



Ruddlesden geotechnical

Phase 1: Preliminary Geotechnical and Contamination Assessment Report



Proposed Lidl, Mercia Road, Gloucester

Lidl UK GmbH

May 2017

CR/JW/SR/17254/PGCAR

REPORT CONTROL SHEET

Site Address	Mercia Road Gloucester GL1 2SQ
Client	Lidl UK GmbH
Report Title	Phase 1: Preliminary Geotechnical and Contamination Assessment Report
Issue Date	23 May 2017
Report No.	CR/JW/SR/17254/PGCAR
Revision No.	0

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APPENDIX A	PHOTOGRAPHS (11 pages)
APPENDIX B	DESK STUDY INFORMATION Historical Ordnance Survey Maps (33 pages) Environmental Information (67 pages) Petroleum Records Search Correspondence (2 pages)
APPENDIX C	SITE PLANS Site Location Plan (1 page) Aerial Photograph (1 page) Existing Site Layout (1 page) Proposed Site Layout (2 pages)



EXECUTIVE SUMMARY

Proposals It is understood that the site is to be redeveloped for commercial purposes with the construction of a new Lidl store with an associated car park and access. The proposed layout is presented in Appendix C of this report.

Site History The majority of the site is shown to have remained undeveloped on first edition Ordnance Survey mapping (dated 1884), with a small watercourse, associated with the River Twyver, present along the eastern site boundary and partially entering the eastern site boundary. By 1936, the watercourse was no longer shown (assumed to have been infilled or culverted) and a road (**St Oswald's Road**) was shown to partially enter the northwest of the site. Two large buildings were constructed within the centre and southeast of the site by 1972, resembling the present day buildings, together with two tanks, with the building in the **centre of the site labelled as being a 'tyre and vehicle service depot'**.

It is of note that a refuse heap, is shown within the southwestern part of the site, and small mounds are also shown at the site, from circa 1965 until 1972. In addition, a track was also historically present approximately present 70m to the southwest of the site, which continued to an area resembling bare ground/ infilled land, located approximately 250m outside the northwest of the site boundary until 1965. It is understood that these features might be representative of historical filling (i.e. landfill), which is understood to have taken place at the site and the area to the west.

The site is situated within an area of industrial activity, particularly to the south and west of the site, with numerous depots, garages, works and an abattoir, all being historically present, including a large livestock market complex, approximately 50m to the west. Since the most recent historical map (dated 1995), the area of the cattle market has been redeveloped as a commercial retail park, although the area to the south of the site still remains as numerous industrial buildings.

Site Geology The British Geological Survey (BGS) map of the area indicates the site to be underlain by the Jurassic and Triassic Lias Formation and Charmouth Mudstone Formation (undifferentiated).

Superficial Quaternary Alluvium deposits are recorded to overlie the bedrock geology across the majority of the site, **with the exception of the site's northeastern corner.**

Although not recorded by BGS mapping, the obtained environmental information indicates that the site is located within an area of former landfill (Gloucester Cattle Market). Therefore, it is anticipated that significant depths of made ground could be present overlying the bedrock strata and Alluvium deposits. This made ground (fill) is likely to



contain household-type wastes.

Foundations	Given that the site is recorded within an area of landfill (i.e. significant depths of made ground are anticipated to be present) and that superficial Alluvium deposits are also recorded to overlie the bedrock strata, it is currently envisaged that piled foundations are likely to provide the most suitable foundation solution for the proposed building at this site.
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Soakaways	Soakaways are not considered likely to provide a suitable method of surface water drainage at this site and an alternative drainage solution is likely to be necessary. If soakaways are required, in-situ soakaway testing should be carried out in accordance with BRE 365: Soakaway Design.
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Preliminary Contamination Risk Assessment	The results of this preliminary contamination risk assessment indicate that the anticipated levels of contamination may be potentially harmful to human health and to the water environment. An intrusive (Phase 2) investigation is required to assess the risks and the extent of any remedial works required.
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Radon/ Ground Gas	No radon protection measures are required. However, in-situ ground gas monitoring is required to assess whether or not ground gas protection measures are necessary.
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Further Work	Intrusive investigation, comprising windowless sample boreholes together with geotechnical and contamination laboratory testing, is required at this site. These will likely need to be supplemented with cable percussive boreholes, to provide greater information on the ground conditions at depth.
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This information should then be used to provide information for the design of foundations and associated structures and to enable a human health and controlled waters risk assessment to be carried out. In addition, contamination laboratory testing will assist in classifying the soils for off-site disposal purposes and provide information for water supply pipe selection.

Ground gas monitoring is required to confirm the ground gas regime beneath the site and hence whether ground gas protective measures are required. Given that the site is within an area of historical landfill, at least 12 No. monitoring visits are required.

This executive summary is to be read in conjunction with, and not in isolation from, the full report text and appendices.



1 INTRODUCTION

1.1 General

It is proposed to redevelop land at Mercia Road, Gloucester, for commercial purposes.

In order to gain background information to aid the design and construction of the new development, a Phase 1: Preliminary Geotechnical and Contamination Assessment has been undertaken which included the study of historical Ordnance Survey maps, geological maps, environmental information, geological information, radon information and a walkover survey.

The investigation was undertaken in May 2017 and carried out by Ruddlesden geotechnical Ltd, acting on behalf of Lidl UK GmbH.

1.2 Development Proposals

It is understood that the site is to be redeveloped for commercial purposes with the construction of a new Lidl store with an associated car park and access. The proposed layout is presented in Appendix C of this report.

