic tubing, rubble bags and soil) was seen in the layby.</p>	 <p>Photo taken on Lower Higham Road, looking west.</p>  <p>Fly-tipped wood and rubble (September 2018).</p>  <p>Fly-tipped plastic and rubble (September 2018).</p>	<p>5.1</p>




Area name	Site/location description	Photographs	ID
Lower Higham Road (Area 5)	Foam concrete works on Lower Higham Road, which is the location of Filborough Farm (a former historical landfill site).	 <p data-bbox="683 752 1198 819">Photo taken from Lower Higham Road, looking north.</p>	5.2
	Fly-tipped construction waste was noted on a footpath to the west of the concrete works, comprising concrete, plastic, tiles, metal and ash.	 <p data-bbox="683 1296 1305 1364">Photo taken from public footpath, looking north-east.</p>	5.3
	Former gravel pit adjacent to the north of Lower Higham Road (seen from offsite). Apart from a shallow depression in the ground surface, no evidence of the former gravel pit was identified.	 <p data-bbox="683 1821 1222 1888">Former gravel pit at Lower Higham Road (viewed from offsite).</p>	5.4




Area name	Site/location description	Photographs	ID
Shorne Marshes – between Lower Higham Road and the North Kent Railway line (Area 6)	The site mainly comprises pasture land and grass-covered fields bounded by drainage ditches. A small pond was noted immediately south of the railway line.	No photo available	6.1
North Kent Railway line, and Thames and Medway Canal – between Shorne Marshes and Milton Rifle Range (Area 7)	North Kent Railway line runs parallel to the Thames and Medway Canal and a public footpath. The railway line has a pedestrian crossing and is accessed from the public footpath.	 <p data-bbox="683 1079 1292 1146">North Kent Railway Line viewed from a public crossing point.</p>	7.1
	The canal is overgrown with vegetation and potentially infilled at the eastern end.	 <p data-bbox="683 1628 1292 1724">Thames and Medway Canal, looking east. Shorne Marshes is in the background to the right.</p>	7.2


Area name	Site/location description	Photographs	ID
<p>Milton Rifle Range – adjacent to south of River Thames (Area 8)</p>	<p>The periphery of the rifle range comprises scrub and rough grassland. The central area forms the ‘firing range floor’, comprising short grass and a series of raised mounds at approximately 100m intervals. The range is orientated east to west, firing towards a brick target butt in the east of the site.</p> <p>A designated watercourse runs approximately east-west along the southern area of the site, which is fed by a series of internal drainage ditches.</p> <p>The site is enclosed with a chain link fence, with locked access gates in the south-west corner.</p>	 <p>Photo taken from a public footpath, looking south-east towards the firing range.</p>	<p>8.1</p>
<p>Adjacent to east/north-east of Milton Rifle Range (Area 9)</p>	<p>Several drainage ditches with sluice gates are present around Milton Rifle Range.</p>	 <p>Surface water channel viewed from a public footpath, looking south-west.</p>	<p>9.1</p>

Area name	Site/location description	Photographs	ID
<p>Adjacent to east/north-east of Milton Rifle Range (Area 9)</p>	<p>The drainage ditches appear to discharge into the River Thames via an outfall.</p>	 <p>Surface water outfall into the River Thames viewed from a public footpath, looking north.</p>	<p>9.2</p>
	<p>Large electricity substation adjacent to the west of Milton Rifle Range with hardstanding/gravel floor, brick building, pylons and electricity transformers.</p>	 <p>Photo taken from a public footpath, looking south-west.</p>	<p>9.3</p>


Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE Group/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>Large area of land raising works carried out by Ingrebourne Valley Ltd at the site of a former Victorian landfill area (Goshems Farm) with areas of pulverised fuel ash (PFA) from the nearby power station (now demolished). The land is currently being further raised as part of a permitted restoration plan with uncompacted tunnelling spoil from building projects in London. The site surface was noted to comprise disturbed/levelled soil with occasional fragments of rock, glass, metal, plastic, ceramic and brick. At the time of the walkover, certain areas had been raised by between 2 and 4m above the surrounding land. Information from Ingrebourne Valley Ltd reveals historical encounters with hand grenades during vegetation clearance at the site and the presence of sink holes. An occasional organic odour was noted from the land raise area during the site walkover survey.</p>	 <p>Typical surface of land raise area, looking west.</p> <p>Pile of construction waste on land raise area, looking west.</p>	<p>10.1</p>




Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>The site also comprises a north-east to south-west haul road. There is a public footpath that runs parallel to the northern bank of the River Thames. A construction project was being carried out on the northern bank of the River Thames (southern side of the land raise area).</p>	 <p>Construction project and haul road viewed from the north,</p>	<p>10.2</p>
	<p>Man-made valley present at the eastern edge of the land raise area which serves as habitat to amphibians and reptiles relocated from various parts of the site. It was estimated to be up to 40m wide at the time of the walkover survey.</p>	 <p>Man-made valley at the eastern edge of land raise area, looking north.</p>	<p>10.3</p>
	<p>Area of PFA landfilling from adjacent Tilbury Power Station (now demolished). The northerly area was capped and vegetated with small hummocks/mounds. The southerly area was landscaped with small hummocks to provide reptile habitats.</p>	 <p>Landscaped reptile habitat on PFA landfill, looking south-west.</p>	<p>10.4</p>




Area name	Site/location description	Photographs	ID
Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)	Area of Tilbury Ash Disposal landfill (PFA landfill) to the north of the power station (now demolished), which had been mined for construction materials.	 <p>Area of PFA mining/land stripping looking, north-east.</p>	10.5
	Waterlogged area of landfill, which had been used for PFA aggregate storage.	 <p>Waterlogged former PFA storage area, looking north.</p>	10.6
	Surface drainage ditches noted between land raise area and the RWE site. The water appeared to be stagnant and discoloured.	 <p>Surface water channel, looking north.</p>	10.7



Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>The former Tilbury Power Station buildings were in the process of being demolished. Large piles of metal, concrete and demolition waste, heavy machinery and demolition compounds were present.</p> <p>Former coal storage area and National Grid substation area adjacent to the north of the power station.</p>	 <p>Photo shows partially dismantled Tilbury Power Station (now demolished), viewed from the west, looking east.</p>	<p>10.8</p>



Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>East Tilbury Landfill site (located to the east of the Ingrebourne Valley land raise area). Former landfill site, now covered in rough grassland.</p>	 <p>Typical vegetated surface of the site. Tilbury Power Station (now demolished) in the background.</p>  <p>Area of broken hardstanding on the northern side of the site, with some fly-tipped waste.</p>  <p>Area of PFA mining being carried out adjacent to the north-western boundary of the landfill site.</p>	<p>10.9</p>




Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>Former chalk pit and gun battery (defensive installation), (East Tilbury). No evidence of the former gun battery or chalk pit remaining apart from a raised bank which was very overgrown and surrounded by a water-filled ditch.</p>	 <p>Overgrown mound – potentially the former gun battery.</p>	<p>10.10</p>



Area name	Site/location description	Photographs	ID
<p>Ingrebourne Valley land raise area and RWE/Tilbury Power Station – adjacent to north of River Thames (Area 10)</p>	<p>Revisited May 2022</p>	 <p>Working stockpile area to the west of the IVL site</p>  <p>Piles of stored or waste wood bundles and concrete rings next to main haul road</p>  <p>Informal compound and loading dock on the edge of the raised area</p>	<p>10.11</p>

Area name	Site/location description	Photographs	ID
		 <p>Shipping containers onshore from the dock area used for storage – one marked as containing oil surrounded by waste tyres and wood pallets.</p>  <p>Land looking west from the dock area towards Tilbury substation</p>  <p>Small waterlogged area of the raised land close to the the southwest corner of Goshem's Farm</p>	

Area name	Site/location description	Photographs	ID
		 <p>Pair of monitoring boreholes within the raised area of Goshem's Farm</p>  <p>View of eastern edge of Goshem's Farm raised area and monitoring boreholes.</p>	

Area name	Site/location description	Photographs	ID
<p>Saltings Landfill (Area 11)</p>	<p>Saltings Landfill East Tilbury (adjacent to the north of Coalhouse Fort). The landfill is now a designated wildlife site (Site of Special Scientific Interest (SSSI)/Special Protection Area (SPA)/Special Area of Conservation (SAC)) and local nature reserve, which is part of the Coalhouse Fort estate. The site manager stated that the landfill bund was constructed from sacks of mud and silt. The landfill used to receive dredging waste from the River Thames, but has long since dried up and re-vegetated into rough grassland and scrub. Several protected plant, insect and bird species were stated to be present.</p>	 <p>Typical rough grassland vegetation covering the former Saltings Landfill.</p>  <p>Flood defence wall along the western boundary of the landfill site.</p>	<p>11.1</p>

Area name	Site/location description	Photographs	ID
<p>Coalhouse Fort (Area 12)</p>	<p>The fort was stated to be from the late Victorian era, with WWII fortifications. The fort is surrounded by parkland and rough grassland/marshland. Parts of the site have scheduled monument status for military heritage. At the time of the site visit, the Victorian fort was undergoing repairs to the roof.</p>	 <p>Part of the original fort, which is under repair.</p>  <p>Part of the WWII fortifications.</p>	<p>12.1</p>
		 <p>There is a moat and boating lake around the east side of the fort.</p>	<p>12.2</p>

Area name	Site/location description	Photographs	ID
		 <p data-bbox="683 707 1283 808">WWII radio tower on marshland at Coalhouse Fort (part of the scheduled monument designation of the site).</p>  <p data-bbox="683 1247 1283 1319">Former jetty at Coalhouse Fort (part of the scheduled monument designation of the site).</p>	12.3












Area name	Site/location description	Photographs	ID
		 <p data-bbox="683 745 1257 846">Part of the moat system (in the foreground), with former Victorian quickfire battery and searchlight building (in the background).</p>  <p data-bbox="683 1310 1203 1377">Former sewage infrastructure (pumping chamber). which is no longer in use.</p>	12.4
		 <p data-bbox="683 1859 1300 2027">Gas valve compound at Coalhouse Fort. There is a gas pipeline from the gas compound passing in a southerly direction under the Thames and in a north-westerly direction beneath fields.</p>	12.5




Table 1.3 North of the River Thames




Area name	Site/location description	Photographs	ID
<p>Cole land (Area 13)</p>	<p>Cole land comprises arable farmland and Cole Farm is bisected by the Tilbury Loop railway line and Station Road.</p> <p>The farm contains a large reservoir for irrigation purposes, pylons and overhead power lines, mature trees and an electric substation.</p> <p>Information from the farmer during the walkover indicates the presence of a network of shallow land drains.</p>	 <p>Cole land, looking south-west.</p>	<p>13.1</p>
<p>Cole land (Area 13)</p>	<p>Railway line that bisects Cole land.</p>	 <p>Railway line bisecting Cole land, looking north-east.</p>	<p>13.2</p>




Area name	Site/location description	Photographs	ID
Cole land (Area 13)	A stockpile of soil was noted on Cole land at the side of the railway tracks, along with railway sleepers, wooden pallets and rubber matting.	 <p data-bbox="619 748 1267 786">Stockpile of soil on Cole land, looking south-east.</p>	13.3
	There is a pond on Cole land which, according to anecdotal evidence, is groundwater fed.	No photo available.	13.4
	There is a small active sand and gravel extraction quarry to the north of Muckingford Road on Cole land.	 <p data-bbox="619 1545 1075 1583">Sand and gravel extraction quarry.</p>	13.5

Area name	Site/location description	Photographs	ID
<p>Cole land (Area 13)</p>	<p>On the north-western edge of the quarry there is a derelict house, shipping container, large fuel tank and drums of engine oil unbanded and on bare ground. There was a skip containing plastic waste and scattered metal waste.</p>	 <p>Large fuel tank, viewed from the east.</p>  <p>Fuel drums and waste skip, viewed from the east.</p>	<p>13.6</p>
<p>Gun Hill – Potential LGS</p>	<p>View of Gun Hill taken from the road, with geological exposure evident to the north (first photo).</p>	 <p>Geological exposure of Gun Hill</p> 	<p>13.7</p>

Area name	Site/location description	Photographs	ID
<p>Low Street (a former landfill site, now an EMR scrapyards) (Area 14)</p>	<p>The site comprises a bare levelled plot of land with a perimeter of earth bunds. The site is currently used for temporary lorry storage and turnaround area, and skip storage for the adjacent scrapyards.</p> <p>It was stated that the site was originally a brickworks, which was infilled to form the level ground surface now present. Environment Agency records state that the historical landfill was infilled with non- hazardous industrial and commercial waste.</p>	 <p>Skip storage onsite, viewed from the west.</p>	<p>14.1</p>
	<p>Several large soil/rock mounds (containing metal, ceramic, concrete, plastic and brick) were present, which were stated to be used for the earth bund, as well as a large area where burning appeared to have taken place.</p>	 <p>Soil/rock mound, viewed from the north.</p>	

Area name	Site/location description	Photographs	ID
<p>Low Street former landfill (and EMR scrapyards) (Area 14)</p>	<p>Two boreholes onsite in brick housing which, according to anecdotal evidence, were used to supply water to the Tilbury Power Station. It was stated that there are below-ground water pipes and electrical cables beneath the site.</p>	 <p>Brick housing for borehole onsite, viewed from the north.</p>	<p>14.1</p>
	<p>Small brick building on the north-western edge of the site, which appeared to be a substation for the adjacent railway or a pumping station.</p>	 <p>Brick building onsite, viewed from the north-east.</p>	
	<p>The EMR scrapyards are adjacent to the east of the former Low Street landfill site. The scrapyards currently process and recycle scrap metal from local activities such as the dismantling of Tilbury Power Station.</p>	 <p>EMR scrapyards viewed from the north-west (formerly the Low Street landfill site). Access onto the EMR scrapyards was not available.</p>	<p>14.2</p>





Area name	Site/location description	Photographs	ID
<p>Low Street Pit and potential LGS (Area 14)</p>	<p>Former gravel pit adjacent to the south of Station Road.</p>	 <p>Overgrown with rough grassland and scrub. No evidence of the former gravel pit remaining.</p>  <p>Revisited May 2022: Still overgrown with rough grassland and scrub.</p>  <p>Infestations of ermine moth caterpillars observed in several hawthorn bushes along the northern boundary (Station Rd)</p>	<p>14.3</p>




Area name	Site/location description	Photographs	ID
		 <p data-bbox="619 701 1238 763">Fly tipping and remnants of burned waste were observed along Station Rd</p>	
<p data-bbox="164 786 312 891">Low Street Lane (Area 15)</p>	<p data-bbox="376 786 592 1016">Fly-tipping noted on Low Street Lane, including tyres, plastic, furniture and electrical goods.</p>	 <p data-bbox="619 1205 1246 1267">Fly-tipping on Low Street Lane, viewed from the north.</p>	<p data-bbox="1294 786 1353 815">15.1</p>
<p data-bbox="164 1285 352 1361">Love Lane Pit (Area 16)</p>	<p data-bbox="376 1285 580 1753">Former landfill site, which is now a solar farm. It is mainly grassed with an area of concrete adjacent to the gate. Access onto the site was not available (viewed from the road).</p>	 <p data-bbox="619 1709 1086 1738">Solar panels, viewed from the road.</p>	<p data-bbox="1294 1285 1353 1314">16.1</p>

Area name	Site/location description	Photographs	ID
<p>Thames Industrial Estate (East Tilbury) (Area 17)</p>	<p>Industrial estate comprising several light industrial activities such as the former 'Bata' Shoe Factory (derelict at the time of our walkover – now regenerated), car servicing and repairs, and packaging, storage and distribution warehouses. Several buildings were derelict.</p>	 <p>Drums (unbundled) being stored outside hydraulic cylinder servicing/ repairs.</p>  <p>Former 'Bata' shoe factory (unused at the time of our walkover).</p>  <p>Solar panel factory or storage facility.</p>  <p>Derelict factory/workshop at Thames Industrial park.</p>	<p>17.1</p>




Area name	Site/location description	Photographs	ID
		 <p data-bbox="619 678 1246 745">Revisited May 2022: Derelict shoe factory is still present and appears unused</p>  <p data-bbox="619 1128 1169 1196">Businesses around the estate store waste including tyres, palletes and mixed waste</p>  <p data-bbox="619 1771 1150 1830">Small substation on site in an overgrown condition.</p>	





