Appendix B
Preliminary Phase 1 Land Quality Assessment to Inform Proposed Development for 12 mppa Planning Application

Bristol Airport Limited

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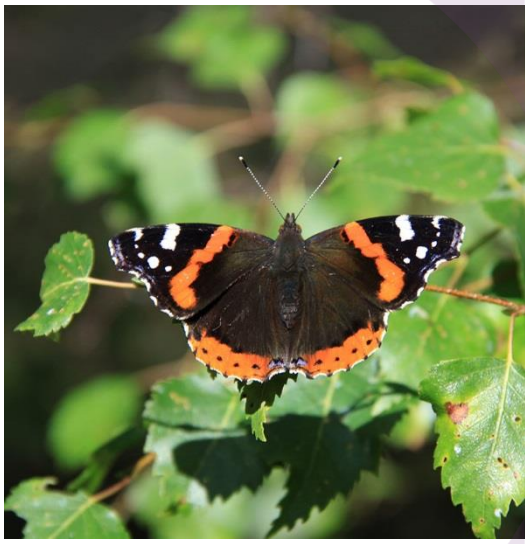

Wood Environment & Infrastructure Solutions UK Limited – June 2018

Report for

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Bristol
BS48 3DY

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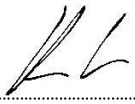
p.p. 

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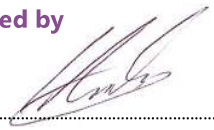

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Document revisions

No.	Details	Date
1	Draft Report	30.05.18
2	Final Report	11.06.18

Executive Summary

Background	Wood Environment & Infrastructure Solutions UK Ltd (Wood) was commissioned by Bristol Airport Ltd (BAL) to prepare a Preliminary Phase 1 Land Quality Assessment (LQA), including a review of available existing information in relation to the Proposed Development. The Proposed Development comprises enhancement of existing facilities at the airport including car parking, roads and extensions to the terminal.
Purpose of the report	This report has been produced for the purpose of supporting a planning application for the Proposed Development to facilitate a proposed increase to 12 million passengers per annum (mppa).
Site description	The whole BAL site covers an area of approximately 192 hectares, but this report focuses on specific parts of the BAL site where development is proposed associated with the current proposed planning application. These are in the north eastern landside and airside zones, and the southern landside zone.
Site history	The BAL site was undeveloped farmland prior to the Second World War (WWII), other than historical areas of former quarrying and lead and calamine workings. From 1941 the site was developed as an RAF training airfield known as Lulsgate Bottom. After the war the airfield was disused until 1955, when it began to be developed as a civil airport. The airport has undergone a number of infrastructural enhancements over the years, including a substantial westward extension to the runway in the 1960s.
Geology, hydrogeology and hydrology	The BAL site is likely to be underlain by widespread Made Ground associated with the existing infrastructure; underlain by superficial deposits of clay and limestone bedrock. There are a number of collapse feature and voids noted within the proposed development and broader BAL site associated with the natural geology. The British Geological Survey indicate that the site is within a higher probability radon area. The groundwater sensitivity is assessed as high - the site is underlain by a Principal Aquifer (the Black Rock Limestone) and a Secondary A Aquifer (the Brockley Down Limestone) with relatively thin and intermittent drift cover (unproductive strata). The majority of the Bristol Airport site lies within a Zone 2 outer Source Protection Zone (SPZ). In addition, an inner Zone 1 SPZ is located directly to the east of the A38. Surface water sensitivity is assessed as low due to the absence of surface water features at the BAL site.
Ecology	There is a Local Nature Reserve to the east of the A38 at Feltham Common. There are no other statutory ecological designations (SSSI etc.) within the vicinity of the BAL site and Proposed Development. The ecological sensitivity is assessed as low.
Regulatory information	There are no known regulatory issues relating to land quality pertaining to this site. There are a number of surface water drainage discharge consents via soakaways at the BAL site and a permitted landfill site close to the north eastern boundary of the Proposed Development.
Findings of previous reports	Previous reports prepared for BAL that have been reviewed as part of this Preliminary Phase 1 LQA include: • An Interim Constraints Overview Report (Amec Foster Wheeler Report Ref. 38970C0143i3, dated 17 July 2017); • A Post Planning Application Conditions Phase 1 Contaminated Land Desk Study (Entec UK Ltd, Report Ref. 28770RR002i4, dated June 2011); and • A draft "briefing note" on kerosene contamination dated 2014 by Cascade Consulting (Ref. Bristol Airport, Eastern Terminal Ground Investigations, Briefing Note. December 2014. Draft - Interim Technical Note for Information Only). No other factual or interpretative ground investigations reports or information have been made available for review during the preparation of this report.
Potentially contaminative land uses and ground conditions	Potential contamination sources at the BAL that are either within, or in close proximity to the Proposed Development, include historical and current potential contaminant sources and poor ground conditions: • Made Ground, level-raising and infilling of features (such as historical quarries); • Former sewage works; • Potentially contaminative WWII site uses, aircraft operation and maintenance facilities; • Electricity substations; • Bulk oil and fuel storage; • Hydrocarbon contaminated shallow groundwater; • Historical quarrying and historical lead workings; and • Geological hazards including collapse features and voids (including "swallets" marked on geological map), geological fault lines (at the northern extent of the Proposed Development) and natural radon gas (the BAL site is with a higher probability radon area). Potential risks from UXO and radioactive contamination are considered to be low based on the information that has been made available.