1.3 Scope of Investigation

The investigation covers geotechnical and contamination aspects relating to the development. The brief was understood to comprise the following:

- Study historical, geological and environmental information relating to the site.
- Undertake a walkover survey of the site.
- Produce a conceptual site model.
- Make preliminary recommendations for foundations and associated structures.
- Comment on any other geotechnical matters arising from the investigation.
- Undertake a preliminary contamination risk assessment.
- Undertake a preliminary ground gas assessment.
- Propose extent of any intrusive investigation, if proven to be necessary.

1.4 Scope of Report

The report is presented as a description of the data obtained. This is followed by an interpretation and discussion of the results together with preliminary engineering recommendations for foundation design, a conceptual model of the site and preliminary contamination risk assessment. The final part of the report comprises proposals for any intrusive investigation required.

The presence of asbestos containing materials (ACM) within buildings and invasive plants are outside the scope of this report and should be addressed by respective suitably qualified experts, if necessary.



2 THE SITE

2.1 Site Location

The site is located at Mercia Road, Gloucester, see Appendix C (Dwg. Nos. 17254/01 and 17254/AP). The British National Grid Reference of the site is 383172, 219358 and the postcode is GL1 2SQ.

The site is located within a commercial/ light industrial area, approximately 850m to the northwest of Gloucester city centre.

Access to the site is gained via Mercia Road, to the west/ southwest of the site.

2.2 Site Description

The site is irregular in shape, measuring approximately 100m x 140m (1.22 hectares), and is generally flat and level, lying at around 10.50m AOD.

The site comprises two light industrial buildings, within the centre and southeast of the site, together with surrounding areas of hardstanding and soft landscaping.

The building within the centre of the site is predominantly of single-storey, metal framed construction, with a combination of concrete block, brick and metal clad walls, and large metal roller shutter doors. At the time of the site walkover, the western part of this building was being used as offices, the eastern part was being used as a vehicle maintenance workshop and the southern part was being used as a vehicle parts storage warehouse.

The vehicle maintenance workshop, located within the east of the central building, was operational at the time of the site walkover and comprised a series of maintenance bays with vehicle inspection pits, approximately 1m deep. The surfacing within this part of the site was observed to comprise concrete, in a good state of repair, although some relatively minor oil spillages and stains were noted to be present locally. Based on site observations, it appears that the maintenance work is predominantly undertaken on haulage vehicles and other large vehicles, predominantly manufactured by DAF.

A series of 200L metal drums were observed within the southeast of this area and were noted to contain anti-freeze, engine oil and fuel mixtures. Some of these drums had been placed upon plastic drip-trays, although the majority were placed directly on the concrete surfacing. A plastic bin store was also observed within this area, with a drip-tray at its base, which was being used for the storage of empty fuel, oil and lubricant containers. Some minor stains were noted within this area of the site, particularly surrounding the metal drums.

An area of relatively small containers of motor oil, hydraulic oil and lubricants was also observed within the centre of this area, all of which were placed on drip-trays, with some free-phase oil product located at the base of the trays. Notably, no spillages were observed within this area on the concrete surface. A series of oil application pumps (manufactured by Tecalemit) were also observed within this area of the site, and according to on-site personnel, these are connected to a series of oil tanks within the north of this area (see below).

Six above ground fuel storage tanks are present within the northern part of the vehicle maintenance workshop and, as mentioned above, are understood to contain oils which are fed to a series of overhead pipelines, connecting to the oil pumps within the centre of this area. The tanks are of metal construction, each measuring approximately 1.5m x 1.25m x 1.25m high, with taps at the base of



each, and are estimated to each be of approximately 2250L capacity. Labelling on the tanks indicates that they contain diesel engine oil (10w/40), mineral gear oil (85w/40) and mixed engine oil (15w/40). Labelling on one of the tanks indicates it to have a capacity of 2250L and that it was manufactured in 1992.

A vehicle washing area, comprising a metal vehicle ramp and underlying drainage catch pit, was also observed to the north of the central building. A metal grate was observed at the base of the catch pit and some stains were noted within this area together with some standing water. The surfacing within this area comprises concrete at the surface in a moderate condition.

A relatively modern-looking fuel pump, for the refuelling of **'AdBlue'**, is located immediately outside the east of the vehicle maintenance workshop and includes an integral above ground fuel storage tank (total dimensions of 2.0m x 1.5m x 2.0m high). The pump and tank were of metal construction and were positioned directly onto the concrete surfacing. No stains or spillages were noted on the concrete surfacing.

The vehicle parts storage warehouse, located in the southern part of the central building, was being used for the storage of vehicle parts, fuels, lubricants and oils. Notably, numerous new plastic containers of chemicals, up to 20L in capacity, including washing chemicals, brake and clutch cleaner, **'AdBlue'** and deionised water were observed within this area, although these were all unopened and were stored appropriately with no spillages present. A single 200L oil drum was also observed within this area, although this was placed on a plastic drip-tray.

Numerous oil drums and empty plastic containers were also observed within the external eastern part of the site, some of which were placed on the back of a lorry trailer, ready for off-site disposal. In addition, some 1000L IBCs were observed within this part of the site and were labelled **as containing 'AdBlue', with some part-full**. The external eastern part of the site predominantly comprises concrete at the surface in a relatively poor state of repair, with numerous cracks present.

A metal manhole cover, sprayed in red, was observed within the external eastern area of the site and was surrounded by gravel surfacing. The manhole cover was lifted which did not give any indication of its purpose, although some black oil staining was observed around the sides of the manhole chamber. Based on the above, particularly that it is surrounded by gravel surfacing, it is considered that this manhole could be indicative of an underground fuel storage tank. A further red manhole cover was noted within the southeastern part of the site, which may also be indicative of an underground fuel storage tank, although it is considered that this sprayed colouration may also be indicative of a foul drain.