Area name	Site/location description	Photographs	ID
<p>Tarmac Building Products (formerly Linford Quarry) (Area 18)</p>	<p>This site is a former gravel pit that is currently a plant for making Durox Aircrete Blocks, operated by Tarmac Building Products. The blocks are made from PFA, sand, cement, aluminium powder, lime and water.</p> <p>An inert waste landfill is located at the western end of the site, which is used to dispose of rejected or broken blocks (produced onsite). It was not possible to view the landfill at the time of the walkover due to access issues. Several silos and hoppers containing cement, sand and lime sand were noted, along with tanks of banded 'stabilisation oil'.</p>	 <p>Finished Durox blocks.</p>  <p>100-tonne cement silos.</p>  <p>20,000 litre stabilisation oil tanks in concrete bund.</p>  <p>Sand being fed onto a conveyor belt for use in the manufacturing process.</p>	<p>18.1</p>




Area name	Site/location description	Photographs	ID
		 <p>Rejected blocks waiting to be sent to landfill.</p>  <p>Slurry tanks. Slurry from waste blocks is recycled into new blocks.</p>  <p>Aluminium powder is used in the manufacturing process, which is tightly controlled (due to its highly flammable/explosive properties) in a secured area away from potential ignition sources.</p>  <p>'Frame oil'/tanks (in shallow brick bund and Adblue stored in intermediate bulk containers) (IBCs) (unbundled), used in the manufacturing process.</p>	<p>18.1 Continued</p>

Area name	Site/location description	Photographs	ID
	<p>Cooling system and boiler plant used in the manufacturing process.</p>	 <p>Cooling system. The blue tank in the foreground contains hydrochloric acid.</p>  <p>Reservoir used in the cooling process.</p>  <p>Salt and brine plant used in the boiler/cooling process.</p>	<p>18.2</p>




Area name	Site/location description	Photographs	ID
	<p>Emergency generator and reserve fuel tanks, which were banded.</p>	 <p>156,000-litre gas oil (reserve boiler fuel) tank in concrete bund.</p>  <p>Emergency generator.</p>  <p>Electricity substation and high voltage electricity transformer.</p>	<p>18.2 Continued</p>




Area name	Site/location description	Photographs	ID
	<p>There is a landfill site in the western side, where rejected Durox blocks are sent to landfill.</p>	 <p>The top photograph shows a wide view of a landfill site with a large pile of white, rectangular blocks. The bottom photograph shows a similar view from a slightly different angle, with some trees in the foreground.</p> <p>View across landfill site</p> <p>View across landfill site</p>	18.3
Turners Farm Gravel Pit – potential LGS	<p>The gravel pit is now filled with water.</p>	 <p>A photograph showing a large body of water, likely a former gravel pit, surrounded by lush green trees and vegetation.</p>	18.4
Clearserve landfill site/aggregate recycling (formerly Rainbow Shaw Quarry) (Area 19)	<p>Former sand and gravel pit now used as an inert waste landfill site and aggregate recycling facility.</p>	 <p>A photograph showing an aggregate recycling area with several large piles of sand and gravel. There are some structures and equipment visible in the background.</p> <p>Aggregate recycling area.</p>	19.1




Area name	Site/location description	Photographs	ID
		 <p>Inert waste landfill (mostly soil and stones). The landfill area is nearly full.</p>  <p>Unbunded fuel tanks noted onsite on broken hardstanding.</p>  <p>Plant, equipment and materials storage onsite.</p>	
		 <p>Fly-tipped furniture, cardboard and plastic noted in a layby at the site entrance.</p>	19.2




Area name	Site/location description	Photographs	ID
<p>Orsett Golf Club on the eastern side of Brentwood Road (Area 20)</p>	<p>Landscaped golf course which slopes down towards the south-east. According to anecdotal evidence, there has been a golf course here since the 1800s and was landscaped using natural materials.</p>	 <p>Golf course viewed from the north-west.</p>	<p>20.1</p>
<p>Orsett Depot Quarry potential LGS (Area 20)</p>	<p>Adjacent to the north of the golf course there is a disused quarry (sand and gravel) which is now densely vegetated.</p>	 <p>Disused and overgrown former quarry, viewed from the east.</p>	<p>20.2</p>
<p>Dansand Quarry – between Brentwood Road and A13 (Area 21)</p>	<p>This active sand and gravel extraction quarry which is also used for stockpiling, processing and recycling aggregates, soils, concrete, rock, ceramics and asphalt. The site could potentially receive and process soils or made ground from construction or demolition sites.</p>	 <p>Materials processing carried out at Dansand Quarry.</p>	<p>21.1</p>

Area name	Site/location description	Photographs	ID
		 <p>Stockpiles of used concrete and metal awaiting processing.</p>  <p>Revisited May 2022: stored aggregate, concrete and IBCs on site</p>  <p>Scrap cars and machinery located on site – no visual or olfactory evidence of contamination was noted.</p>	




Area name	Site/location description	Photographs	ID
Fire station at A13 and gravel pit/quarry to the south (Area 22)	Fire station with waste skips and IBCs. Viewed from public road.		22.1
Baker Street – former garage (Area 23)	No evidence of the former garage identified. The area is now occupied by a housing estate.	 <p data-bbox="620 1149 1212 1220">Baker Street housing estate, viewed from the former landfill site to the south-east.</p>	23.1
Local authority landfills (former gravel pit) between Stanford Road and A1089, Orsett Heath (now a recreation area) (Area 24)	Former landfills are now grassed common land used for recreation. No evidence of the former landfills was seen. Construction work/earthworks were being carried out at the southerly landfill site, which was partially being redeveloped into housing.	 <p data-bbox="620 1657 1212 1729">Grassed common land at the former northern landfill site.</p>	24.1




Area name	Site/location description	Photographs	ID
		 <p data-bbox="619 712 1254 779">Earthworks/construction works being carried out at the southerly landfill site.</p>	24.2
Former sand and gravel pit (now wooded recreation area) (Area 25)	Former sand and gravel pit, now a publicly accessible wooded nature reserve. No evidence of the former quarry was seen, although the site was very overgrown and observations were made from the footpath only.		25.1
Ockendon landfill site (operated by Veolia) (Area 26)	An active and historic landfill site. It mainly receives waste from domestic waste transfer stations. According to anecdotal evidence, the site was mothballed for approximately five years before being reopened in 2016.	 <p data-bbox="619 1778 1174 1812">Active landfill area, viewed from the south.</p>	26.1

Area name	Site/location description	Photographs	ID
	<p>The historic landfill has been restored/capped and has leachate and gas monitoring systems.</p>	 <p>Historic landfill area with gas/leachate monitoring systems.</p>	26.2
	<p>There is a pond (assumed to be man-made) onsite, which is being drained by Veolia.</p>	No photo available.	26.3
Former Hall Farm landfill site (Area 27)	Former landfill site, now vacant and very overgrown with scrub, rough grassland, reeds and bushes.	 <p>Typical scrub vegetation covering the site.</p>  <p>Area of potentially disturbed ground in the foreground.</p>	27.1

Area name	Site/location description	Photographs	ID
	<p>Occasional large concrete blocks were noted towards the centre of the site where there was an embankment, with concrete visible on the surface.</p>	 <p>Large concrete block.</p>  <p>Embankment with pieces of concrete.</p>	<p>27.1 Continued</p>
	<p>There is an artificial fishing pond to the north-west of the landfill site.</p>	 <p>Fishing pond to the north-west of the Hall Farm landfill site</p>	<p>27.2</p>

Area name	Site/location description	Photographs	ID
<p>Stubbers Adventure Centre (formerly gravel pits/landfill site) (Area 28)</p>	<p>Former gravel pit now used as an outdoor activity centre.</p>	 <p>There is a fuel storage area adjacent to the boat shed in the centre of the site with a 1,950-litre petrol tank and adjacent spill kit.</p>  <p>The former gravel pits have been infilled and are now used as recreation/boating lakes.</p>	<p>28.1</p>
<p>Agricultural farmland – between Ockendon Road and B186 (Area 29)</p>	<p>Agricultural fields bisected by railway line. Overhead power cables present.</p>		<p>29.1</p>

Area name	Site/location description	Photographs	ID
	Evidence of fly-tipped wood, metal and furniture in a fields on the eastern side of Pike Lane.	 <p data-bbox="619 712 1254 779">Fly-tipped wood, metal and furniture in a field on agricultural land, viewed from the west.</p>	29.2
	Fishing lake adjacent to agricultural land, which is assumed to be artificial. Water appeared to be stagnant. Evidence of fly-tipped car tyres were noted around the lake.	 <p data-bbox="619 1218 1086 1256">Fishing lake, viewed from the north.</p>	29.3
Agricultural farmland – between Ockendon Road and B186 (Area 29)	Railway line that bisects farmland.	 <p data-bbox="619 1693 1225 1760">Railway viewed from a railway bridge from the south.</p>	29.4

Area name	Site/location description	Photographs	ID
	Potential asbestos roof on farm buildings at farm shop.	 <p data-bbox="620 712 1066 745">Farm shop, viewed from the west.</p>	29.5
Light industrial activities around the B187 road (Area 30)	Industrial estate off B187 road includes a range of light industrial and commercial businesses, including garage doors, software and media, wholesale garage supplies, and an MOT centre.		30.1
Light industrial activities around the B187 (Area 30)	Scrap metal works off the B187.	 <p data-bbox="620 1704 1246 1771">Entrance to the scrap metal works, viewed from a public road to the north.</p>	30.2

Annexes

Annex A Low Street Pit Potential Local Geological Site

A.1 Executive summary

- A.1.1 Low Street Pit ('the site') is an overgrown former sand and gravel quarry located near East Tilbury along the route of the A122 Lower Thames Crossing (the Project). It has been identified as a potential Local Geological Site (LGS) because the former quarry is an exposure (visible area) of a particular river terrace deposit (Mucking Gravel) of the River Thames.
- A.1.2 As part of the Development Consent Order (DCO) application, the Applicant must assess the effect that construction of the Project has on designated geological sites and non-designated geological features. This technical note summarises the information available for the site and the relevant features of geological interest, plus the potential effects of construction.
- A.1.3 The Lower Thames Valley contains a 'staircase' of river terraces. These were formed by downcutting (where the riverbed is eroded) during repeated glaciations throughout the 'Pleistocene Epoch' (from 2.6 million to 12,500 years ago). The site is situated on the southern limit of the Mucking Gravel Terrace. Research into the Thames river terraces is important for reconstructing past climate and environmental changes in the recent geological past. Palaeolithic artefacts are also commonly found in River Terrace Deposits.
- A.1.4 Only limited references to the site have been found, and it does not appear to be a subject of much scientific study. However, it might form a useful part of a network of Lower Thames Quaternary (the last 2.6 million years) sites. Much of the river terrace material onsite has already been excavated and the remaining material is confined to a small area to the east of the former quarry. Preservation of permanent conservation faces is difficult in unconsolidated sediment, such as River terrace deposits.
- A.1.5 The Tilbury Viaduct and associated embankments and link roads are proposed in the west of the site, but the Mucking gravel quarry has already been excavated in this area. A temporary construction compound would be located in the east of the site and a drainage pond east of the link road embankment. There is a potential for adverse impacts if the remaining sand and gravel is excavated or the existing eastern quarry face is removed.

A.2 Introduction

- A.2.1 This technical note has been prepared to identify geological features at Low Street Pit (the site), which is a potential Local Geological Site (LGS) within the Order Limits, and to outline the potential effects of the construction.
- A.2.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel portals would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.
- A.2.3 Construction of highways and associated infrastructure may have positive or negative effects on a range of geological receptors, such as bedrock geology and superficial deposits. This includes designated geological sites and sensitive or valuable non-designated features in line with the guidance set out in the Design Manual for Roads and Bridges (DMRB) LA 109 Geology and soils (Highways England, 2019).
- A.2.4 Geological receptors have been identified in Chapter 10: Geology and Soils of the Environmental Statement (Application Document 6.1). Low Street Pit lies approximately 1.2km north of the tunnel's North Portal, at the southern limit of the proposed Tilbury Viaduct. It is the only geological receptor site within the Order Limits and therefore the only geological receptor likely to be affected by the construction.
- A.2.5 A description of the site in relation to its potential LGS status is below:
- A.2.6 *'Low Street Pit is a disused, wooded sand and gravel pit south of Station Road between east Tilbury and West Tilbury. It is situated on a patch of Mucking Gravel, which is the downstream equivalent of the Taplow terrace of the Thames and was laid down about 200,000 years ago. The gravel has been excavated down to the Thanet Sand below which is exposed on the floor of the pit.'* (Essex Field Club, 2020a)

Objectives and scope

- A.2.7 The technical note presents a description of the Low Street Pit site. It summarises, as far as can be ascertained, the features of geological interest on the site, and the potential effects of the proposed construction works. The Applicant's commitments to geology and soils receptors within the Project area are recorded in the Register of Environmental Actions and Commitments (REAC), which can be found in the Code of Construction Practice (Application Document 6.3, Appendix 2.2).
- A.2.8 The Low Street Pit site is not formally designated as an LGS but is identified as a potential LGS (Section A.5). Chapter 10: Geology and Soils of the Environmental Statement (Application Document 6.1) sets out the value (sensitivity) of the identified geological and soil receptors/resources using the criteria shown in Table 10.5, which is taken directly from DMRB LA 109 Geology and Soils (Highways England, 2019). Low Street Pit has been assumed to be an LGS and therefore has been assigned medium value (sensitivity). The site is the only geological receptor located within the Order Limits and so has been assessed in detail as the potential effects are higher than for sites outside the Order Limits.
- A.2.9 The site has also been designated as a Local Wildlife Site and identified as partially Thames Terrace grassland, which is a regionally important Biodiversity Action Plan habitat. This acid grassland habitat supports several rare plant and invertebrate species (Thurrock Council, 2007). Effects on the terrestrial biodiversity of the site from construction of the Project are not considered in this technical note and are assessed in Chapter 8: Terrestrial Biodiversity of the Environmental Statement (Application Document 6.1).

Sources of information

- A.2.10 Several sources of information sources have been used. A brief review of the relevant published literature was carried out (using online and offline sources) to gather information on the geological context of the site. The review is not intended to be a complete summary of that literature.
- A.2.11 Freely available and proprietary datasets were obtained to inform the technical note, comprising:
- a. Composite Light Detection and Ranging (LiDAR) data (25cm resolution) published by the Environment Agency (EA, 2017).
 - b. British Geological Survey (BGS) recorded mineral sites, BritPits, potentially infilled land (non-water), and potentially contaminative industrial land uses, obtained from Landmark (Landmark, 2019).

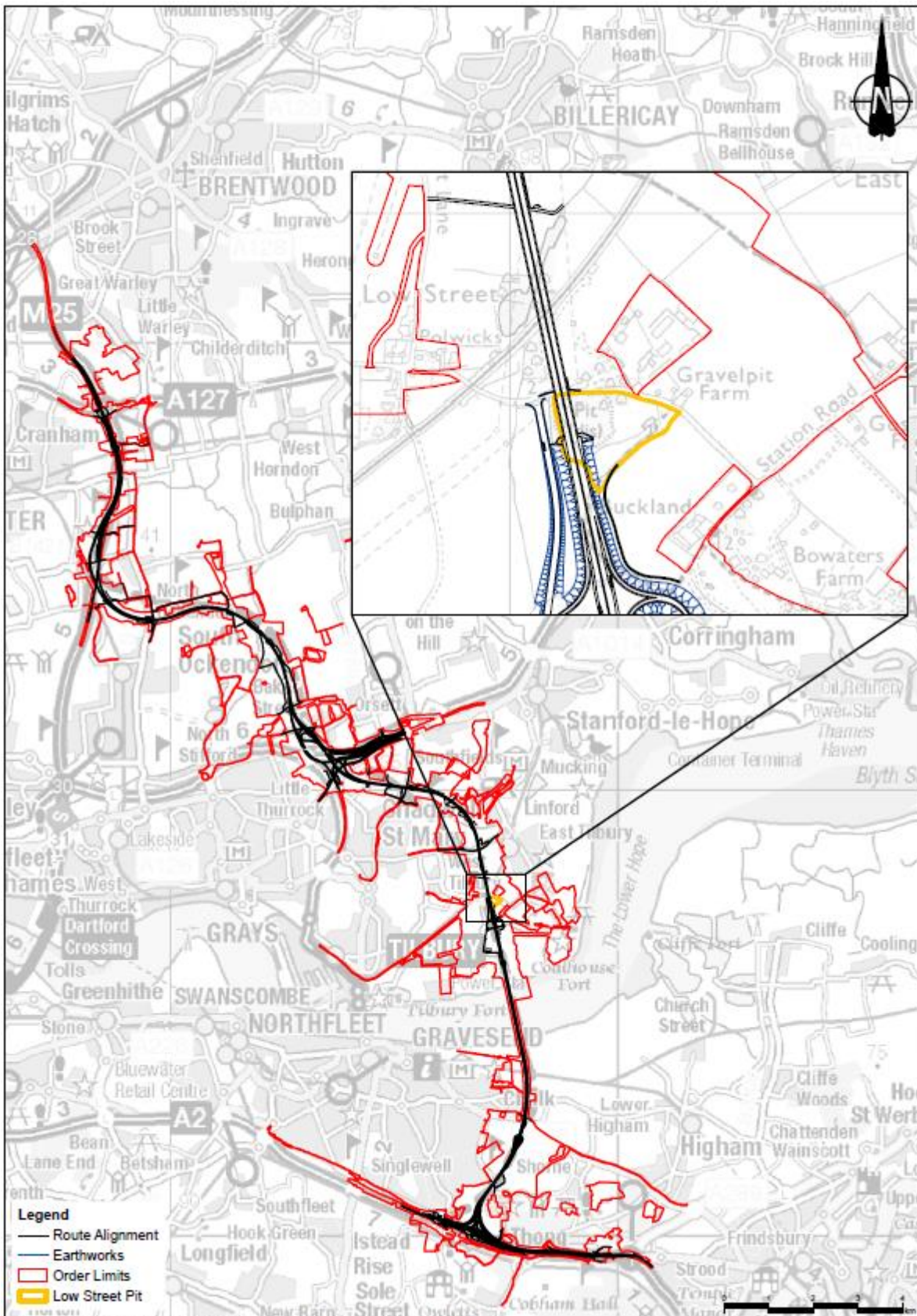
- c. BGS archived historical borehole records.
 - d. Historical maps, purchased from Groundsure Ltd.
- A.2.12 Information from the ongoing programme of ground investigation has also been reviewed. Relevant findings are summarised in Section A.3.
- A.2.13 A walkover survey was carried out at Low Street Pit by Cascade on 10 August 2020. The survey focused on potential geological features where these were accessible and visible, although the survey was restricted by dense vegetation within the site. Adjacent land was viewed from publicly accessible areas. The findings of the survey are reported in Section A.3 and Figure 2 and photographs presented in Annex B.
- A.2.14 Further sources of information are listed in the references in Section A.7.