Preliminary Risk Assessment Summary	Made Ground is considered likely to be present throughout the BAL site and no specific investigation information is available to identify or quantify potential contaminants within the Proposed Development areas. The preliminary risk assessment has assessed the potential risks to future site users associated with Made Ground from previous site uses as Moderate. Kerosene contamination has been reported in the area east of the existing terminal building. Specific detailed information has not been provided and it is not known whether any further measures have been implemented. Potential risks to future site users and groundwater have been assessed as Moderate. The presence of collapse features and voids has been noted at the BAL site. It is not known whether any investigation of potential voids and collapse features has been carried out within the Proposed Development, and in the absence of such information the risk to property has been assessed as Moderate. The HPA places the BAL site within a higher probability radon area, such that 10 – 30% of homes are above the Action Level. In the absence of any site-specific information to indicate otherwise, the risk to future site users has been assessed as Moderate. All other potential risks at the site have currently been assessed as either Low or Low to Moderate. The risk assessment should be revised as more information becomes available.
Conclusions	Where Moderate or greater risks are identified, further investigation is normally required to clarify the risk and to determine the potential liability. The preliminary risk assessment has identified Moderate risks to future site users within the Proposed Development associated with Made Ground from previous site uses; spillage / leakage associated with bulk fuel storage and use; and radon gas from the natural geology underlying the site. In addition, the presence of collapse features and voids has been documented at the BAL site and a Moderate risk has been assessed to property. All other potential risk at the site have currently been assessed as either Low or Low to Moderate. Following development, it is anticipated that the majority of the Proposed Development will be occupied by either buildings or hard surfacing, which will effectively break potential contaminant pathways to human receptors, such as dermal contact and ingestion pathways and will limit infiltration to underlying ground. It should be noted that risks to current site users and redevelopment workers have been excluded from this assessment. Should further information become available, or further investigation be completed to clarify risks and potential liabilities, the risk assessment should be reviewed and revised. This may decrease or increase the assessed risk depending on the information.
Recommendations	The following specific actions are recommended to permit refinement of the risk assessment and Conceptual Model, and to determine whether any remedial action is required: • Confirm whether any other regulatory baseline information and further information held by BAL is available to supplement the information reviewed in this report and allow the Conceptual Model to be refined. • Acquire further information regarding potentially contaminated ground conditions within and adjacent to the footprint of the Proposed Development. This may include ground investigations where information is unavailable. • Acquire further information regarding possible voids, collapse features, infilled solution cavities, and historical limestone quarrying and lead workings within the footprint of the Proposed Development. This may include geophysics and/or targeted ground investigation where supplementary information is unavailable. • Ensure that radon protection measures are designed to be installed where required and consideration to be given to commissioning a site-specific radon assessment report. • Included all relevant information / references associated with contamination and ground conditions within the pre-construction information for the Proposed Development. • Ensure that the integrity of drainage systems and soakaways is maintained during the construction phase. • Manage earthworks appropriately to avoid exacerbating risks associated with contamination, including potentially increased risk from mobilisation of contamination as windblown dust, run off to surface water and leaching to groundwater; and • Include provision for dealing with any unforeseen contamination that may be encountered during site works and construction associated with the Proposed Development within the Construction Phase Health and Safety Plan.