The building within the southeast of the site is predominantly of single-storey brick construction, with corrugated fibrous cement roofing and guttering, potentially containing asbestos, and is of two-storey construction within the east. Some significant cracking of the external brickwork was observed along the northern wall of this building, particularly within the northeast of this area, where cracking was observed below the damp-proof membrane (i.e. indicative of movement of the foundation). It is of note that a narrow external passageway is present to the south of this building, within the site boundary, although access to this area was not available at the time of the site walkover (locked gate).

At the time of the site walkover, the southeastern building was being used as a vehicle MOT and servicing centre for Fiat, also operated by Imperial Commercial.



The internal areas of the building typically comprised vehicle bays with concrete at the surface and numerous equipment and tools.

A disused above ground fuel storage tank was observed within the upper storey of the eastern part of this building and was estimated to measure 1.5m x 3.0m x 1.0m high. The tank was located upon a wood and brick platform with some stains and spillages locally present.

An oil storage area was also observed within the west of the southeastern building. A further above ground storage tank was observed within this area, measuring approximately 3.0m x 0.5m x 1.5m high, and was noted to contain waste oils. The tank was of metal construction, was located upon concrete surfacing and some stains were noted around its base. Several 200L metal oil drums, labelled as containing oil filters, motor oils and hazardous waste were observed adjacent to the above ground storage tank and were placed on plastic drip trays. Some spillages were noted around the area of the plastic drip tray.

The northwest, north and northeastern parts of the site are currently used as parking, predominantly for haulage vehicles, and are covered by a combination of bitmac and concrete at the surface.

No trees are located at the site, although numerous trees are located around the **site's perimeter, particularly to the north.**

The site is bordered to the north by areas of soft landscaping (including a play park), to the east by residential properties, to the south and southwest by similar **light industrial buildings and to the west by a road (St Oswald's Road)**, before a retail park.

Photographs of the site are presented in Appendix A. The main site features and the existing site layout are shown on the site features plan (Dwg. No. 17254/02), included within Appendix C.



3 DESK STUDY

3.1 General

A desk study was undertaken, comprising the consultation of:

- Old Ordnance Survey maps;
- Geological maps;
- Environmental information; and
- Petroleum records.

This information was used to produce a conceptual site model.

3.2 Site History

A full set of historical Ordnance Survey maps of the site was obtained as part of the desk study (Appendix B of this report). The salient points are listed below:

1884 The site is shown to be undeveloped and comprises part of a field, within **an area labelled as St Catherine's Meadow. A small watercourse, flowing towards the north, is shown to be present along the site's eastern boundary and partially enters the eastern part of the site.** 'Stones' are also shown within two areas of the site.

The areas surrounding the site are typically undeveloped fields, with an **area labelled as 'city gardens'** present immediately to the southeast.

1886 No significant changes are shown within the site boundary, although the **water course along the eastern site boundary is labelled as being a 'ditch'**, associated with the River Twyver. Residential development is shown to have taken place less than 100m to the east and southeast of the site and a railway line is also shown to have been constructed approximately 150m to the south, trending approximately northwest to southeast.

1902 No significant changes are shown within the site boundary. The railway, located approximately 200m to the south of the site, is now labelled as **the 'Great Western Railway' and a vinegar works is now also shown** approximately 200m to the southeast of the site. The city garden, located immediately outside the southeast of the site and is now shown to be allotments and further residential development is shown to have taken place nearby (<100m) to the east of the site. A spot height of 28ft is recorded approximately 75m west of the site.

1923 An orchard is shown to be present immediately to the northeast of the site and further residential development is shown to have taken place nearby (<100m) to the east of the site.

1936 A road (**St Oswald's Road**) is now shown within the northwest of the site, trending northeast to southwest. **A 'benchmark' of 37.8ft is recorded on St Oswald's Road, on the western site boundary.** The ditch located along **the site's eastern boundary is no longer shown** and is assumed to have been infilled or culverted and the orchard and allotment gardens immediately to the east of the site are no longer shown.

Residential development is now shown to have taken place immediately to the east of the site, with some associated rear gardens partially entering the eastern site boundary.

1954 No significant changes are shown within the site boundary. A corporation salvage depot is now shown approximately 20m outside the southwest of the site. A track is now shown approximately 70m outside the southwest of the site and continues to an area resembling bare ground/ infilled land,



- located approximately 250m outside the northwest of the site boundary.
- 1965 A refuse heap is shown within the southwestern part of the site. In addition, small mounds are also shown within the west and southeast. The track, located 70m to the southwest of the site, is no longer shown and the vinegar works, 200m to the southeast, is no longer labelled. The area to the northwest and south of the site is now shown to have been significantly developed, with a livestock market present approximately 50m to the northwest, works present immediately to the southwest (area of former corporation salvage depot), an abattoir present 150m to the southwest and garages present 100m to the south.
- 1972 The area resembling bare ground/ infilled land in the southwest of the site and the spoil mounds are no longer shown. A building is now present **within the centre of the site, labelled as a 'Tyre and Vehicle Service Depot'** and a further unlabelled building is shown within the southeast. Both of these buildings resemble the buildings currently present at the site. Two tanks are also now shown within the eastern and southern parts of the site. Further light industrial buildings are now shown within the surrounding areas, including a food depot immediately to the south, an engineering works 50m to the south, a tyre service depot 100m to the southwest and a large garage 125m to the south.
- 1986 A spot height of 9m is recorded approximately 300m north of the site. No significant changes are shown within the site boundary or the nearby surrounding areas.
- 1994 The building within the centre of the site is now labelled as being a depot. A spot height of 11.9m is recorded on the northwest corner of the site, on **the St Oswald's road.**
- 1995 No significant changes are shown within the site boundary or the nearby surrounding areas.