A.3 Site description and survey information

Location

- A.3.1 Low Street Pit is located south of Station Road, roughly 1km south-west of the village of East Tilbury in Essex. The hamlet of Low Street is 300m to the west. The approximate centre of the site is at National Grid Reference (NGR) 567220, 177500. The site is situated within the Thurrock Unitary Council administrative area.
- A.3.2 The site is within the Order Limits, and the Project route runs through the west of the site (as shown in Plate A.1).

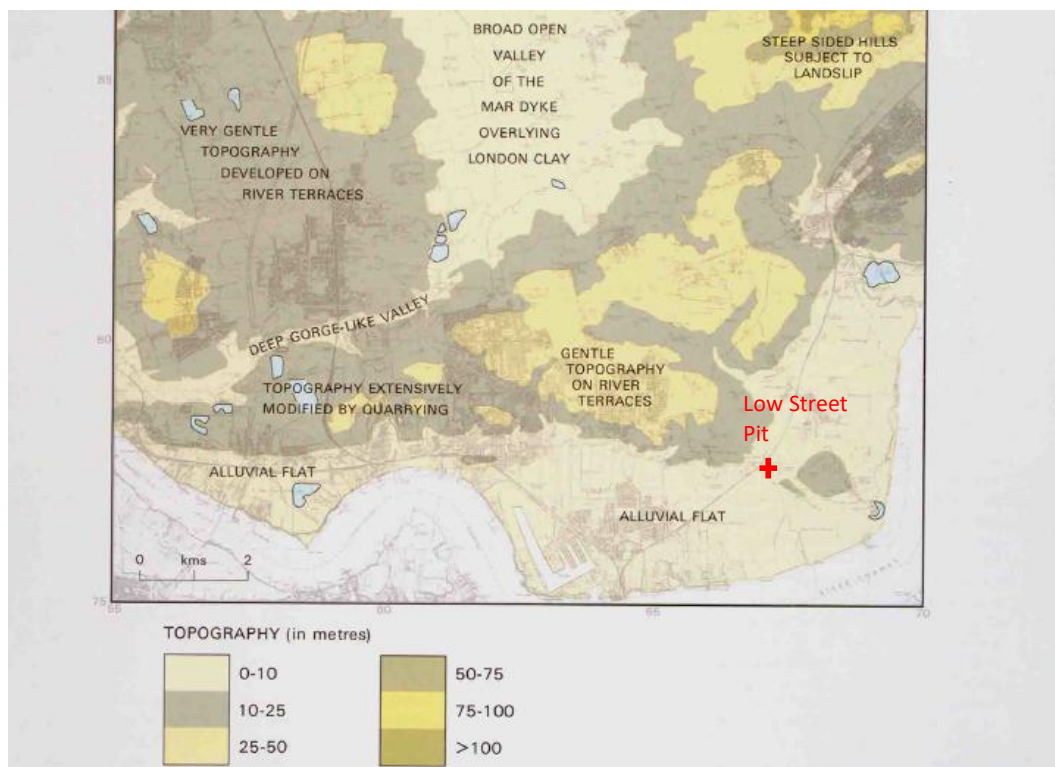
Plate A.1 Site location



Site setting

- A.3.3 The site is an irregular triangular shape approximately 300m north-south and 180m east-west. It covers an area of around 3.9ha. It is approximately 2km north of the River Thames in an area of low-lying undulating topography.
- A.3.4 The former quarry is located in the west of the site and is approximately 1.3ha. The surface elevation in the base of the quarry is between 1.5 and 2m above ordnance datum (AOD). Outside the quarry, the land generally rises from 0.8m AOD in the south, to 6.8m AOD in the north-east of the site. A Digital Terrain Model (DTM) of the current ground surface, derived from LiDAR data (EA, 2017), is shown in Figure 1.
- A.3.5 The site sits on the northern edge of the of the River Thames intertidal floodplain. The East Tilbury Marshes immediately to the south are former alluvial mudflats which have been heavily modified by land reclamation and land raise in the 19th and 20th centuries. To the north of the site is a series of stepped river terraces formed of sands and gravels deposited by the River Thames (Plate A.2).

Plate A.2 Site setting



Extract from Moorlock & Smith, 1991

- A.3.6 The site and its surroundings are drained by a network of small streams and field boundary ditches, two of which run along the west and south-east boundary. These discharge to the River Thames in the south and have likely been modified by land raising in this area. A small pond is shown on OS mapping in the east of the site.
- A.3.7 Land use in the surrounding region is generally agricultural, with small industrial sites and isolated residential properties. The Tilbury and Southend Railway is 140m to the north-west. North of Station Road opposite the site are Gravel Pit Farm and Readmans Industrial Estate, the latter principally consists of a large metal recycling facility operated by EMR. This site is a former clay pit and brickworks, described in further detail below.

Site history

- A.3.8 The superficial sand and gravel deposits in south Thurrock are an important economic resource and have been extensively quarried within relatively small localised pits, sometimes leaving only the ground beneath the roads unworked. Some have been infilled, but derelict worked ground is widespread in the Thurrock area. Most quarries are in areas where the sand and gravel deposits outcrop (where rock is visible) at the surface or are only covered by a thin layer of Holocene alluvium deposits (Moorlock & Smith, 1991). Holocene alluvium is sandy gravel, silt and clay.
- A.3.9 The area of the quarry as indicated by LiDAR data and partially confirmed by the walkover survey is approximately 1.3ha (13,000m²). Assuming an average excavation depth of 3m from the same data sources gives an excavated volume of 39,000m³.
- A.3.10 The site history has been investigated through review of historical maps and aerial photographs, as well as mineral records held by the BGS. Details of the desktop study carried out as part of the conceptual site model (CSM) for the Project are set out in Appendix 10.6: Preliminary Risk Assessment Report (Application Document 6.3). The site is identified as a potential contamination source (medium risk) and given a reference of HLU0515 in the CSM, as the presence of filling or tipping had not been ruled out.
- A.3.11 Features visible on the DTM that might be relevant to the site history are shown in Figure 1. These include a possible access ramp on the northern boundary.
- A.3.12 The site is shown as a field on the earliest available historical map dated 1868. The gravel pit is shown excavated in the north-west corner on the 1895 map and dug out to its current extent on the 1921 edition. In 1938, a mineral railway is shown extending onto the site from the north and into the pit. No further details are known regarding this railway and it is not shown on the 1955 map.

- A.3.13 The pit appears vegetated on the 1967 map and is shown as disused by 1973. No evidence of backfilling is apparent from the historical maps or other sources. Extracts from the historical OS maps are shown in Annex C.
- A.3.14 The BGS mineral site and BritPits records (BritPit ref. 18571) show extraction of Wolstonian sand and gravel and Thanetian sand, which has now ceased, but gives no further details.
- A.3.15 The Geological Survey of Great Britain Memoir for the Dartford area dated 1924 indicates that the quarry was being worked for railway ballast at this time (Dewey, et al., 1924).

Walkover survey

General

- A.3.16 The site is a parcel of disused land that is heavily vegetated, and the ground surface is uneven. The vegetation is predominantly thick scrub and mixed woodland with small areas of open grassland.
- A.3.17 Small quantities of litter are present but no significant fly-tipping was seen. The Public Right of Way in the south of the site was signposted but heavily overgrown in places.

Boundaries

- A.3.18 The north of the site is bounded by Station Road. The boundary is heavily vegetated with remains of barbed wire and steel cable on rotted wooden fence posts opposite the industrial estate. The site is approximately 1m higher than the road level at this point.
- A.3.19 The Public Right of Way runs along the south-east boundary, beyond the ditch (Figure 2). The land rises another metre or so to the agricultural field, which appeared to be sown with grass.
- A.3.20 The west and south-west boundaries were inaccessible at the time of the survey.

Former quarry

- A.3.21 Access to the former quarry was difficult due to the vegetation, but the slopes of the side walls were visited at the points shown in Figure 2.
- A.3.22 The ground to the south-east of the quarry was irregular with a number of large ruts or scrapes, possibly indicating disturbed or filled ground from quarrying, but may also have been caused by a former use as an off-road track.
- A.3.23 The quarry wall was accessible at two points in the east and west as shown in Figure 2. The sides were estimated to be between 3m and 4m high, but vegetation has obscured the crest and toe of the slope in most places.

- A.3.24 In the east, the side had eroded to an overall angle of approximately 30 degrees, with signs of slumping and erosion of the top edge. Topsoil covered the entirety of the slope, but several eroded flint pebbles were visible. These were well-rounded to subangular, medium to coarse gravel-sized flints.
- A.3.25 Access to the north and south edges of the former quarry was not possible due to dense vegetation.

Surface water

- A.3.26 A small pond shown on OS mapping in the east of the site was heavily overgrown and there was no sign of surface water. The ground here was waterlogged and abundant reedmace was growing in the location of the pond. It may have almost completely silted up.
- A.3.27 The stream shown on the OS map running south-west from the pond was dry at the time of the survey. The ditch running south-west from here north of the public footpath gets gradually deeper to approximately 1.5m below the adjacent field in the south of the site.
- A.3.28 No other surface water was encountered apart from a small, flooded ditch in the floor of the quarry, with several discarded tyres (Annex B).

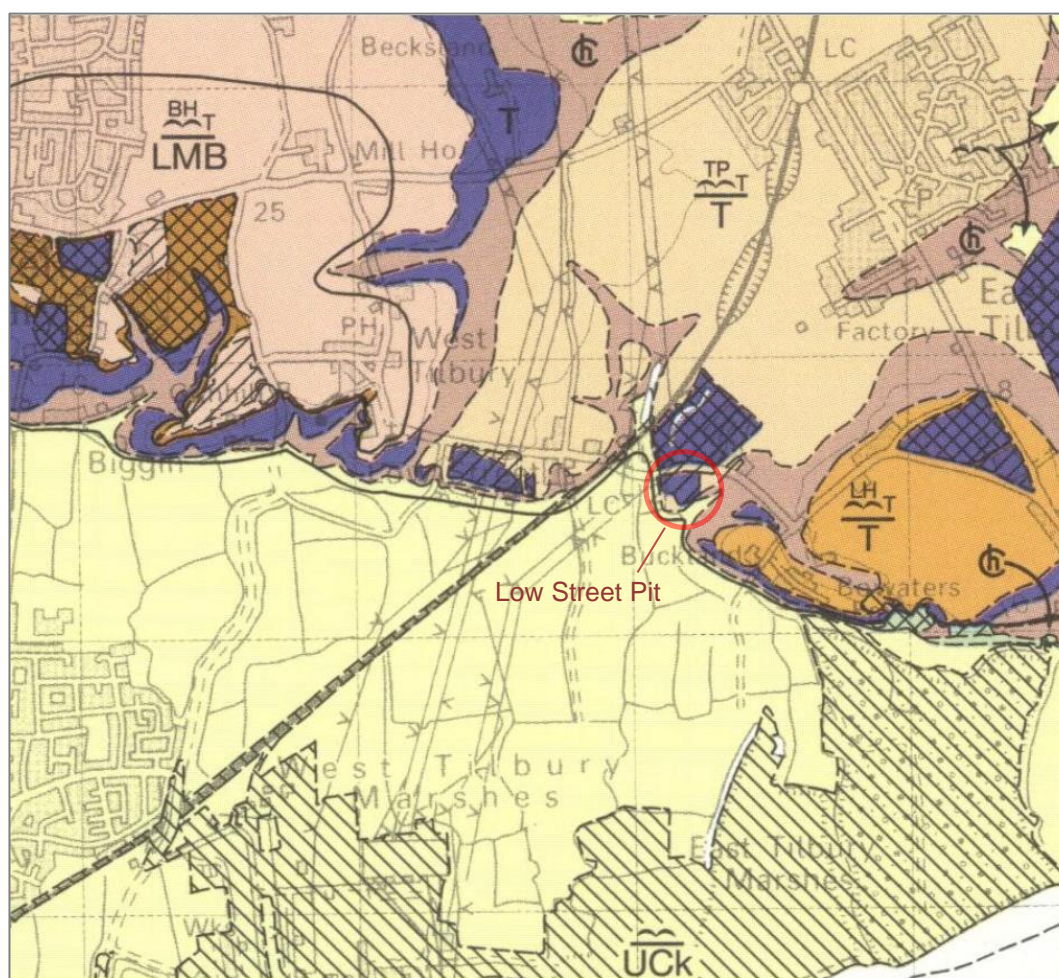
Anthropogenic/contamination


- A.3.29 No evidence of structures, hardstandings or quarry machinery was seen.
- A.3.30 Some patches of vegetation dieback were seen in the former quarry. The cause of this is unknown but a small area in the north of the site appeared burnt.
- A.3.31 Overhead electrical lines run from the east of the site opposite the industrial estate to the west over the former quarry.

Mapped geology

- A.3.32 The BGS geological map shows the superficial deposits at the site to comprise River Terrace Deposits, Alluvium and Head Deposits (Plate A.3). The Alluvium bounds the site to the south and west and extends into the site along the line of the stream on the south-east boundary.

Plate A.3 Geological map extract



(Extract from BGS Geological Map (BGS, 1998). ~: Alluvium, : Head Deposits, BH: Boyn Hill Gravel, TP: Taplow Gravel, LH: Lynch Hill Gravel, LMB: Lambeth Group, T: Thanet Formation, UCK: Upper Chalk)

- A.3.33 The Head Deposits are shown in the east of the site and underlie the pond. The lithology is given as clay in the BGS 1:10:000 superficial deposits dataset. The Head Deposits are associated with the higher ground to the south-east of the site, which is mapped by the BGS as the Lynch Hill Gravel (Corbets Tey Gravel in Gibbard (1994)).
- A.3.34 The River Terrace Deposits at the site are mapped as Taplow Gravel, but are more properly known as Mucking Gravel, which is the equivalent age as the Taplow Gravel of the Middle Thames area, but deposited further downstream (Gibbard, 1994).
- A.3.35 The River Terrace Deposits are absent within the area of the former quarry.
- A.3.36 The Lower Thames region lies within the London Basin syncline, a downward fold of the Tertiary and late Cretaceous bedrock. The sedimentary bedrock in this area generally dips northwards (Moorlock & Smith, 1991).

- A.3.37 The bedrock underlying the site is shown as the Thanet Formation, which was deposited in the late Palaeocene Epoch 58-55 million years ago in an open marine environment (BGS, 2020). The Thanet Formation is described by the BGS as pale yellowish-brown, fine-grained sand that can be clayey (soil containing clay) and glauconitic (a green-coloured mineral). A glauconite-coated, nodular flint layer is at the base of the formation.
- A.3.38 The Thanet Formation is not present to the south or west of the site, where the bedrock is shown as the underlying chalk.
- A.3.39 The geology of the site is shown on Figure 3.

Ground investigation

- A.3.40 Information from several exploratory holes around the site, from the Phase 1 and Phase 2 intrusive ground investigation works carried out for the Project and archived BGS records has been collated. The exploratory hole locations are shown on Figure 3.
- A.3.41 A brief summary of the exploratory hole log information is given below.