Contents

1. Introduction

Background	Wood Environment & Infrastructure Solutions UK Ltd (Wood) was commissioned by Bristol Airport Ltd (BAL) to prepare a Preliminary Phase 1 Land Quality Assessment (LQA) on land contamination and ground conditions, including review of available information in relation to the Proposed Development at the BAL site. It is understood that the principal objective of the Proposed Development is to facilitate increased growth to 12 million passengers per annum (mppa). The Proposed Development to facilitate this strategy and which forms the subject of this report comprise: extensions to the existing terminal building; including walkways and a new pier; new airside facilities and aircraft stands; taxiway widening; new car parking facilities in the north and south of the site; modifications to the A38 junction in the north east; and enhancements of the internal road network (further details are outlined in Section 2).
Purpose of the Report	The purpose of the report is to provide updated desk-based information to input to the Environmental Impact Assessment (EIA) to support production of the Scoping Report and Environmental Statement (ES) for Land Quality. To this end the report identifies preliminary potential land quality related constraints and risks associated with the proposed development of the site. The Proposed Development areas are presented in Figure 1 and Figure 2 in Appendix A.
Legislative Context	Planning guidance relating to the development of land potentially affected by contamination is detailed in the National Planning Policy Framework (NPPF) 2012. The NPPF 2012 sets out the Government's planning policies for England and how these should be applied. The NPPF 2012 states that: • The natural environment should be conserved and enhanced by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land; • In preparing plans to meet development needs, the aim should be to minimise pollution and other adverse effects on the local and natural environment. Plans should allocate land with the least environmental or amenity value; and • Planning policies and decisions should encourage the effective use of land by re-using land that has previously been developed (brownfield land), provided that it is not of high environmental value. Planning policies and decisions should also ensure that: • A site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or effects on the natural environment arising from that remediation; • After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990; and • Adequate site investigation information, prepared by a competent person, is presented. In addition, the North Somerset Core Strategy (CS), January 2017, states in CS3: *Environmental impacts and flood risk assessment – Development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation.*

Scope of work	The scope of work comprises the following:
	• Review of previous reports:
	  ▶ Phase 1 Contaminated Land Desk Study report prepared by Entec UK Ltd, 2011 (Entec, 2011)[1]. This report includes a preliminary unexploded ordnance (UXO) assessment;
	  ▶ Environmental database information reported by Envirocheck, 2017[2] (presented in Appendix B); and
	  ▶ Interim Constraints Overview Report prepared by Amec Foster Wheeler E&I UK Ltd, 2017[3].
	• Review of information made available from by BAL, including site walkover information, summary report of possible kerosene contamination in groundwater and drainage plans;
	• Develop a Conceptual Site Model (CSM) and complete a Preliminary (Qualitative) Risk Assessment for the Proposed Development; and
	• Provide conclusion and recommendations.

Limitations	The conclusions reached and advice given in this report are based in part upon information and/or documents that have been prepared by third parties. In view of this, we accept no responsibility or liability of any kind in relation to such third-party information and no representation, warranty or undertaking of any kind, express or implied, is made with respect to the completeness, accuracy or adequacy of such third party information. In preparing this report we have assumed that all information provided is complete, accurate and not misleading.