In summary, the majority of the site is shown to have remained undeveloped on first edition Ordnance Survey mapping (dated 1884), with a small watercourse, associated with the River Twyver, present along the eastern site boundary and partially entering the eastern site boundary. By 1936, the watercourse was no longer shown (assumed to have been infilled) and a road (**St Oswald's Road**) was shown to partially enter the northwest of the site. Two large buildings were constructed within the centre and southeast of the site by 1972, resembling the present day buildings, together with two tanks, with the building in the centre of the site **labelled as a 'tyre and vehicle service depot'.**

It is of note that a refuse heap, is shown within the southwestern part of the site, and small mounds are also shown at the site, from circa 1965 until 1972. In addition, a track was also historically present approximately present 70m to the southwest of the site, which continued to an area resembling bare ground/ infilled land, located approximately 250m outside the northwest of the site boundary until 1965. It is understood that these features might be representative of historical filling (i.e. landfill), which is understood to have taken place at the site and the area to the west.

The BBC's Domesday site indicates that prior to the construction of the cattle market, the land was the floodplain of the River Severn, locally known as 'Mean Ham'. Anecdotally, the floodplain was used as the city's rubbish tip until the level of land was sufficiently raised to facilitate the cattle market.



The site is situated within an area of industrial activity, particularly to the south and west of the site, with numerous depots, garages, works and an abattoir, all being historically present, including a large livestock market complex, approximately 50m to the west. Since the most recent historical map (dated 1995), the area of the cattle market has been redeveloped as a commercial retail park, although the area to the south of the site still remains as numerous industrial buildings. In addition, as part of the recent redevelopment outside the west of the site, **St Oswald's Road was rerouted to outside of the site boundary.**

3.3 Site Geology

The British Geological Survey (BGS) map of the area indicates the site to be underlain by the Jurassic and Triassic Lias Formation and Charmouth Mudstone Formation (undifferentiated).

Superficial Quaternary Alluvium deposits are recorded to overlie the bedrock **geology across the majority of the site, with the exception of the site's northeastern corner.**

Although not recorded by BGS mapping, the obtained environmental information indicates that the site is located within an area of former landfill (Gloucester Cattle Market). Therefore, it is anticipated that significant depths of made ground will be present overlying the bedrock strata and Alluvium deposits. The made ground (fill) is recorded to contain household-type wastes.

Two published historical BGS borehole records carried out approximately 300m to the northwest of the site encountered the following ground conditions:

- MADE GROUND, to a depths of 2.75m (9 feet) and 3.35m (11 feet), **underlain by...**
- Soft silty clay/ clayey silt (Alluvium), to depths of between 11.25m (37 feet) and **15.25m (50 feet), underlain by...**
- Silty ballast, underlain locally by sandy silt (Alluvium), to the base of the boreholes, to depths of 15.35m (52 feet) and 18.90m (62 feet).
- Groundwater was encountered at a depth of approximately 3.65m (12 feet).

It is noted that these boreholes were carried out a relatively long time ago (1959) and, based on the historical maps and environmental information, it is considered that further filling may have taken place within the area of these boreholes.

3.4 Environmental Information

The key environmental information contained within the Groundsure Enviro Insight report (Appendix B of this report) is listed below:

- The nearest landfill site is located as being on-site: Gloucester Cattle Market; household waste. A further historical landfill (also named Gloucester Cattle Market) is located 7m to the northwest of the site.
- There are twenty-one records of potentially contaminative industrial land uses within 250m of the site. The nearest and most significant of which are detailed below:
 - On-site; unspecified depot; mapped between 1973 and 1994.
 - 102m southwest; abattoir; mapped between 1973 and 1994.
 - 137m to the southeast; unspecified works; mapped in 1960.
 - 139m to the southeast; vinegar works; mapped in 1924.



- There are twenty-one records of historical tanks within 250m of the site boundary. The nearest twelve records relate to on-site tanks: unspecified tanks; mapped between 1972 and 1998.
- There are twenty-nine records of historical energy features within 250m of the site. The nearest is located 64m to the east: electricity substation; 1972.
- There are no historical petrol and fuel station sites within 250m of the site boundary.
- There are thirty-six records of historical garage and motor vehicle repair sites within 250m of the site boundary. The nearest is located on-site: tyre and vehicle service depot; mapped between 1972 and 1991.
- There are two records of potentially infilled land within 250m of the site, both of which relate to ponds as near as 113m to the southeast of the site and were mapped in 1883.
- There is one record of Part 2A and Part B activities enforcements located at the site: Wicliffe Motts, Gloucester; respraying of road vehicles; no enforcement notified.
- There is one recorded pollution incident within 250m of the site: March 2002; other pollutant; no impact (Category 4) to either water, land or air.
- There are thirty-two records of potentially contaminative current industrial sites within 250m of the site. The nearest and most significant of which are detailed below:
 - On-site; depot; container and storage.
 - On-site; Imperial Commercials Ltd; new vehicles.
 - 13m to the southwest; Gantry; travelling cranes and gantries.
 - 14m to the south; Depot; container and storage.
 - 24m to the southwest; Brandon Hire; construction and tool hire.
- The nearest recorded petrol or fuel site is located 45m to the west of the site; Cattle Market Filling Station; obsolete.
- The underlying superficial strata (Alluvium deposits) are classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
- The underlying bedrock strata are classified as a Secondary Aquifer (undifferentiated layers). This classification is assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
- There are no active groundwater or potable abstraction licences within 2km of the site
- The nearest active surface water abstraction licence is located 1459m to the west of the site: Ripple, Gloucestershire; spray irrigation; expires 2022.
- There are no recorded source protection zones within 500m of the site.
- The soils are classified as having a high leaching potential. This classification is assigned based on soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information.
- The nearest surface water feature is recorded 24m to the east of the site: River Twyver; culvert. The main channel of the River Twyver (Primary River) is located as near as 111m to the southeast of the site.