Alluvium and chalk

- A.3.42 Exploratory holes to the south and west of the site were BH08022, CT08006, TP08007, CT08003, BH08020, BH08019. Full details of the works carried out during the ground investigation are provided within the Land Based Works – Phase 2A Area 1 Package B Factual Report on Ground Investigation (Perfect Circle, 2020a) and the Land Based Works - Phase 2A Area 1 Package C Factual Report on Ground Investigation (Perfect Circle, 2020b).
- A.3.43 These boreholes encountered made ground up to 1m thick, overlying Alluvium to a maximum depth of 8.1m below ground level (bgl). The Alluvium was generally described as soft dark grey or brown silty organic clay with peat layers up to 1.5m thick and occasional flint and chalk gravel. Groundwater strikes were recorded at various depths below 1m bgl within the Alluvium.
- A.3.44 The Seaford Chalk Formation was encountered directly beneath the Alluvium at 5.2 to 8.1m bgl (-6.8 to -3.5m AOD), with the highest chalk and thinnest Alluvium towards the north.
- A.3.45 This confirms that the River Terrace Deposits do not extend to the south or west of the site.

Head deposits

- A.3.46 No exploratory hole records are available for this area and so the extent and thickness of the Head Deposits on the south of the site is uncertain.

Taplow/Mucking Gravel and Thanet Formation

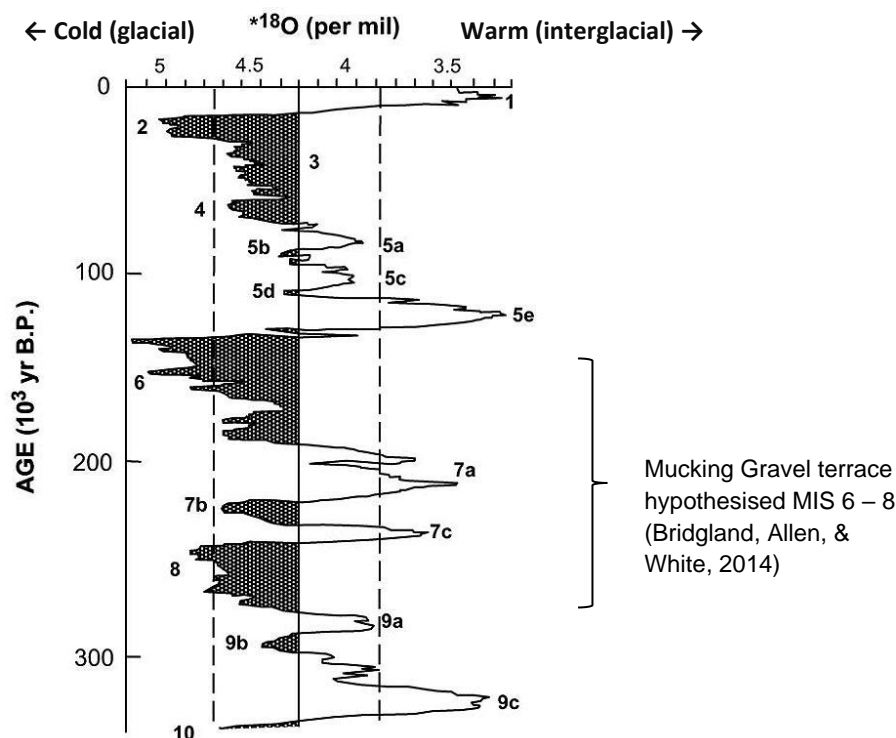
- A.3.47 BGS borehole record TQ67NE39 was sunk in 1984 and located 310m to the north of the site. It encountered 1m of topsoil and fill over 5m of 'silty sand, gravel and cobbles', labelled as River Terrace Deposits. Below this, Thanet Formation was recorded at 5.8m thick (or 2.2m if the 'grey clay' recorded is actually weathered chalk). The borehole then encountered chalk to its maximum depth of 110m bgl. It is not possible to establish levels as the ground level was not recorded. As the location is a former brickworks pit, some of the geology recorded may have been reworked natural ground.
- A.3.48 Exploratory holes near to the site within the River Terrace Deposits and the Thanet Formation for the Project's ground investigation are:
- a. WS09011, 287m north of the site
 - b. BH2612, 390m north of the site
 - c. BH2613, 445m north of the site
 - d. WS09012, 757m northwest of the site
 - e. BH09006, 780m north of the site
- A.3.49 The thickness of the River Terrace Deposits in the above locations was 4.5m to 6.8m. Most of the deposit was yellowish-brown, fine to coarse gravel sand, or subangular (with no sharp angles but not smoothly rounded) to rounded fine to coarse sandy gravel, generally of flint. The sands and gravels were silty in places and occasionally had a low flint cobble content.
- A.3.50 A slightly gravelly sandy clay layer was encountered in WS09011 at the top of the stratum, which was 0.4m thick.
- A.3.51 This indicates the Mucking Gravel is continuous to north of the site (except for the industrial estate landfills north of Station Road), with a comparable thickness with that removed from the quarry.
- A.3.52 The Thanet Formation was encountered in BH2612, BH2613 and BH09006 at -4.2, -3.2 and 6.5m AOD respectively. The top of the Thanet Formation in the base of Low Street Pit (following excavation) is approximately 1.5 to 2m AOD.

A.4 Geological context

Pleistocene history of the Lower Thames Valley

- A.4.1 The Lower Thames Valley from central London to Tilbury is an important area for understanding the Pleistocene history of southern Britain (Gibbard, 1994).
- A.4.2 The Pleistocene Epoch (from 2.6 million to 12,500 years ago) is the first part of the Quaternary Period, which also encompasses the Holocene (12,500 years ago to the present).
- A.4.3 The Pleistocene was characterised by alternating periods of cold (glacial) and temperate (interglacial) climate. The formation of the River Terrace Deposits is closely related to this cycle of glacials and interglacials (paragraph A.4.9).
- A.4.4 Repeat episodes of glaciation occurred in Britain with ice sheets extending as far south as north London during the most extensive glacial (Anglian, approximately 450,000 years ago), while the most recent glacial period (Devensian, approximately 15,000 to 11,700 years ago) saw ice advance to north Norfolk.
- A.4.5 Analysis of oxygen isotopes in benthic foraminifera recovered from marine sediment cores record periods of global cold climate (greater ice volume) and warm climate (lower ice volume). These are called Marine Isotope Stages (MIS), with glacial periods given as even numbers, ascending with age (Plate A.4). The current interglacial (the Holocene) is MIS 1, the Devensian glacial is MIS 2 to 5d.

Plate A.4 Marine isotope record



(modified from: <https://www.isu.edu/digitalgeologyidaho/glaciation/> (Idaho State University, Accessed August 2022))

- A.4.6 At the beginning of the Pleistocene, the River Thames flowed to the north of its current course, through the Vale of St Albans in Hertfordshire, and Essex, and joined the River Rhine in the current area of the North Sea. At this time, the Thames may have drained a large area of the Midlands and parts of Wales. Britain was joined to Europe via the Dover Strait during periods of low glacial stage sea level.
- A.4.7 The Thames was diverted south into approximately its present location within the London Basin Syncline (created by the Alpine Orogeny in the Eocene Epoch) during the Anglian glaciation (MIS 12, 478,000 to 424,000 years ago) (Bridgland, 1994). The discovery of glacial till underlying River Terrace Deposits (Boyn Hill Terrace) at Hornchurch Railway cutting in 1892 confirmed that the fluvial (river) deposits post-dated the glacial deposits.
- A.4.8 There is an abandoned early Thames meander at Ockendon, infilled with gravels, sands and associated deposits. The present-day Mardyke Valley occupies part of this channel.

Thames Terraces and Mucking Gravel

Formation of River Terraces

- A.4.9 Terraces are formed when a river channel erodes downwards into its floodplain, leaving an area of the former floodplain as a terrace. Terraces are relatively flat areas separated by low scarp slopes (terrace risers) forming a 'staircase' of river terraces which get progressively younger towards the valley floor.
- A.4.10 The phases of floodplain deposition (aggradation) and downcutting (erosion) are regulated by climatic variables such as temperature, precipitation, ice melt and vegetation growth. These affect the energy of the river flow and the available sediment load. Tectonic uplift is also required to allow downcutting during erosional periods (Bridgland, 2006).
- A.4.11 Eustatic changes (relative sea level) can also lead to downcutting and terrace formation, although this is not thought to be important in north-west Europe due to the wide continental shelves. There is evidence that terrace formation in many places was synchronised with Milankovitch-scale climate fluctuation (i.e. the main 100,000 year glacial-interglacial cycles) (Bridgland, 2000).
- A.4.12 The deposition phase occurred during warming periods, where large volumes of glacial meltwater provided enough energy to transport coarse sand and gravel material and deposit it within braided river environments.
- A.4.13 During cold stages, rates of river erosion and aggregation were higher, due to increased spring melt and less vegetation producing higher flows and sediment loads.
- A.4.14 Subsequent erosion and reworking of material may have taken place due to periglacial erosion of the slopes, and the terrace surfaces have been heavily modified in many places by later human activity, such as development or quarrying.
- A.4.15 A more detailed model of terrace formation for the River Thames, suggested by Bridgland (2000), is summarised in Annex D.

Importance and correlations

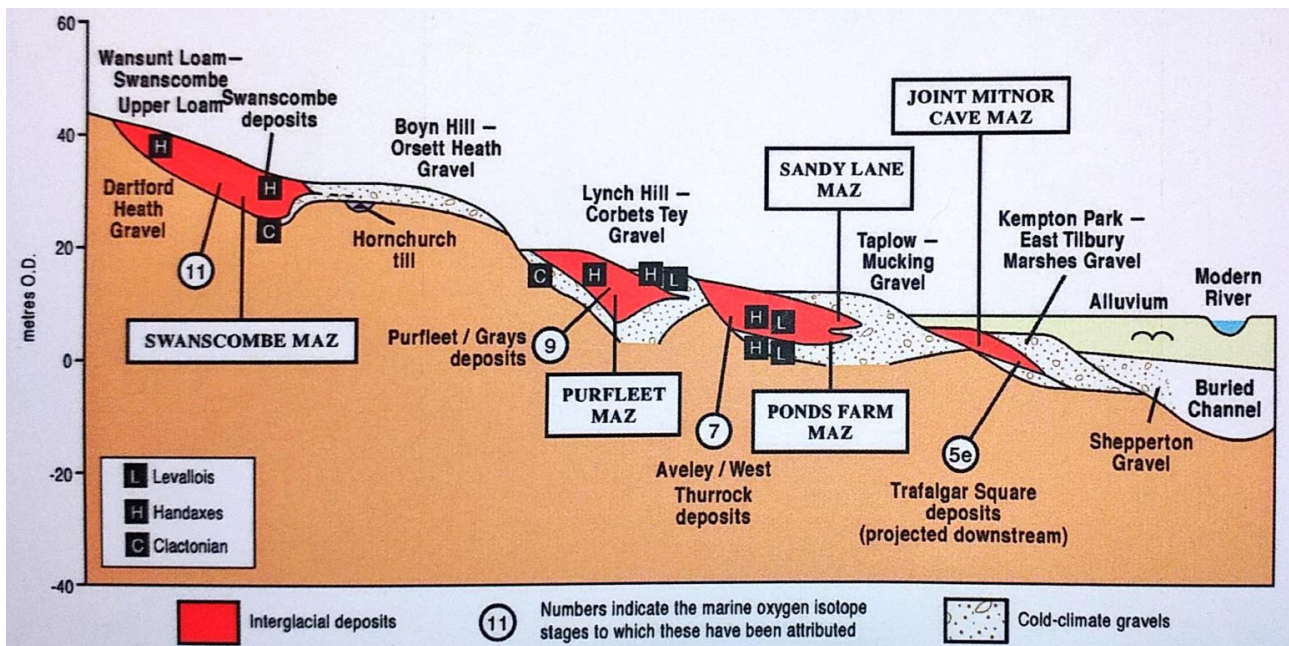
- A.4.16 The River Thames is a large river system and in its current course has been beyond the maximum extent of most glaciations. It is therefore more preserved and continuous than river valleys further north, with deposits throughout the Pleistocene. This makes it an important site for understanding environmental change and enabling a correlation between the terrestrial stratigraphy and the global temperature record (Bridgland, 1994).

- A.4.17 The river terraces formed over the past 300,000 years in the Thames Valley include important fossiliferous and archaeological (Palaeolithic) sites (Gibbard, 1994). Palaeolithic artefacts such as hand axes, dating from the earliest human habitation of the UK, are often found in River Terrace Deposits.
- A.4.18 The order and relative age of the terraces, their deposition and erosional history, are a subject of ongoing research. This focuses on correlating the terraces with the global MIS record and other European sites, using biostratigraphy evidence such as fossils (Mollusca amino-acid sequencing and vertebrates) and pollen analysis of interglacial deposits (Bridgland, Allen, & White, 2014).

Thames terrace sequence

- A.4.19 Various naming systems have been used to map the terraces along the Thames. These have been superseded as further research is carried out on the extent and interrelationship between different terrace deposits.
- A.4.20 The former BGS geological map for Dartford and Romford shows the River Terrace Deposits divided into Boyn Hill Gravel (upper), Taplow Gravel (middle) and Floodplain Gravel (lower), based on work carried out for the Middle Thames. However, the correlation with the Lower Thames gravels has been shown to be incorrect, and local names adopted instead (Moorlock & Smith, 1991).
- A.4.21 The Mucking Gravel is the downstream equivalent of the Taplow Gravel of the Middle Thames, which has been correlated on the basis of gradient and stratigraphical position. A gradient of 25–30cm km⁻¹ is suggested (Gibbard, 1994).
- A.4.22 An idealised section through the Lower Thames terraces is presented in Plate A.5, which shows the Taplow-Mucking Gravel as the first terrace exposed above the modern alluvial floodplain. Interglacial deposits are shown at the northern end of the terrace.

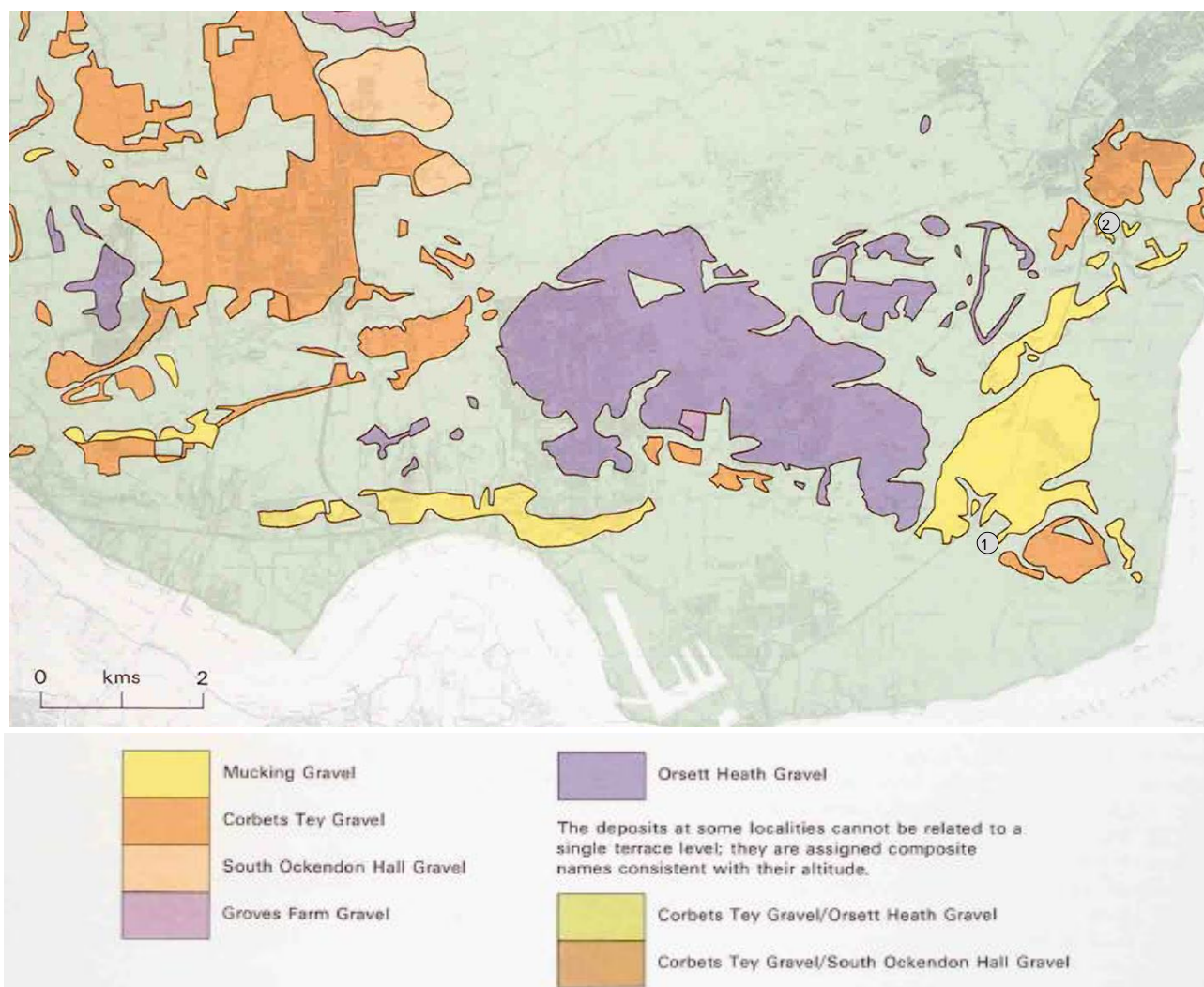
Plate A.5 Idealised terrace sequence in Lower Thames



From (Bridgland, Allen, & White, 2014)

- A.4.23 The type section for the Mucking Gravel is a large gravel pit near Mucking, approximately 4.3km to the north-east of the site (Plate 4.3). The deposit was described as medium gravels in a sand matrix, 5m thick, resting on bedrock. The bedding units are horizontal and 50cm thick, and separated in places by sand bands or shallow sand channel fillings 15-20cm thick. The basal zone includes some boulder-sized clasts (fragments) of flint or sarsan, up to 2m in diameter. A palaeocurrent flow direction of north-east to east was given, but the absence of cross-bedding at this location means this is difficult to determine (Gibbard, 1994).
- A.4.24 The lithology of the gravel component in the Mucking Gravel comprises 90-94% flint, 2-9% vein quartz, 0-2.5% quartzite, and 0-3.5% Greensand Chert (Gibbard, 1994).
- A.4.25 The extent of the Mucking Gravel and other Thames terraces is shown in Plate A.6 below.