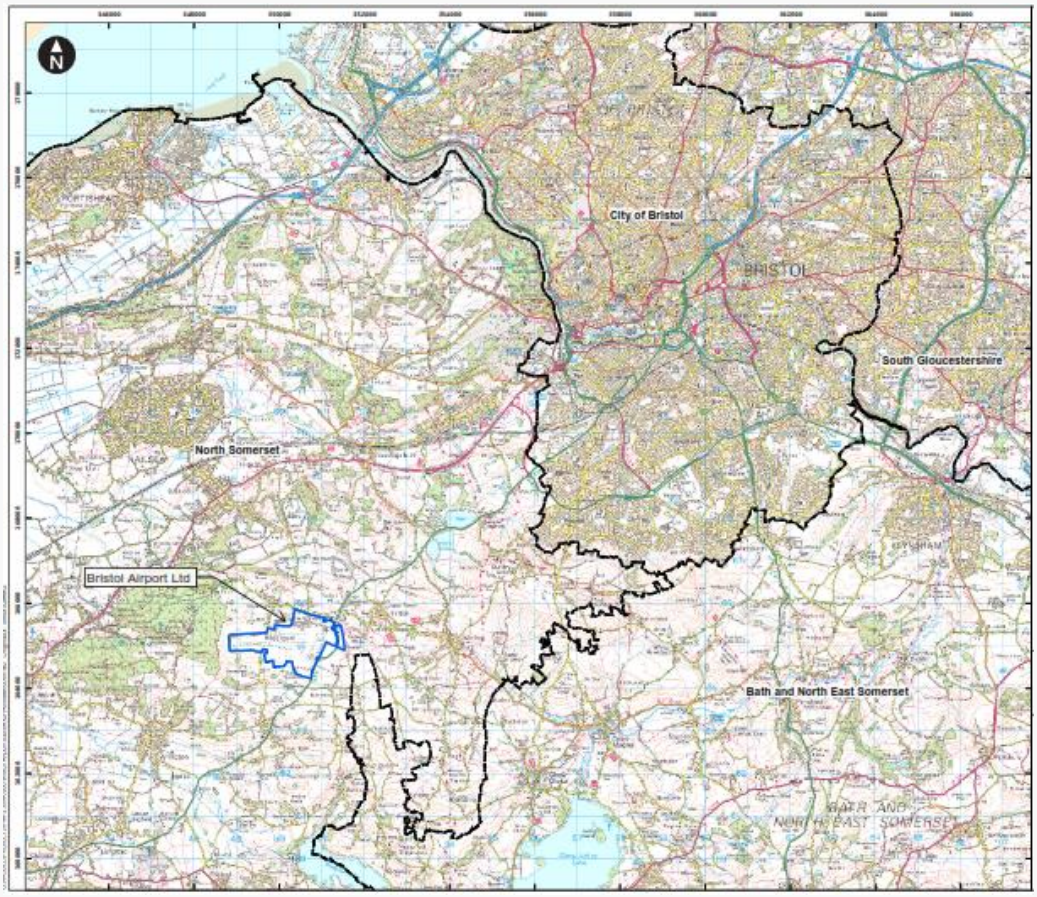
[1] Bristol Airport Limited, Post Planning Application Conditions: Phase 1 Contaminated Land Desk Study, Report Reference 28770 RR002i4, Entec UK Limited, July 2011.

[2] Envirocheck Report, Ref. 128842570_1_1, 16 June 2017 (presented in Appendix B).

[3] Bristol Airport Limited, Interim Constraints Overview Report, Report Ref. 38970C0143i3, Amec Foster Wheeler E&I UK Ltd, 17 July 2018.

2. Site details and environmental context

2.1 Site details

Site Location and Address	The Proposed Development is located at Bristol Airport, Bristol BS48 3DY. The location and extent of land ownership at the BAL site is presented below (ownership boundary demarcated in blue). 
Grid Reference	350280, 165090
Site Description	The BAL site is in a generally rural setting, bounded by the main A38 road on the eastern side, farmland and woodland to the south and east, and residential housing, farmland, a golf course and a sewage treatment works to the north. The whole airport site comprises a 196 hectare irregular shaped area of land. The main areas of the Proposed Development are located in the north east and south of the site, as presented on Figure 1 (north eastern area) and Figure 2 (southern area) in Appendix A. The north eastern area contains most of the existing administrative facilities including the terminal building, car parks and other infrastructure, including the A38. Most of the Proposed Development in this area is on land previously developed since 1940, much of it currently covered by hard surfacing or existing buildings, and surrounded by similar land uses including small islands of soft landscaping. The exception is a strip of proposed taxiway widening which is currently grass alongside the existing taxiway. The southern area contains the proposed Cogloop car park. This area is currently undeveloped agricultural land. The central area of the BAL site is relatively flat at approximately 185m above ordnance datum (AOD). The surrounding land generally falls away more or less steeply on all sides, including the Proposed Development Areas at the north east and south of the BAL site.

Current boundaries to the BAL site (Land uses and relevant features)		**Adjacent**	**Beyond (within 200m)**
	North	Downside Road, scattered residential properties, golf course	Farmland
	East	A38 road	Farmland
	South	Farmland	Farmland
	West	Farmland	Woodland
Current site activities	The site is currently an operational civil airport and will continue as such during and after the Proposed Development. There are on-going potentially contaminative activities typical of airport operations, notably fuel storage and handling facilities, aircraft de-icing, fire training maintenance, car parking etc. A site walkover was carried out by Wood on 5 March 2018. No significant potentially contaminative activities or evidence of contamination were noted within the Proposed Development areas.		
Services	Site drainage plans have been provided for the BAL site and indicate that surface water drainage in the northern area discharges to soakaways (i.e. to groundwater) in various locations around the site. The surface water system is protected by a number of oil separators. Drainage plans have not been provided for the Proposed Development in the south; it is presumed that as the land is currently undeveloped, no engineered drainage exists. No other services information has been obtained for the site.		
Proposed Development	It is understood that BAL intends to enhance the existing facilities at the airport by means of the Proposed Development. The areas of specific interest that are covered by this report are as follows: • 1 – West, south and east terminal extensions; • 2 – East pier; • 3 – Multi-storey car park; • 4 – Taxiway widening; • 5 – New taxiway; • 7 – Cogloop car park (in southern area); • 8 – Gyratory road; • 9 – A38 highway improvements; • 10 – New canopy over plaza; and • 11 – New service yard. These areas are shown in detail on Figure 1 (northern) and Figure 2 (southern). All of these areas except the Cogloop car park have previously been developed for a range of airport facilities. Note – Areas 6 and 12 are not included above as the Proposed Development within these areas entails operational changes only, not affecting or affected by land quality.		