3.5 Radon

Site-specific radon information, contained within the desk study information, and British Geological Survey (BGS) data indicates that less than 1% of homes are above the Radon Action Level and that no radon protective measures are required in the construction of new buildings.

3.6 Petroleum Records

A petroleum records search was instructed by Ruddlesden geotechnical Ltd and was undertaken by Gloucester City Council Trading Standards. In summary, the records search indicated there to be no redundant petroleum records at the site, although it was mentioned that records are not held regarding diesel tanks.

For reference, the email response from Gloucester City Council is provided with the obtained desk study information and is included within Appendix B.



4 PRELIMINARY GEOTECHNICAL ASSESSMENT

4.1 Proposals

It is understood that the site is to be redeveloped for commercial purposes with the construction of a new Lidl store with an associated car park and access. The proposed layout is presented in Appendix C of this report.

4.2 Ground Profile

From the published information, the expected underlying geology is superficial Alluvium deposits across the majority of the site, underlain by the Jurassic and Triassic Lias Formation and Charmouth Mudstone Formation (undifferentiated).

Based on the historical BGS borehole record, the Alluvium is anticipated to comprise soft silty clay, sandy silty and clayey silt and could be of significant thickness, perhaps up to 20m.

The Lias Formation and Charmouth Mudstone Formation are likely to comprise firm to stiff clays, progressing into mudstone and shale with subordinate limestone.

Although not recorded by BGS mapping, the obtained environmental information indicates that the site is located within an area of former landfill (Gloucester Cattle Market). In addition, a refuse heap is shown on historical mapping within the southwestern part of the site, and small mounds are also shown at the site, from circa 1965 until 1972. These features are considered to be associated within the recorded landfill at the site. However, Ordnance Survey Mapping suggests that site levels have not changed significantly since 1936, before the mapped period of landfilling. Nevertheless, it should be anticipated that significant depths of made ground could be present overlying the bedrock strata and Alluvium deposits. The fill is likely to contain household-type wastes.

It is of note some significant cracking of the external brickwork was observed along the northern wall of the existing southeastern building, particularly within the northeast of this area, where cracking was observed below the damp-proof membrane (i.e. cracking of the foundation). Given the above, it is envisaged that the foundations for this building are constructed within the Alluvium deposits (or potentially the made ground/ landfill material), indicating that these deposits provide an unsuitable founding stratum.

It is considered that the Jurassic and Triassic Lias Formation and Charmouth Mudstone Formation would provide a suitable founding stratum.

Significant depths of made ground and/ or Alluvium deposits are anticipated to overlie the Lias Formation and Charmouth Mudstone Formation, and, given that these deposits are likely to be particularly loose/ soft and variable in nature, these are not considered likely to provide a suitable founding stratum for the proposed buildings. It therefore considered that an alternative (e.g. piled) foundation solution, founded within the underlying Lias Formation/ Charmouth Mudstone Formation, will likely be required for the proposed building at the site.

Based on the site's topography and the nearby published borehole records, as well as a stream on old Ordnance Survey maps, it is envisaged that groundwater will be encountered at relatively shallow depth beneath the site (less than 5m).



4.3 Preliminary Foundation Recommendations

4.3.1 General

Given that the site is recorded within an area of landfill (i.e. significant depths of made ground could be present) and that superficial Alluvium deposits are also recorded to overly the bedrock strata, it is currently envisaged that piled foundations are likely to provide the most suitable foundation solution for the proposed building at this site.

4.3.2 Piled Foundations

Driven piles would probably present the most economical foundation solution. However, given the proximity of the proposed store to adjacent buildings, the noise and vibration created by driving piles is unlikely to be tolerated. Given the anticipated problems of bore collapse associated with the potentially granular nature of the underlying geology, and likely relatively high groundwater table, some form of augered (possibly CFA) pile is currently considered to be the most suitable piling method at this site.

The type of pile, end-bearing or friction, will depend on the ground conditions encountered, though it is anticipated that end-bearing piles will be most suitable particularly as it should be assumed that no frictional resistance will be provided by the anticipated made ground and probable granular underlying deposits. The length of the piles will depend on the ground conditions encountered, as well as the diameter, type and number of piles, and the proposed loadings.

The advice of a specialist piling contractor should be sought on the suitability and load carrying capacity of their proprietary techniques for use at this site.

4.3.3 Ground Floor Slabs

Due to the requirement for piled foundations and anticipated soft and compressible near surface deposits, a suspended ground floor slab is likely to be required.

If a ground bearing slab is preferred, ground improvement, e.g. excavation and replacement with compacted granular fill will likely be required.

4.3.4 Radon Protection Measures

BRE Report 211 'Radon: Guidance on Protective Measures for New Buildings' and British Geological Survey (BGS) information obtained as part of the desk study (Appendix B of this report) indicate that no radon protection measures are required.

4.4 Soakaways

Given the recorded presence of a historical landfill at the site and that a relatively high groundwater table is anticipated, soakaways are not considered likely to provide a suitable method of surface water drainage and an alternative drainage solution is likely to be necessary.

If soakaways are required, in-situ soakaway testing should be carried out in accordance with BRE DG 365: Soakaway Design.



5 PRELIMINARY CONTAMINATION ASSESSMENT

5.1 General

It is understood that the site is to be redeveloped for commercial purposes with the construction of a new Lidl store with an associated car park and access. The proposed layout is presented in Appendix C of this report.