Plate A.6 Current terrace distribution in the northern Lower Thames Valley



Extract from (Moorlock & Smith, 1991) (1): Low Street Pit, (2): Mucking Marshes (type location)

Published references to Low Street Pit

- A.4.26 The only direct mention of the site in the literature sources reviewed was Dewey (Dewey, et al., 1924). An extract is below:
- A.4.27 *'East of Low Street Station a small patch of gravel rises steeply from the level of the alluvium to a height of about ten ft. This gravel has been worked in large pits, now mostly overgrown, on either side of the road to East Tilbury. One to south of the road is being worked for railway ballast, and shows twelve ft. [3.7m] of sand and gravel containing some large flints, resting on the Thanet Sand.'* (Dewey, et al., 1924).
- A.4.28 The location and depth of the pit described are a good match to the site. The former Low Street Station is now demolished and was shown on historical maps from 1861 to 1967 where Station Road crosses the Tilbury and Southend Railway, 180m west of the site (NGR 566900, 177580). A full description is provided in the Preliminary Risk Assessment (Appendix 10.6, Application Document 6.3).

A.5 Site designation and features of interest

Geoconservation overview

- A.5.1 Geoconservation is the preservation of geodiversity (Bridgland, Allen, & White, 2014). Geodiversity is the variety of rocks, fossils, minerals, natural processes, landforms and soils that underlie and determine the character of our landscape and environment (UKGAP, n.d.). Geoconservation in the UK is primarily achieved through designation of important sites.
- A.5.2 Geological sites of national importance are designated as Sites of Special Scientific Interest (SSSI) and regulated by Natural England.
- A.5.3 Sites of regional, rather than national, importance can be designated as LGSs. These are analogous to Local Wildlife Sites for biodiversity importance. LGS superseded the Regionally Important Geological Site (RIGS) designation, which is still used in some areas and can be considered analogous.
- A.5.4 While owners of SSSI sites have a legal duty under the Wildlife and Countryside Act 1981 to maintain the geological interest(s) of the site, there are no such obligations on owners of LGS (SERC, n.d.). However, locally designated sites are of material consideration in planning decisions, and potential effects on these sites from highways projects must be assessed against the requirements set out in DMRB LA109 (Highways England, 2019).
- A.5.5 Potential LGS are identified by local organisations, using local criteria that are set using national guidelines from the Department for Environment, Food and Rural Affairs (Defra). Notification of these sites to the Local Planning Authority formalises the site as an LGS.
- A.5.6 The selection criteria, targets and thresholds for RIGS/LGS vary by local area but are generally based on four criteria as in the Local Sites: Guidance on their identification, selection and management document (Defra, 2006):
- a. The value of a site for educational purposes in life-long learning
 - b. The value of a site for study by both professional and amateur Earth scientists
 - c. The historical value of a site in terms of important advances in Earth science knowledge, events or human exploitation
 - d. The aesthetic value of a site in the landscape, particularly in relation to promoting public awareness and appreciation of earth sciences

- A.5.7 GeoEssex, a not-for-profit partnership of Essex Field Club, the Essex Rock & Mineral Society and others, is the local organisation responsible for geoconservation in Essex. It has produced a Local Geodiversity Action Plan (LGAP), which sets out broad objectives for managing geodiversity sites in Essex (GeoEssex, 2013). The LGAP states that a condensed list of criteria for assessing potential LGS in Essex has been established, however these are not provided in the document.
- A.5.8 The process of identifying sites in Essex for LGS notification is still ongoing, however, the Essex Field Club maintain a list of potential LGS and other sites of geological interest on its website (Essex Field Club, 2020b). Low Street Pit is not formally designated as a LGS but is identified as a potential LGS.
- A.5.9 The Lower Thames Valley is an important area for Quaternary geoconservation due to the relatively comprehensive age range of the fluvial deposits (Bridgland, Allen, & White, 2014). Valleys further north are more affected by erosion during glacials and therefore older deposits are less likely to be preserved. The history of quarrying in the area has enabled scientific research going back to the late 19th Century. Several sites in the Thurrock area (including Globe Pit and Purfleet Chalk Pit) were selected for SSSI status during the Geoconservation Review (GCR).
- A.5.10 The revised Earth Science Conservation Classification (ESCC) system identifies three main categories of site (English Nature, 2006):
- a. **Exposure/extensive:** contain geological features that are relatively extensive beneath the surface so that removal does not cause significant depletion.
 - b. **Finite:** geological features that are limited in extent so that removal may damage or destroy the resource.
 - c. **Integrity:** a landform (geomorphological) or active process site.
- A.5.11 Most of the quaternary sites in the Lower Thames are classified as finite, as River Terrace Deposits are laterally and vertically limited in extent (Bridgland, Allen, & White, 2014). While quarrying has produced many of the exposures used for research, over-extraction is a threat to finite sites.
- A.5.12 Quaternary sites are also threatened by neglect. This includes build-up of talus, vegetation, and fly-tipping, which can obscure and prevent access to exposures. Flooding can also be an issue for some sites (Bridgland, Allen, & White, 2014)

- A.5.13 Due to the unconsolidated nature of the deposits, steep slopes are inherently unstable and prone to slumping or collapse and may need regular reshaping. For this reason it is suggested that sites are kept accessible for research rather than being exposed (Bridgland, Allen, & White, 2014).
- A.5.14 This may, for example, involve maintaining conservation sections with a slope angle less than the angle of repose, to minimise movement, with minimal, shallow-rooted vegetation to stabilise the slope surface. Sufficient space around the section should be maintained to enable future access for re-excavation and study of temporary exposures. The conservation potential of the site is in Section A.6.

Features of interest at Low Street Pit

- A.5.15 Considering the information presented in Section A.0, and the general criteria in Section A.4, the features of interest at the Low Street Pit site are the Mucking Gravel, and its lithology, stratigraphy, and sedimentary fabric.
- A.5.16 The exposure of the Thanet Formation at the base of the pit where the Mucking Gravel has been removed is not considered a feature of interest and has no geoconservation importance.
- A.5.17 The geoconservation value of the site is discussed in in Table A.1, in relation to the geoconservation criteria. It is for the local geoconservation group (GeoEssex) to determine, based on its criteria, whether the site qualifies as an LGS.

Table A.1 Geoconservation criteria

Criteria	Observations on Low Street Pit
The value of a site for educational purposes in life-long learning.	Limited potential for public engagement due to the minor extent and significance of the site. Difficulties in preserving permanent exposures in soft ground may limit educational value.
The value of a site for study by both professional and amateur Earth scientists.	The site may be valuable as part of a wider network of areas for studying the Pleistocene history of the Lower Thames.
The historical value of a site in terms of important advances in Earth science knowledge, events or human exploitation.	The site has been briefly described in the literature but is not associated with important advances in knowledge.
The aesthetic value of a site in the landscape, particularly in relation to promoting public awareness and an appreciation of Earth sciences.	The site has no aesthetic value in its current condition and has no potential to form a significant feature in the landscape due to its limited extent.

Extent of the Mucking Gravel at Low Street

- A.5.18 Geological mapping, supported by ground investigation indicates that the site is at the southern limit of the river terrace. So it is questionable how much Mucking Gravel remains within the site around the former quarry.
- A.5.19 Mucking Gravel is not present to the south, east or west of the site. It is shown on geological mapping extending 1.5km to the north of the site, although the site itself is constrained by Station Road and the industrial estate, where the Mucking Gravel has been extracted and backfilled.

Significance and alternative sites

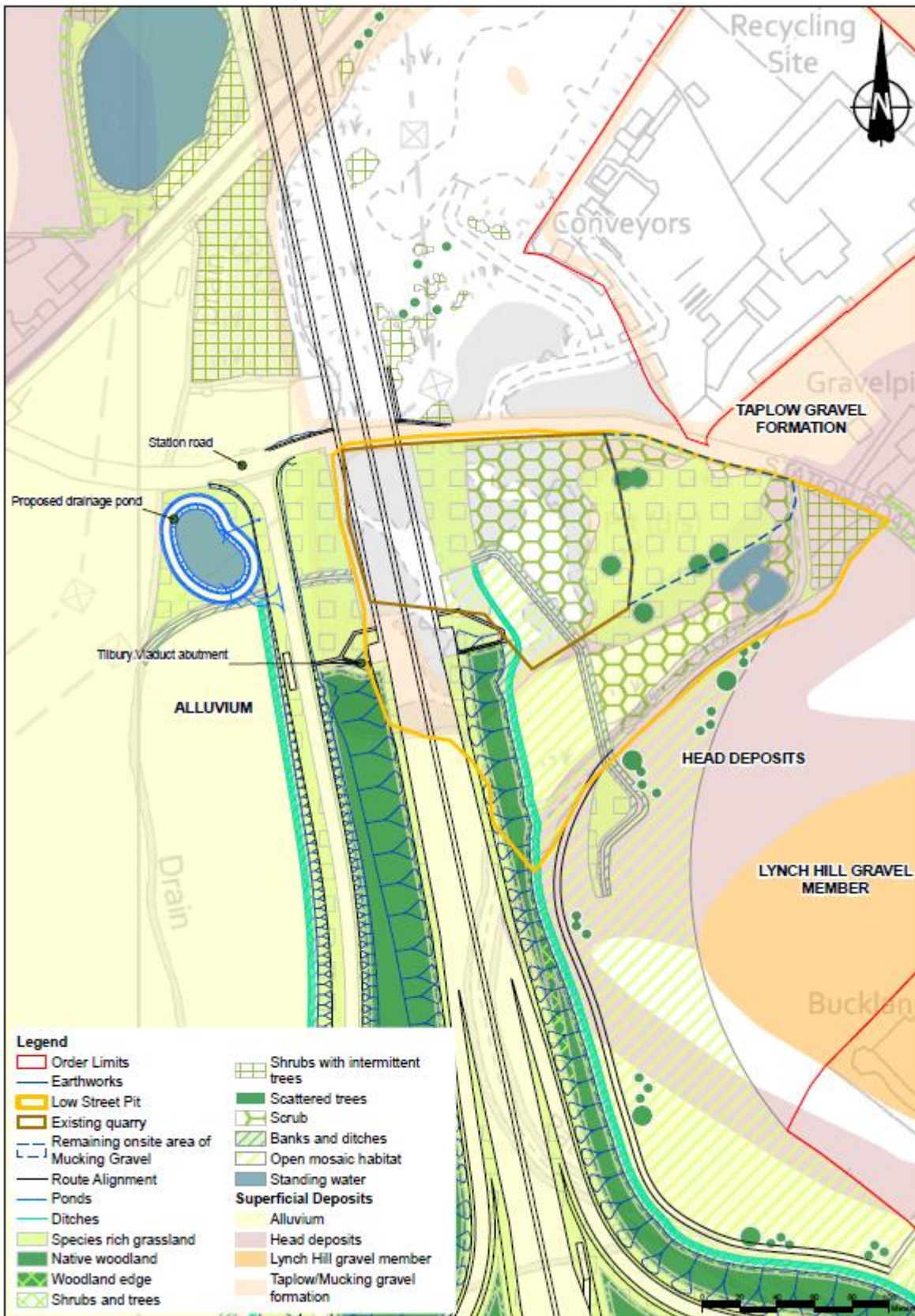
- A.5.20 The site represents only about 1% of the area mapped as Taplow Gravel, although access for study is only possible in the limited existing exposures.
- A.5.21 The older the terrace unit, the less likely it is to have been widely preserved (JNCC, 1996). The Mucking Gravel represents the third youngest terrace in the Lower Thames Valley (Bridgland, Allen, & White, 2014). The Essex Field Club website lists the following sites as exposures of Mucking Gravel:
- a. Stanford Warren Angling Lakes/Mucking Marshes (TQ 689815) (type location), approximately 4.3km northeast of the site.
 - b. Turner Farm Gravel Pit (TQ 677801) (potential LGS), approximately 2.6km north of the site.
- A.5.22 These sites may have better exposures of the Mucking Gravel terrace. However, terraces often comprise several interbedded and laterally discontinuous deposits representing different stages in the glacial-interglacial cycle, and therefore multiple sites are required to characterise the terrace.
- A.5.23 In conclusion, the site represents a limited former exposure of the feature of interest (Mucking Gravel):
- a. Most of the deposit on the site has likely already been extracted and the site is therefore a finite one.
 - b. The site is in poor condition due to neglect and not currently accessible for research.
 - c. There is no potential for further exposures to the north, south or west of the former quarry.
 - d. There may be scope for additional exposures within the site to the east of the former quarry based on mapping. However, there is no ground investigation data confirming the quantity of material remaining in this area.
 - e. The site may be useful as part of a wider network of quaternary sites in understanding the Palaeo-environmental history of the Lower Thames area.

A.6 Project design and effects

Proposed construction

- A.6.1 A brief description of the Project in the area surrounding the site is given below and shown in Plate A.7.
- A.6.2 The main carriageway is on an embankment in the south of the site and the southern abutment of the Tilbury Viaduct is located at the south of the former quarry within the site. The viaduct extends over Station Road to the north of the site, supported by concrete piers.
- A.6.3 Two link roads connect Station Road with the main carriageway. These are on embankments either side of the viaduct through the site. Part of the quarry void will need to be infilled to support the link road embankments.
- A.6.4 The whole of the Low Street Pit site is identified as a construction area for the construction of the viaduct, embankments, and ponds. This may also require the former quarry to be infilled.

Plate A.7 Proposed construction at Low Street Pit



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Summary and conclusions

- A.6.5 Due to the current poor condition of the site, and the location of the proposed viaduct structure over the former quarry, it is not expected that the permanent works (embankments and viaduct) would have an adverse effect on the features of interest. This is because the Mucking Gravel has been almost completely removed from the west of the site.
- A.6.6 The temporary works for access and the construction compounds, and restoration and landscaping of the of the site may, however, lead to a loss of future access for geological research there which would be an adverse impact.
- A.6.7 Proposed mitigation measures to address the potential effects of the Project on the site are given in Chapter 10: Geology and Soils of the Environmental Statement (Application Document 6.1).