2.2 Environmental context

Geology & Hydrogeology

Geology and hydrogeology information has been taken from the British Geological Survey (BGS) Geology of Britain website[4], Magic.gov.uk website[5], previous reports[1] and the Envirocheck 2017[2] **(presented in Appendix B)**, together with borehole logs from previous investigations supplied by the Client. A summary of the strata underlying the BAL site and the Proposed Development is outlined below.

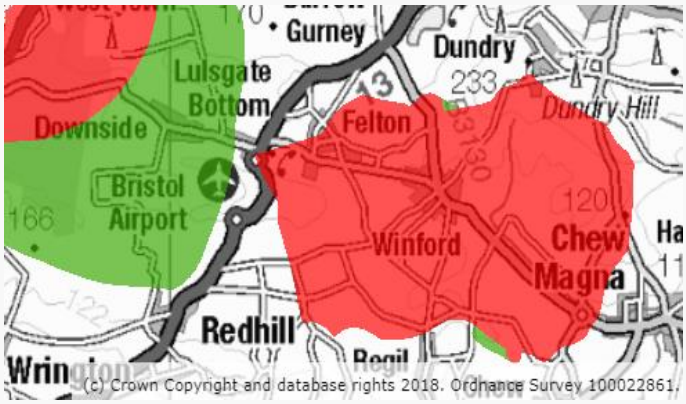
Strata	Brief Description of typical constituents	Average depth to upper surface (m bgl) or thickness (m)	Aquifer and approximate water level if known*	Notable features
Made Ground	Variable, associated with existing infrastructure	Typically <1m, up to 2m thickness	N/A	Variable, tarmac, limestone gravel, sand, clay
Drift	Clay	Typical thickness of 2 to 5m, maximum up to 8m	Unproductive	Firm to stiff red-brown clay with limestone gravel and cobbles
Black Rock, Brockley Down, Westbury, Cotham formations	Limestone	At least 150m	The majority of the BAL site is located on a Principal Aquifer, with the exception of small areas in the south and north west which are located on Secondary A aquifer.	Voids noted at ~40m bgl (noted in Entec 2011[1]). A fault (with associated old lead workings) crossing the southern part of the site may affect the proposed Cogloop car park development

Radon

Bedrock geology is a source of naturally occurring radon (radioactive gas). The Envirocheck 2017[2] (presented in Appendix B) reports that the BGS has designated the area of the BAL site as a higher probability radon area, with 10-30% of homes above the action level.

Hydrogeological sensitivity

The majority of the site lies within a Zone 2 Outer Source Protection Zone (SPZ) (shown in green on the map below) associated with the designated outer catchment of Chelvey Well to the north west of Broadfield Down (located approximately 4.3km north west of the BAL site). There is also a Zone 1 Inner SPZ immediately to the east of the A38 and farther away to the north west (shown in red on the map below).



[4] British Geological Survey (BGS) mapping Geology of Britain website, http://mapapps.bgs.ac.uk/geologyofbritain/home.html [last accessed 04 May 2018]

[5] Magic.gov.uk website, http://www.magic.gov.uk/website/magic/ [last accessed 04 May 2018]

Groundwater Sensitivity	Groundwater Sensitivity – High This reflects the majority of the site overlies a Principal Aquifer and lies within in a Zone 2 Outer Source Protection Zone. There is also a Zone 1 Inner SPZ immediately to the east of the A38.
Hydrology	There are no surface watercourses present on the site, there are none reported within 250m of the site and none are recorded above the 150m contour of Broadfield Down. Below this level, a number of springs are recorded, which are likely to be fed by discharge from the limestone aquifer underlying the site. Surface water bodies in the vicinity of the site are also rare. Six ponds have been recorded within 500m of the airport boundary, although many of these are likely to be artificial.
Hydrological sensitivity	Hydrological sensitivity – Low. The hydrological sensitivity is considered to be low due to the distances to the receptors from the Proposed Development.
Ecology	There is a local nature reserve (Felton Common) close to the eastern site boundary. There are no other ecologically sensitive sites on or within 1km of the site.
Ecological sensitivity	Ecological sensitivity – Low The ecological sensitivity is assessed as Low as the Local Nature reserve is not topographically lower than the airport site, hence unlikely to be impacted by groundwater flow.