The preliminary assessment has been carried out in accordance with the latest guidance using a source-pathway-receptor analysis method, to assess whether or not the recorded levels of contamination are safe and suitable for use and to determine the extent of any further assessment or remedial measures that might be necessary. In particular, reference has been made to the following documents:

- Defra (2014): SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report.
- Defra (2014): SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Policy Companion Document.
- Defra & Environment Agency (2004): CLR 11: Model Procedures for the Management of Land Contamination.
- Defra (2012): Environmental Protection Act 1990: Part 2A: Contaminated Land Statutory Guidance.
- Department for Communities and Local Government (2012): National Planning Policy Framework.
- Environment Agency (2005): The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils.
- Environment Agency (2006): Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination.
- Environment Agency (2009): Human Health Toxicological Assessment of Contaminants in Soil (SR2).
- Environment Agency (2009): Updated Technical Background to the CLEA Model (SR3).
- LQM/ CIEH (2015): The LQM/ CIEH S4ULs for Human Health Risk Assessment. Publication No. S4UL3408.

5.2 Conceptual Site Model

5.2.1 Source

In summary, the majority of the site is shown to have remained undeveloped on first edition Ordnance Survey mapping (dated 1884), with a small watercourse, associated with the River Twyver, present along the eastern site boundary and partially entering the eastern site boundary. By 1936, the watercourse was no longer shown (assumed to have been infilled) and a road (**St Oswald's Road**) was shown to partially enter the northwest of the site. Two large buildings were constructed within the centre and southeast of the site by 1972, resembling the present day buildings, together with two tanks, with the building in the centre of the site **labelled as a 'tyre and vehicle service depot'**.

Given that the site has been subject to past development, made ground is anticipated to be present at this site and this could be generically contaminated. In addition, it is possible that some asbestos containing materials (ACM) may be present on and/ or within the soil at this site. It is of note that, during the site walkover, the roof of the building within the southeast of the site was noted to be



constructed of corrugated fibrous cement, potentially containing asbestos, which indicates that asbestos has been used previously at this site.

Both of the buildings at the site are currently occupied by Imperial Commercials, with the building in the centre of the site used for vehicle maintenance (predominantly haulage vehicles) and the building within the southeast used as an MOT and service garage. In addition, historical maps indicate the building within the centre of the site was historically used as a tyre and vehicle service depot.

The Department of the Environment Industry Profile for road vehicle fuelling, service and repair – transport and haulage centres (best considered to represent the former/ current land uses) indicates that contamination at these sites is likely to arise from spillages and leakages of raw materials, inadequate storage facilities and the improper disposal of waste products. Contaminants are likely to include hydrocarbons (including MTBE), heavy metals and chlorinated hydrocarbons. It is also noted that asbestos may have been used within these types of buildings, used for pipe lagging, fireproofing, roofing and cladding of buildings.

In addition, whilst modern practices dictate that waste oil is now disposed of responsibly, in the past, waste oil is likely to have been disposed of directly into the ground or down a drain, which may have leaked.

During the site walkover, a vehicle washing area was observed to the north of the central building. The Department of the Environment Industry Profile for road vehicle fuelling, service and repair - transport and haulage centres indicates that vehicle washing areas should not pose a threat of potential contamination if a catchment pit with an interceptor is used. However, if inadequate drainage systems are present, potential contaminative chemicals may be released into the ground and leach into the underlying groundwater. Given that most detergents are 80% biodegradable, residual detergent chemicals and their degradation products are likely to be readily leached from the soil.

Numerous above ground storage tanks were observed to be present at the site during the site walkover, including 6 No. oil tanks within the central building, 1 No. AdBlue tank outside the east of the central building, 1 No. redundant unknown tank within the east (upper storey) of the southeastern building and 1 No. waste oil tank within the northern part of the southeastern building. The historical mapping also shows that, by 1972, two tanks were present within the east and south of the site, up until the most recent map dated 1995. The obtained environmental information also makes reference to twelve records relating to on-site tanks, mapped between 1972 and 1998. All of the above tanks are considered to be potential sources of contamination, predominantly as a small leak that goes undetected for any significant length of time can cause significant contamination of the ground. Significant contamination is more associated with older tanks as they tend to be less well constructed than newer tanks, which are also now monitored for discrepancies between input and output rates.

A former spray painting area was observed within the northern part of the southeastern building during the site walkover. In addition, the environmental information indicates there be one record of Part 2A and Part B activities enforcements located at the site, relating to the respraying of road vehicles. Therefore, some contamination of the ground beneath the site might have occurred from paints leaking thorough the concrete and into the ground beneath. However, the concrete within this area was observed to be in good condition, which should reduce the potential risk of any contaminants leaking into the ground.



Numerous large 200L drums containing various different types of oils and fuels were noted to be present across the site, particularly inside the buildings, and some stains and spillages were noted within these areas of the site. In addition, numerous other containers containing various chemicals were noted to be present across the site, particularly within the vehicle maintenance workshop in the central most building, the vehicle parts warehouse in the south of the central building and within west of the southernmost building. It is envisaged that, if these containers were to have leaked or their contents accidentally spilled, these chemicals could leach into the ground beneath and are therefore considered to be potential sources of contamination. It is noted that the concrete surfacing within the existing buildings is likely to provide an impermeable barrier between any contaminants and the underlying ground.

However, some 200L drums were noted to be present within the eastern external areas of the site, where the concrete was observed to be in a relatively poor condition, and contamination of the ground beneath is therefore more likely to have occurred from any historical spillages and/ or leakages.