A.7 References

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Annex B Walkover survey photographs

Plate B.1 Pond in east of site



Plate B.2 North-east area of site



Plate B.3 Bank to south of site



Plate B.4 Ditch in base of quarry



Plate B.5 Eastern quarry slope



Plate B.6 Eastern quarry slope material



Plate B.7 Area of vegetation dieback



Annex C Historical maps and photographs

Plate C.1 Extract from Ordnance Survey 1:10,560 sheet dated 1865

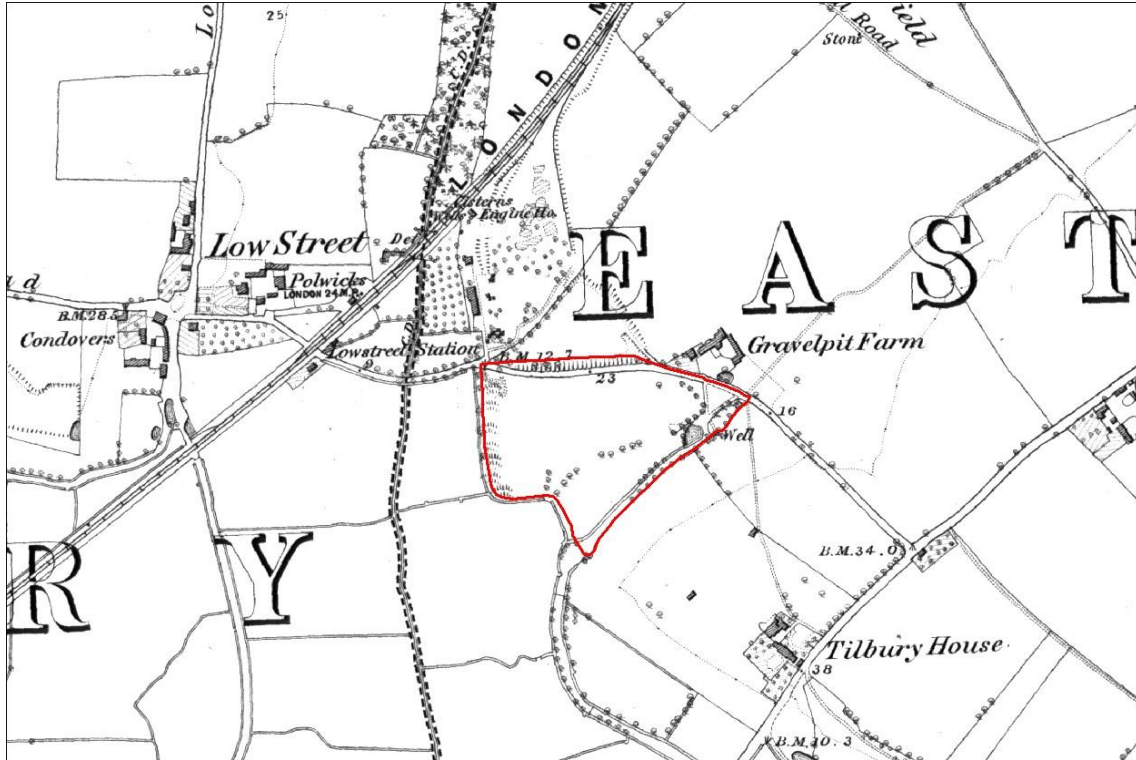


Plate C.2 Extract from Ordnance Survey 1:10,560 sheet dated 1895

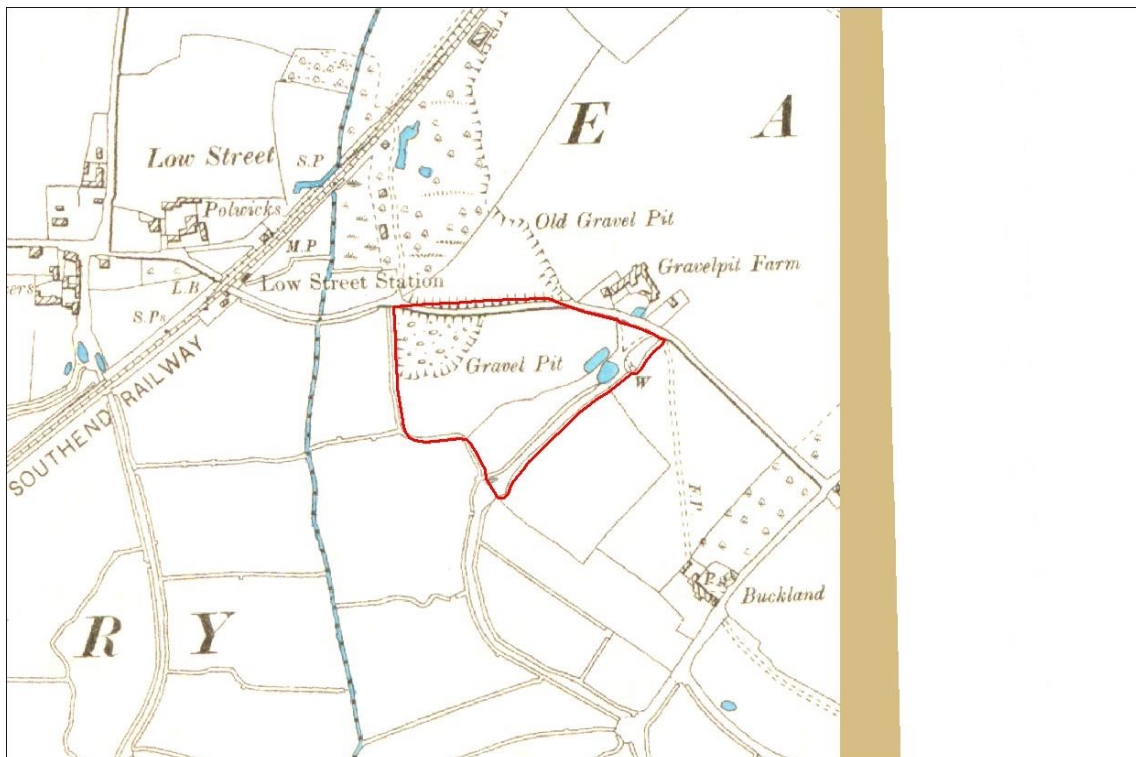


Plate C.3 Extract from Ordnance Survey 1:10,560 sheet dated 1898

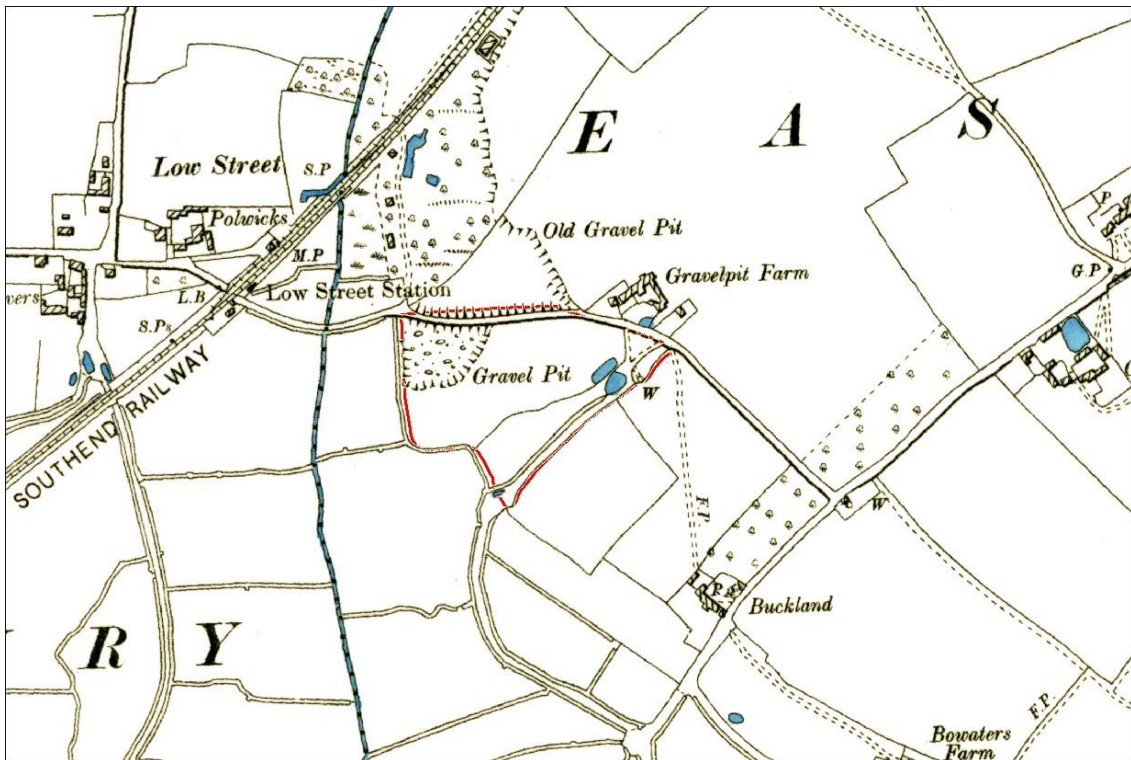


Plate C.4 Extract from Ordnance Survey 1:10,560 sheet dated 1921

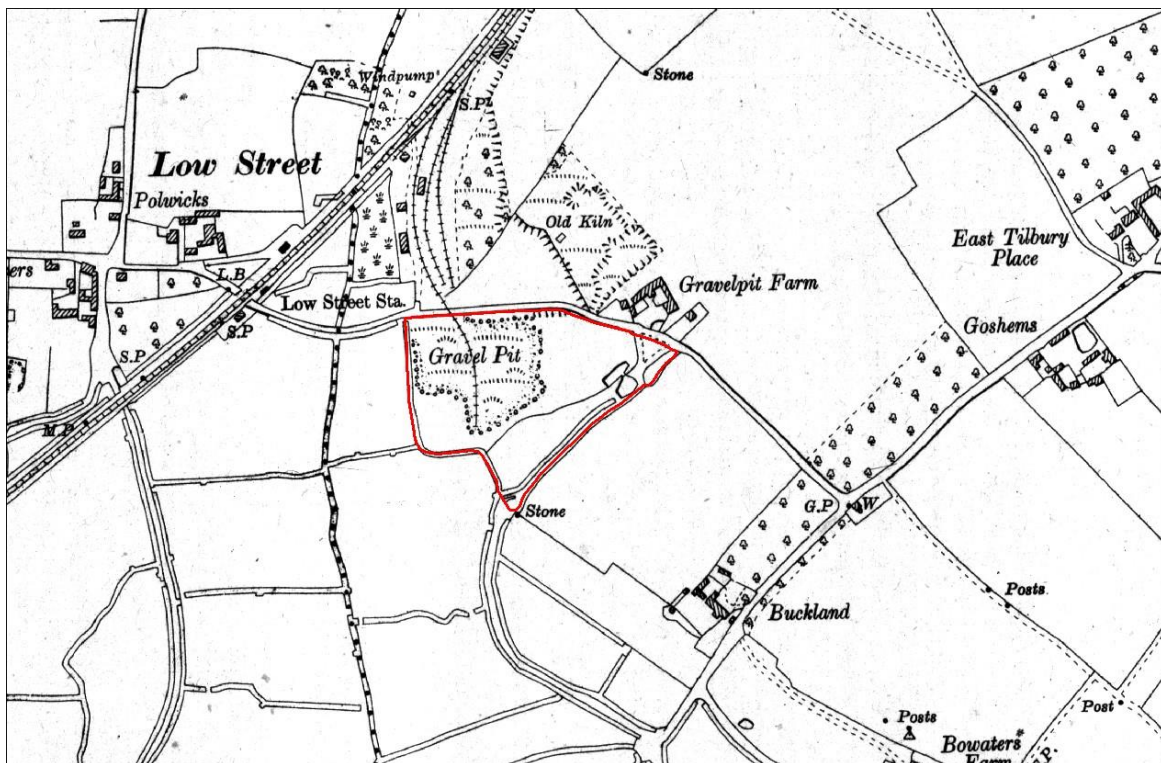


Plate C.5 Extract from Ordnance Survey 1:10,560 sheet dated 1923

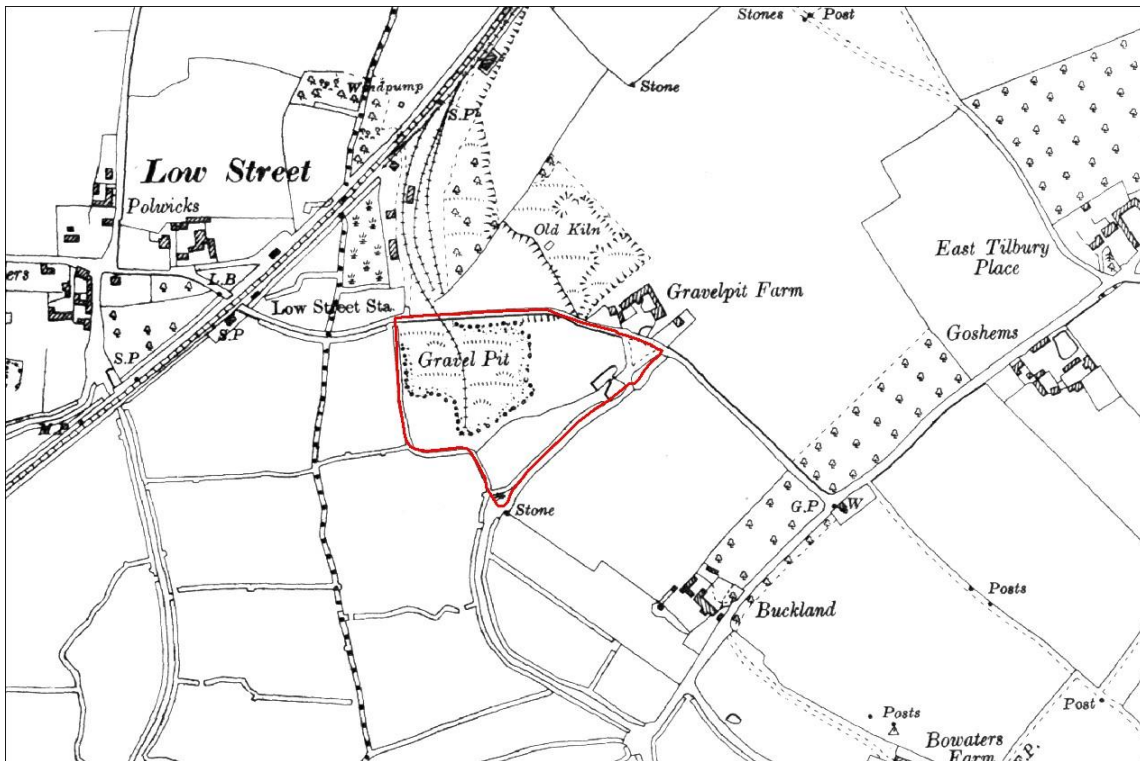


Plate C.6 Extract from Ordnance Survey 1:10,560 sheet dated 1938

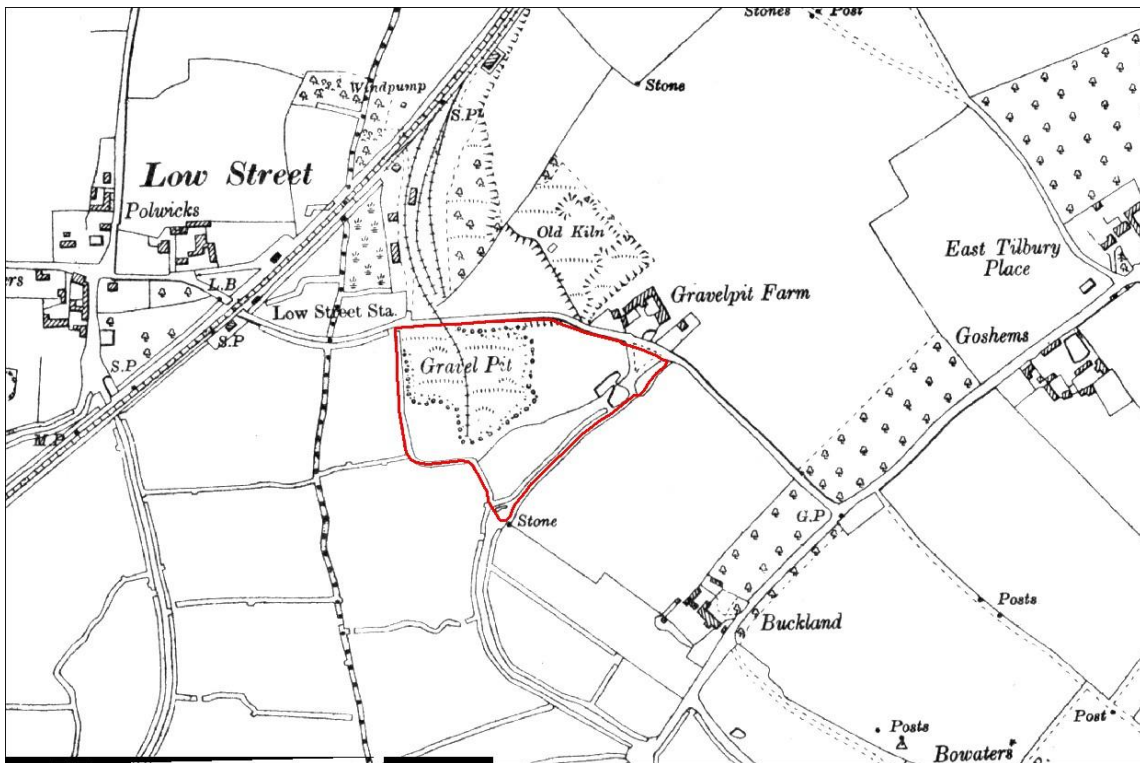


Plate C.7 Extract from Ordnance Survey 1:10,560 sheet dated 1955

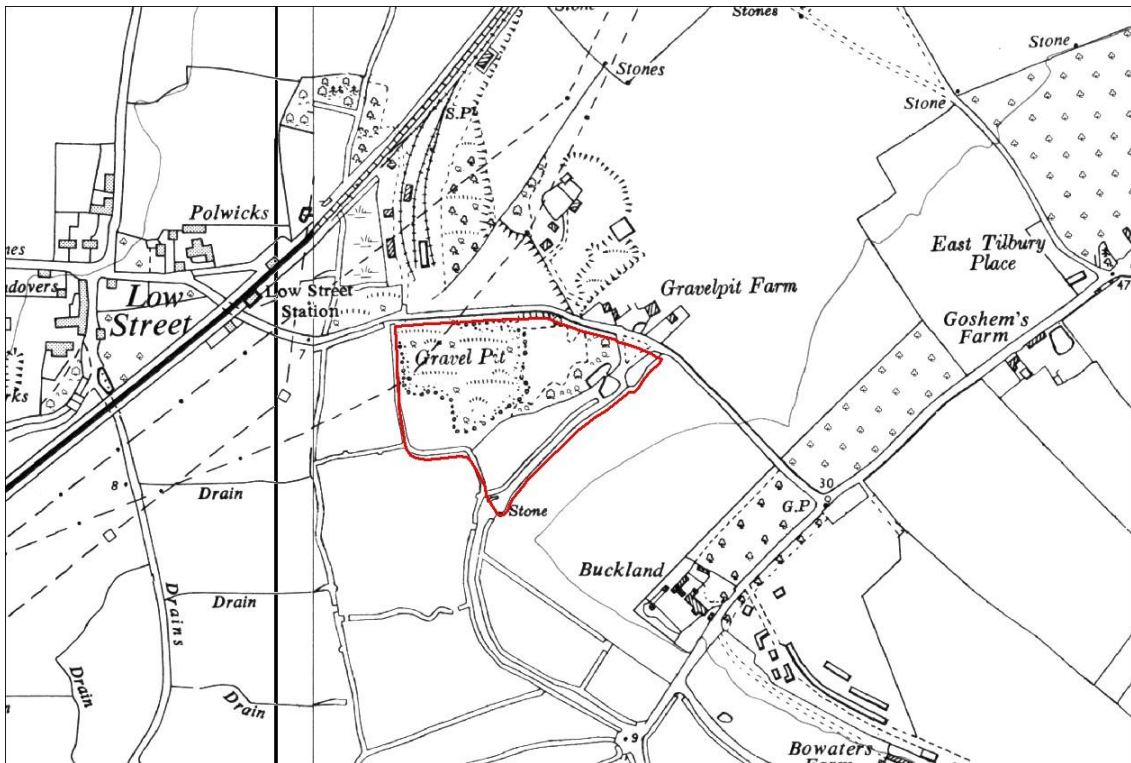
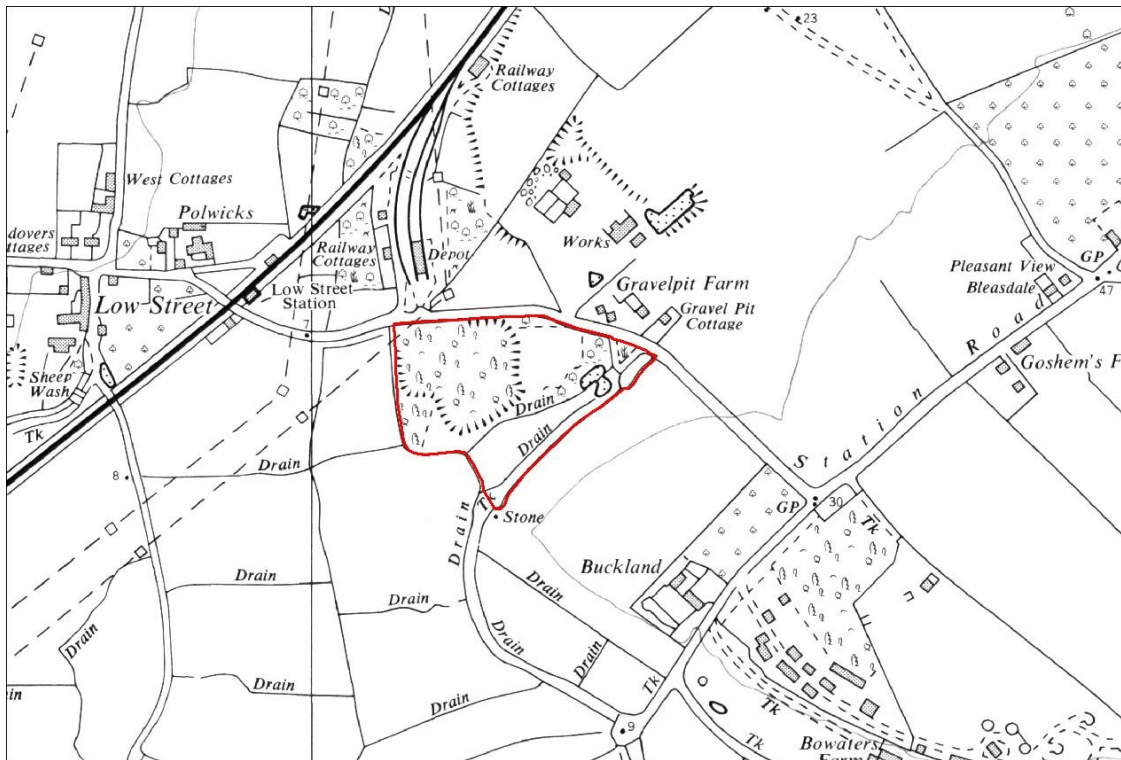


Plate C.8 Extract from Ordnance Survey 1:10,000 sheet dated 1967



Annex D River Terrace formation (after Bridgland, 1994)

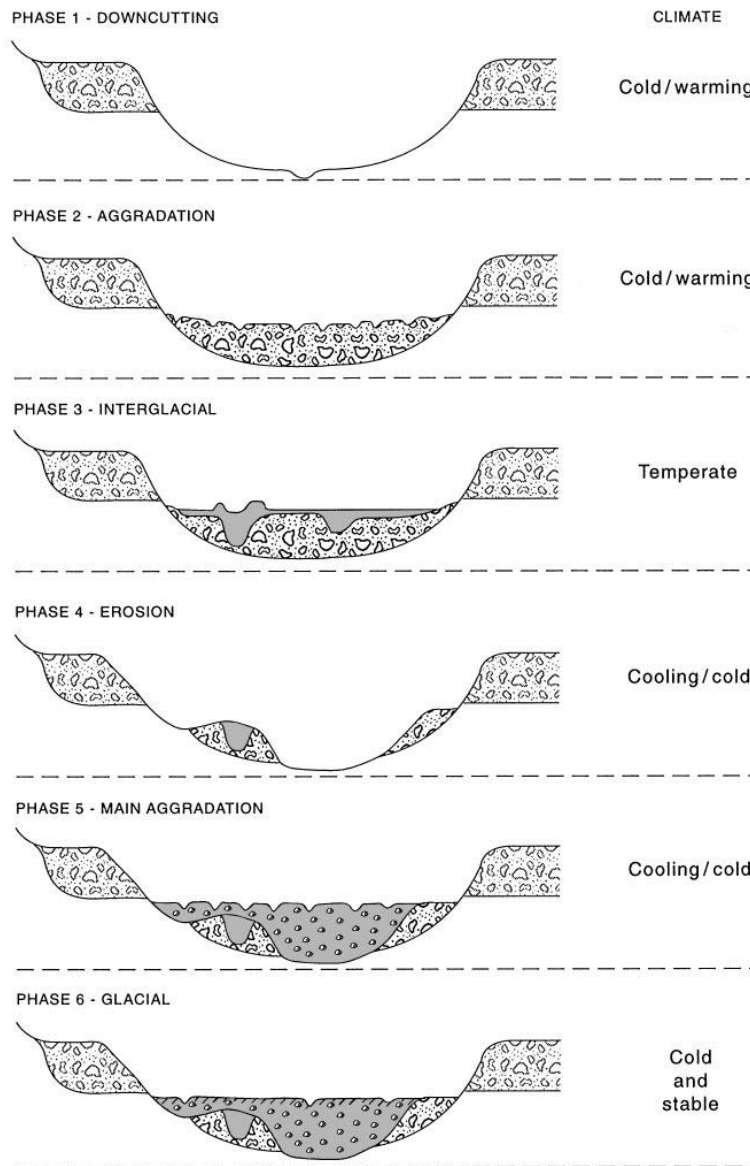
D.1.1 A six-phase model of terrace formation in relation to glacial cycles is given in Bridgland (2000) (Plate D.1) and is summarised below.

GLACIAL	Following a glacial maximum, vast quantities of meltwater from the ice sheet erode adjacent surfaces and downcutting occurs, forming a terrace. Downcutting continues to the new base level generated by uplift.
Warming/melting	When sedimentation starts to exceed erosion rates as melting slows towards the end of the glacial half-cycle, aggregation of coarse sediment in braided river channels occurs, forming a new floodplain surface below the old terrace.
	During the warm interglacial phase, fine sediment is deposited on top of the coarse sediment by less powerful, single channel rivers. Deposits are thicker in the channel bed but overbank deposits cover the floodplain.
INTERGLACIAL	A further phase of incision due to cooling climate conditions. As interglacials are short, there has not been enough uplift since phase to generate new terraces in this phase
Cooling	Large quantities of sediment are deposited (main aggregation) during cooling transition period to glacial climate (due to cooling temperatures, vegetation dies back and enables greater erosion of sediment). River is generally in braided form.
GLACIAL	Glacial stage – no aggregation or incision as area is in periglacial climate and minimal fluvial activity, as most water locked up in ice sheets or permafrost. Uplift continues during longer glacial stage.

D.1.2 Terraces are not formed during every glacial-interglacial cycle – as not enough uplift has occurred – as shown by interglacial deposits within terrace sequences. Tectonic uplift is posited to relate to gradual long-term isostatic adjustment due to rock erosion (Bridgland, 1994).

D.1.3 Aggregation occurs both at the beginning and end of the glacial, with the latter being the main episode. Downcutting occurs from when the ice starts to melt at the end of the glacial.

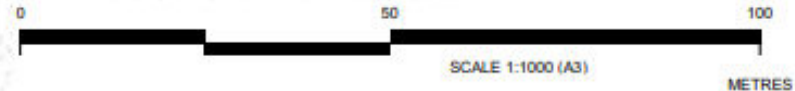
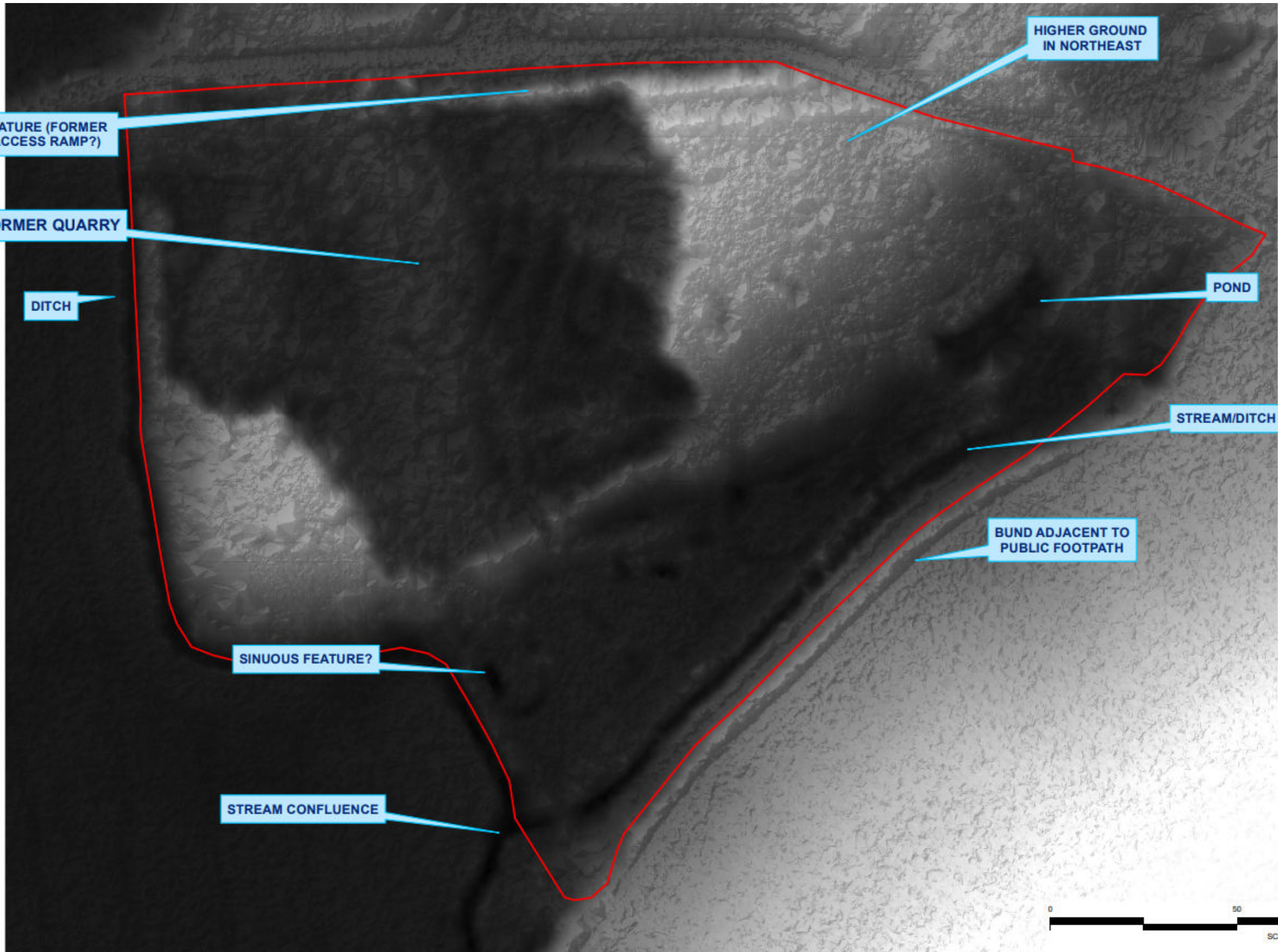
Plate D.1 River Terrace Formation



D.1.4 During interglacials (phase iii), sea level rise flooded lower reaches and led to deposition of fine-grained estuarine deposits, above the cold-stage sands and gravels, such as in the Lower Thame Valley

D.1.5 Sand and gravel from the aggregation phases ii and iv, and fine-grained sediment from phase iii may form a bedded deposit, or it may be stacked laterally due to the different depositional environments within the floodplain. Each terrace may therefore contain the interglacial sediment and the sand and gravel deposits associated with the end of one glacial and the start of the next. This can complicate the chrono-stratigraphy as if the interglacial sediments are absent the glacial sediments are indistinguishable, despite being under the same terrace surface and possibly identical elevations. So it is important to investigate the entire sedimentary sequence within each terrace (Bridgland, 1994).