The site is known to be within a historical landfill site (Gloucester Cattle Market) and a further large historical landfill site is recorded 7m to the northwest of the site (also named as Gloucester Cattle Market). The environmental information indicates that both of these landfills accepted household-type wastes. It is therefore considered that these infilled materials might contain elevated levels of contamination and the on-site and nearby off-site landfills are therefore considered to be potential sources of contamination. In particular, given the anticipated shallow groundwater table, it is likely that any contamination would leach readily in the underlying groundwater, potentially posing a significant risk to controlled waters.

In addition, the historical maps showed a refuse heap, within the southwestern part of the site, together with small mounds, from circa 1965 until 1972. These features are considered to be associated within the recorded historical landfill at the site and therefore also considered to be potential sources of contamination.

The historical Ordnance Survey mapping from 1884 shows that a small water course was historically present along the eastern site boundary, partially entered the eastern site boundary, and was no longer shown by 1936 (assumed to have been infilled or culverted). Any materials used to backfill the watercourse are therefore also considered to be a potential source of contamination.

As well as being general sources of soil and groundwater contamination, the on-site/ off-site historical landfill sites, the on-site historical infilled land feature/ gravel pit within the southwest and the on-site infilled (possibly culverted) former water course within the east are also considered to be potential sources of ground gas (i.e. methane and carbon dioxide), depending on whether any significant depths and/ or significant quantities of biogenic material are present, which could pose a risk to future site users. In particular, given that the on-site and off-site historical landfills are recorded to have accepted household-type waste, it is likely that these will be producing significant quantities of ground gas (carbon dioxide and methane).

The site is situated within an area of industrial activity, particularly to the south and west of the site, with numerous depots, garages, works and an abattoir, all being historically present, including a large livestock market complex, approximately 50m to the west. These surrounding land uses are therefore also considered to be potential sources of contamination, which could have migrated beneath the site through soil or groundwater. However, given their distance from



the site and the historical on-site activities, it is currently considered that these off-site sources are of less significance than those recorded at the site.

Of particular note, the environmental information and historical mapping records a cattle market to have been present approximately 50m to the west of the site, from 1965, up until the most recent historical map dated 1995. In addition, the environmental information records that a fuel station was present (now recorded as obsolete) 45m to the west of the site, relating to the Cattle Market Filling Station. Given the distance (and size) of the cattle market and fuel station from the site, these should be considered to be a potentially significant sources of contamination that could migrate to beneath the site, particularly from the leakages of fuels from underground fuel storage tanks. However, it is noted that since the most recent historical Ordnance Survey map (dated 1995), the cattle market to the west of the site, including the area of this fuel station was redeveloped as a commercial retail park. Therefore, during the redevelopment works, any contamination associated with the fuel station (and the cattle market) is likely to have been remediated and are therefore likely to be of less significance than if these remained present.

Based on desk study information, it is considered that other past and present off-site land uses are unlikely to have caused any significant contamination of the ground at the site, greater than those described above.

5.2.2 Pathway

In accordance with the CLEA model, a commercial land use is considered to be most appropriate for this development and has been used in this risk assessment. The following exposure pathways potentially linking contamination to humans have been considered:

- Direct soil and indoor dust ingestion.
- Skin contact with soils and indoor dust.
- Inhalation of indoor and outdoor dust and vapours.

If present, groundwater flow within the Alluvium deposits, any made ground and underground service runs, underlying Lias Formation and Charmouth Mudstone Formation, or fractures within the underlying bedrock, is considered to be the main migration pathway linking any contamination to the water environment.

5.2.3 Receptor

As a commercial land use, end users are considered as potential receptors of any contamination, with a working female adult (aged 16 to 65 years old), being the critical receptor.

There are no recorded active groundwater, surface water or potable abstraction points within 1km of the site. Therefore, the nearest surface water feature, located 24m to the east of the site (River Twyver culvert) and groundwater beneath the site (Secondary A Aquifer and Secondary Aquifer (undifferentiated)) are considered to be the main potential controlled waters receptors.



5.3 Discussion and Recommendations

In order for land affected by contamination to cause harm, there must be a source of contamination, a receptor that can be harmed and a pathway by which the receptor can be exposed to the contamination.

The results of this preliminary contamination risk assessment indicate there to be numerous potential sources of contamination at this site that could pose a risk to human health or to controlled waters.

Intrusive investigation is required to obtain representative soil (and groundwater where present) samples for laboratory contamination testing. The results of the testing would be used to undertake human health and controlled waters contamination risk assessments to ascertain the risk to end users and the water environment, and hence whether any remedial measures are required.

Precise remedial recommendations will depend on the extent and nature of contamination. However, given the current proposals, it is likely that covering the site in permanent hardstanding (buildings and car parks) will break the majority of the source-pathway-receptor linkages (other than ground gas/ vapour inhalation (see section 5.4 and below)) with no additional remedial measures likely to be necessary. However, a capping layer of clean soil may be required in soft landscaped areas.

Nevertheless, if the intrusive investigation works show there to be a risk to controlled waters or particularly heavy contamination to be present, removal or treatment of the contamination source may be required to protect controlled waters from contamination.

Based on site observations, it is also noted that the following potential underground fuel storage tanks are thought to be located at the site, although no confirmatory evidence has yet been obtained.

The locations of these tanks are discussed within the site description and photographs are shown within Appendix A.

- East of the site – suspected presence, unknown use/ contents.
- South of the site - suspected presence, unknown use/ contents.

It is of note that the petroleum licence search undertaken by Gloucester City Council Trading Standards did not hold any records regarding petroleum storage at the site. However, the historical maps of the site record two tanks to have been present historically at the site, within the same areas as the suspected tanks highlighted during the site walkover. It will therefore be necessary to determine the presence, use and integrity of these potential tanks, prior to determining if any remedial measures are necessary.