Figures

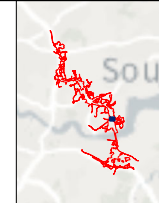


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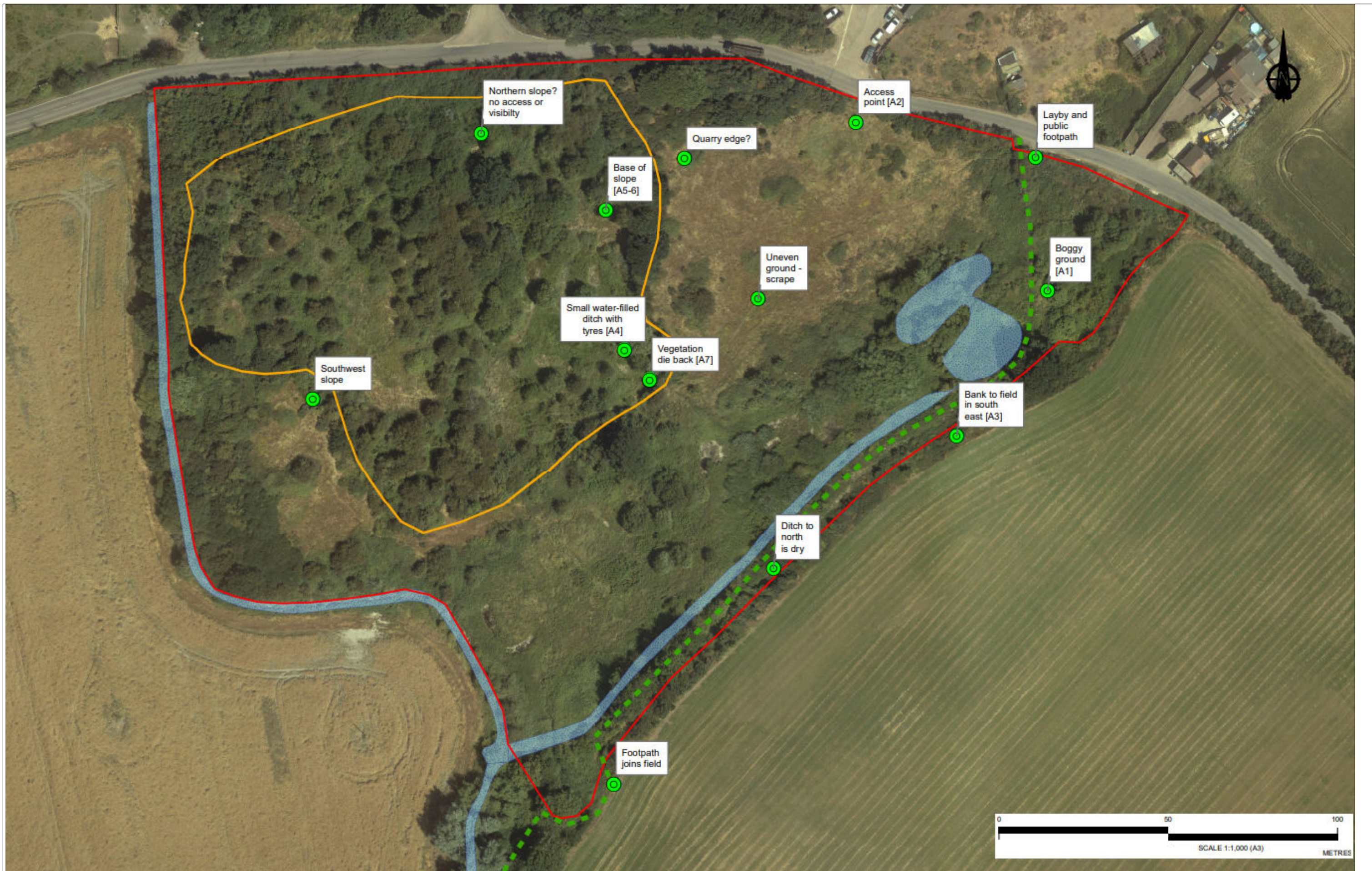
Legend
 DTM - Composite LiDAR data Site Boundary
 mAOD
 High : 12.276
 Low : 0.346



Client

 Project
LOWER THAMES CROSSING

Status	DCO APPLICATION	Original Size	A3	Revision	P01
Application Document Number	TR010032/APP/6.3	Scale			
Drawing Title	Low Street Pit Local Geological Site Figure 1 - Digital Terrain Model				
Drawing Number	HE540039-CJV-GEN-GEN-MAP-GEO-00224				



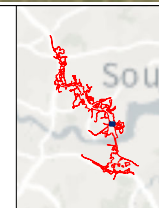
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Legend

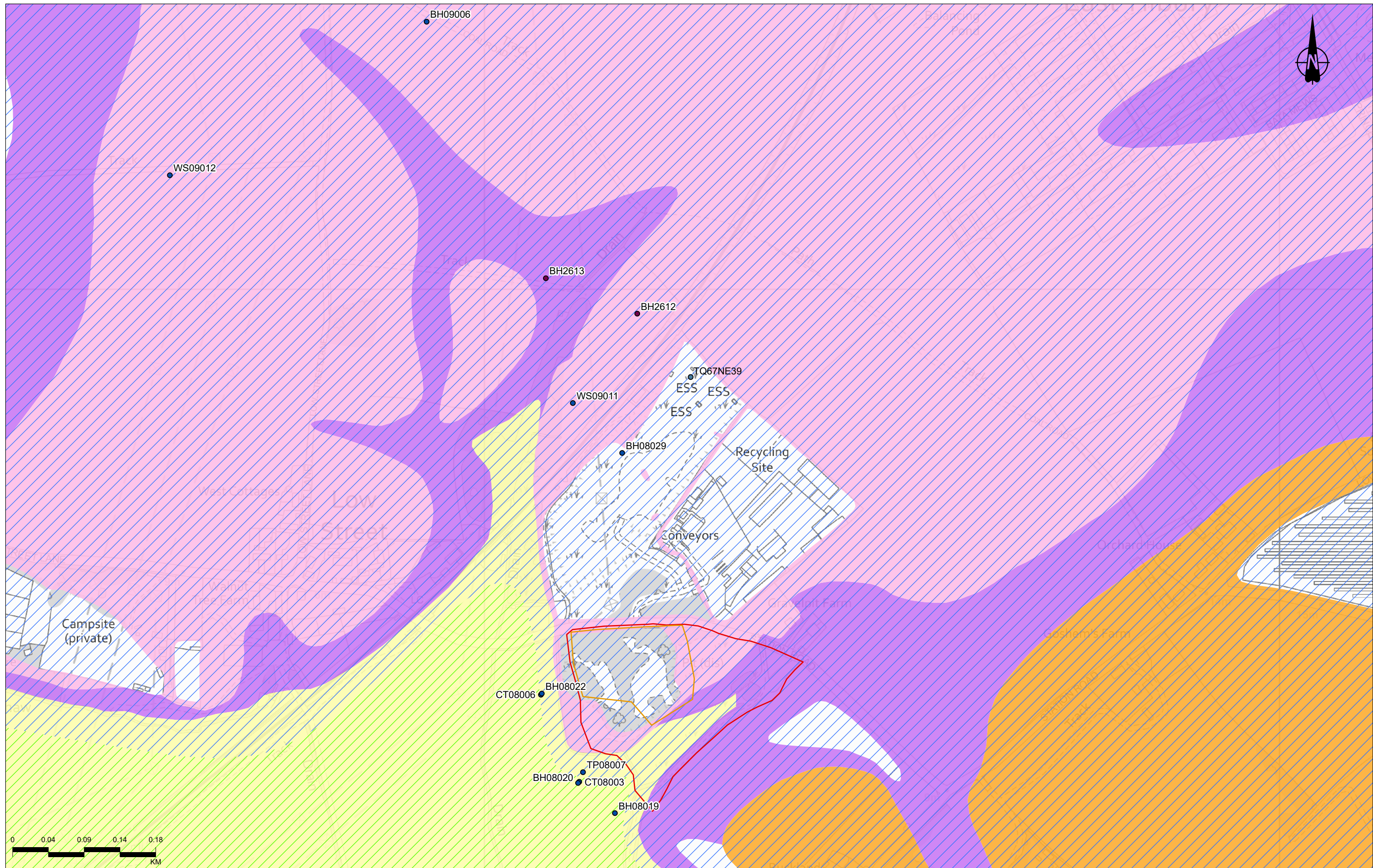
	Walkover Survey Point [Appendix A photo]		Approximate Quarry Extents
	Right of Way		Site Boundary
	Surface Water Features (from OS map)		



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LOWER THAMES CROSSING

Status	DCO APPLICATION	Original Size	A3	Revision	P01
Application Document Number	TR010032/APP/6.3	Scale	1:1,000		
Drawing Title	Low Street Pit Local Geological Site Figure 2 - Site Layout and Walkover Survey				
Drawing Number	HE540039-CJV-GEN-GEN-MAP-GEO-00225				

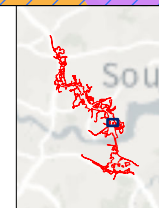


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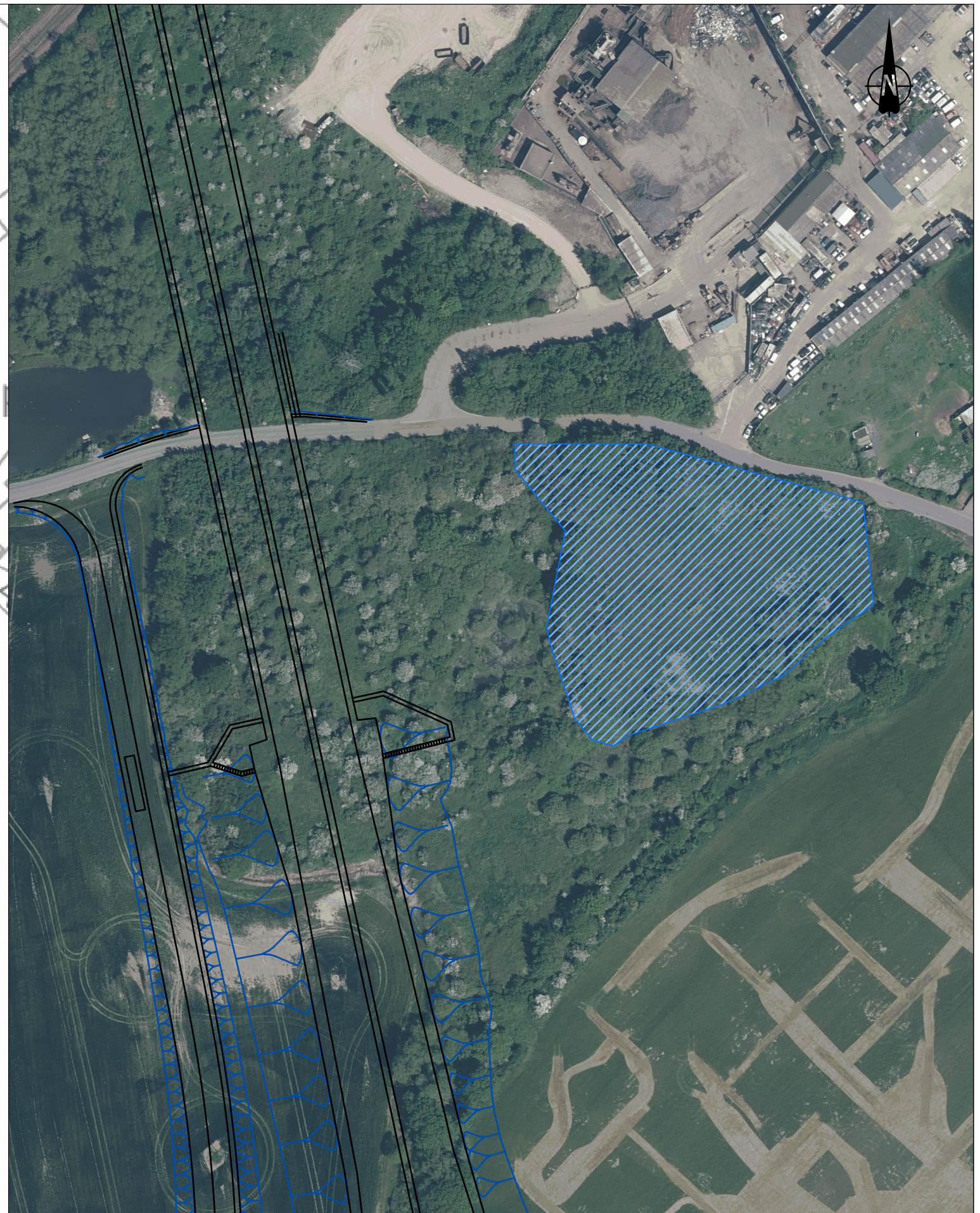
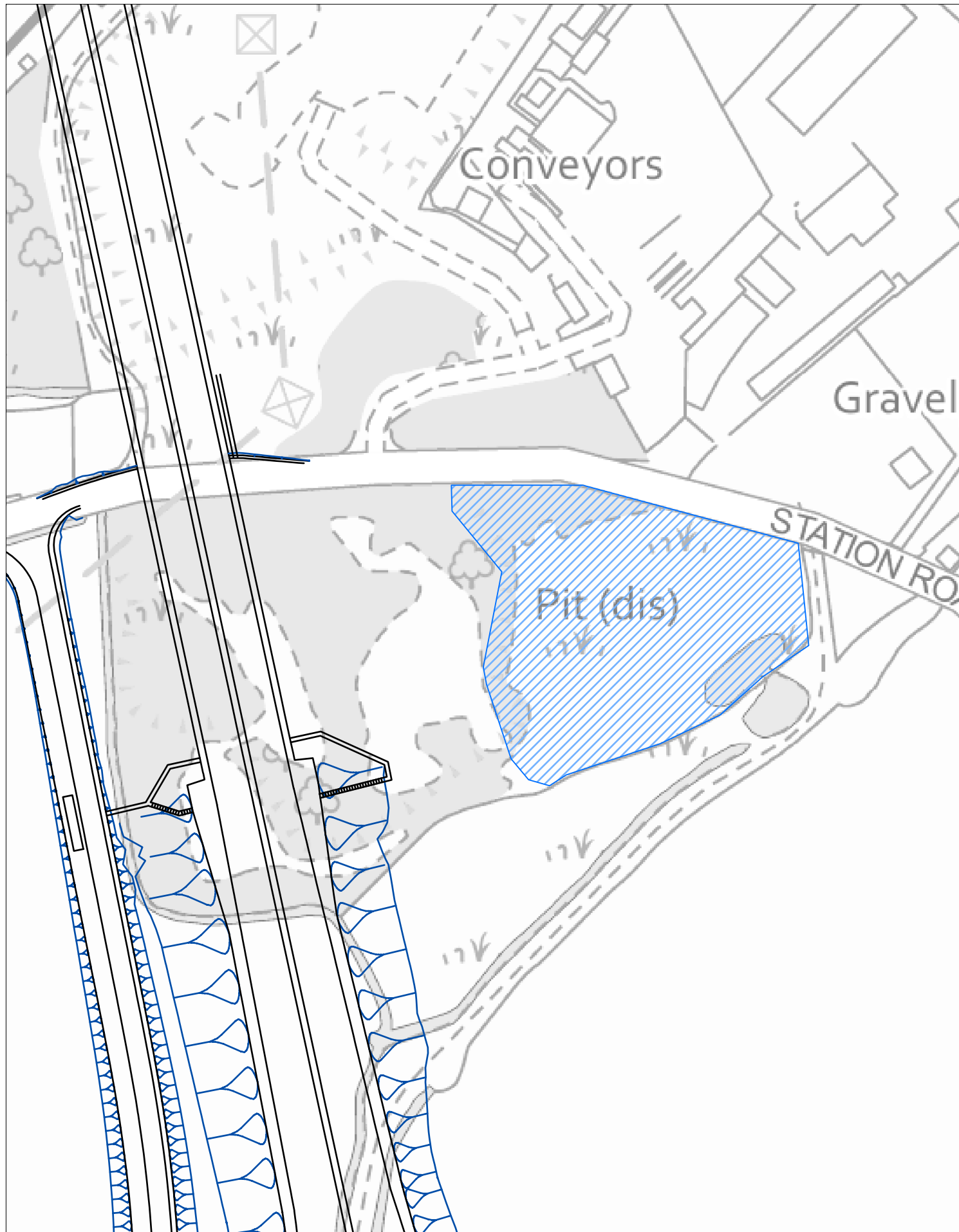
Legend		Superficial Deposits	Bedrock
●	BGS Boreholes	Alluvium	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)
●	LTC Exploratory Holes (Phase 1 GI)	Head Deposits	Thanet Formation
●	LTC Exploratory Holes (Phase 2 GI)	Lynch Hill Gravel	
□	Approximate Quarry Extents	Taplow/Mucking Gravel	
□	Site Boundary		



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

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Application Document Number	TR010032/APP/6.3	Scale	1:4,308		
Drawing Title	Low Street Pit Local Geological Site Figure 3 - Geology and Site Investigation				
Drawing Number	HE540039-CJV-GEN-GEN-MAP-GEO-00226				

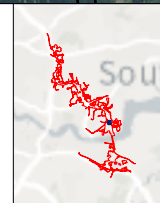


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- Legend**
-  Geological Restriction Zone
 -  Route alignment
 -  Earthworks

P01	S8	30/09/2022	DCO Application	SW	MW	BF
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chkd	Appr'd



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Project
LOWER THAMES CROSSING

Status	DCO APPLICATION	Original Size	A3	Revision	P01
Application Document Number	TR010032/APP/6.3	Scale			
Drawing Title	Low Street Pit Local Geological Site Figure 4 - Proposed Restricted Areas				
Drawing Number	HE540039-CJV-GEN-GEN-MAP-GEO-00227				

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