The presence or absence of any widespread contamination surrounding these potential tanks should be investigated as part of the proposed ground investigation, details of which are found within section 6 of this report. If any widespread contamination is found to be present, then further work is likely to be required in order to demonstrate to the regulatory bodies, including the Environment Agency, that no unacceptable levels of contamination remain in the ground.

As well as determining which parts of the source-pathway-receptor chain are present with respect to human health and controlled waters, the intrusive investigation will also need to consider the presence of potentially hazardous



soils, for off-site disposal purposes, and to confirm the water supply pipe requirements for the local water authority (see section 6 of this report).

5.4 Preliminary Ground Gas Assessment

The desk study information indicates that no radon protective measures are required at this site.

In order to assess the risks posed by ground gas, the principles outlined in BS **8485 (2015)** 'Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide **Ground Gases for New Buildings**' have been followed.

The breakdown of organic material in made ground can produce ground gas, though it may also be produced by other, natural, sources (e.g. coal, peat). The principal components of ground gas are methane (potentially explosive) and carbon dioxide (potential asphyxiant).

A historical landfill site, named as Gloucester Cattle Market, is recorded to be present beneath the site and the surrounding area to the south. In addition, a further, larger, landfill site is recorded 7m to the northwest of the site, also named as Gloucester Cattle Market. Both of these landfill sites are recorded to have accepted household waste, which may be producing potentially harmful quantities of ground gases (i.e. methane and carbon dioxide) as part of the biodegradation process, i.e. a potential ground gas source.

In addition, historical Ordnance Survey mapping from 1884 shows that a small water course was historically present along the eastern site boundary, partially entered the eastern site boundary, and was no longer shown by 1936 (assumed to have been infilled, although this also could have been culverted). If this infilled material is of significant depths and/ or contains significant quantities of biogenic material, this could also be a source of ground gas.

Whilst considered to be of less significance than the above sources, further generic made ground and Alluvium deposits are also recorded to be present at the site, which, depending on the quantities of biogenic materials present, might also be sources of ground gas.

Furthermore, if significantly elevated levels of SVOCs/ VOCs are encountered, a hydrocarbon vapour resistant membrane may be required to protect end users, depending on the results of in-situ testing.

In-situ ground gas monitoring is therefore recommended. The number of monitoring visits required should be reviewed following site observations and the results of initial monitoring. However, given the high potential for ground gas generation at this site, a minimum of twelve fortnightly visits are recommended. These should include variable environmental conditions, including low and falling atmospheric conditions.



6 PROPOSED INTRUSIVE INVESTIGATION

In order to confirm the above preliminary recommendations, an intrusive ground investigation is required.

As the site is partly occupied by buildings and still in use, windowless sample boreholes are considered to be the most suitable method of investigation at this site, primarily to provide information for contamination assessment purposes, but also to provide some geotechnical information.

The windowless sample boreholes would be particularly useful as these cause minimal site disturbance, the rig can access restricted access areas and these boreholes allow in-situ Standard Penetration Tests (SPTs) to be undertaken, to provide quantitative strength information for foundation design.

In addition, the boreholes would allow the installation of ground gas/ groundwater monitoring wells to facilitate long-term monitoring, particularly given that the site is located within an area of recorded landfill.

The windowless sample boreholes would be positioned at an even spread across the site, as well as targeting the potential sources of contamination, detailed within the conceptual site model (section 5.2.1).

Given the anticipated depths of made ground (landfill materials) and Alluvium deposits and the likely requirement for a piled foundation solution, it is envisaged that cable percussive boreholes are also likely to be required. These boreholes would need to be advanced within the area of the proposed building and undertaken to rock-head, to provide information for piled foundation design.

It is currently envisaged that it would be best to undertake the windowless sample boreholes in the first instance, with the cable percussive borehole following at a later date, once the ground conditions have been established.

Representative soil samples should be taken and tested for geotechnical classification purposes, to determine the likely volume change of the soil for foundation design. As the underlying soils are recorded to comprise Jurassic clays, BRE SD1 suite should be undertaken to determine whether pyrites are likely to be present and hence whether any special design measures are required to protect buried concrete.

For environmental purposes, soil, and where possible, groundwater samples should also be taken and tested for the following suites of contaminants: general heavy metal suite; speciated polycyclic aromatic hydrocarbons (PAH); total petroleum hydrocarbons (TPHs); soil organic matter (SOM); asbestos. Given the historical use of the site, it is also recommended that samples should be tested for site-specific contaminants, including volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The sample locations should be targeted to the most likely sources of contamination, outlined within the conceptual site model (section 5.2.1).

This new data would enable human health and controlled waters risk assessments to be undertaken so that appropriate remedial measures, if any, may be proposed. The contamination laboratory test data would also provide information for water supply pipe selection.



If information regarding the off-site disposal of soils is required, waste acceptance criteria (WAC) testing should be undertaken, followed by a formal waste characterisation, using the contamination testing results.

In-situ ground gas monitoring of borehole installations should also be undertaken to confirm the ground gas regime beneath the site and hence whether ground gas protective measures are likely to be required. In particular, these borehole locations should be targeted to the most likely sources of ground gas (i.e. on-site/ nearby landfill sites, former infilled watercourse, made ground and Alluvium deposits).

In line with current guidance (BS 8485), it is recommended that a minimum of twelve monitoring visits be undertaken for carbon dioxide, methane, oxygen, VOCs and gas flow. Further visits may be required if the levels of ground gas are particularly high and/ or variable.



7 REFERENCES

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