2.3 Other regulatory database information

Only regulatory data within 250m with the potential to affect the Proposed Development has been detailed below.

Activity	On-Site	0-250m	Details
Waste management/ transfer/ treatment facilities/disposal	0	0	Waste management facilities are understood to be operated at the BAL site, but are not specifically identified within the Envirocheck Report, 2017[2] and are not listed here.
Landfill	0	1	The closest landfill site is situated approximately 250m to the north east of the BAL site. The facility has a licence for non-hazardous waste disposal. This is within 250m of proposed improvements to the A38 junction and could potentially affect the works.
Sites handling hazardous or explosive substances (including COMAH or NIHHS) planning hazardous consents	0	0	None reported within the Envirocheck Report, 2017[2].
Mineral Extraction Activities	Some possible	many	The Entec, 2011 report[1] identifies that there are numerous possible historic lead mines around the site. Their precise location is unknown.

2.4 Site history

Site history summary and pertinent features relating to Land Quality	A summary of the historical development of the BAL site, based on historical Ordnance Survey (OS) maps, is outlined below. The historical maps are presented within the Entec, 2011 report[1], which provides more detailed historical information for the BAL site. Where relevant, interpretation of the maps is supported by knowledge from the discussions with the client and other stakeholders and previous reports for the area of the BAL site. Prior to 1941 the area of the BAL site was agricultural land but contained at least one small quarry, Lulsgate Farm Quarry, located to the south of the present terminal building. This was marked "old quarry" on the 1938 mapping. It is likely to have been infilled with unknown materials to enable the RAF airfield construction. The area of the BAL site was first developed as an airfield in 1941 for use during WWII, known as RAF Lulsgate Bottom. The airfield infrastructure included a number of fuel storage installations within the present terminal area that may have left a legacy of ground contamination. After the war, in 1946, the airfield was abandoned by the RAF. During the next ten years the airfield was used by Bristol Gliding Club and motor race meetings were organised by the Bristol Motor Cycle and Light Car Club. The Bristol Corporation (Bristol City Council) acquired the airfield in 1955 and work began on airport terminal facilities. The new aerodrome known as Bristol (Lulsgate) Airport opened in 1957. Extensions were made to the terminal building in 1965 and work to lengthen the main runway to the west was completed in 1963. As part of the development, most of the wartime infrastructure other than the runways was removed. In 1987 Bristol City Council set up a company called Bristol Airport plc. It is understood that the central apron was developed in three phases between 1984 and 1992. In 1997, the City Council sold a majority share in the airport and the name was changed to Bristol International Airport. In 2000 a new terminal building opened, the new control tower was completed and the Category III all-weather landing system (which required diversion of the A38 main road) was installed. It is understood that raising of ground levels occurred during both the runway extension and the construction of the current Terminal building.

2.5 Previous works at the site

It is known that some previous site investigations have been carried out at the site, probably in 2005 and possibly at other times also, as noted in the Entec 2011[1] report. Some contamination was found and reportedly remediated; however, no quantitative details have been made available for assessment.

A draft briefing note provided by BAL (full title: Bristol Airport, Eastern Terminal Ground Investigations, Briefing Note. Cascade Consulting, December 2014. Draft - Interim Technical Note for Information Only), gives a summary of investigations to the east of the terminal building where some kerosene contamination has been found. The spatial extent of the contamination appears to have been delineated by a number of boreholes and is indicated to impinge on one of the proposed development areas that are the subject of this report, namely the eastern terminal extension. Specific detailed information has not been provided.

3. Generic Quantitative Risk Assessment

3.1 Conceptual Model

The Conceptual Model (CM) and plausible contaminant linkages are defined below based on the desk study review of previous reports and publically available information, as summarised in the previous sections. The CM is carried out in line with Contaminated Land Report 11[6] (CLR11) and is based on the proposed commercial land use. The CM provides an assessment of the site's potential contamination status and identifies the presence of potentially significant contaminant linkages that require further consideration.

The Entec 2011[1] report gives a comprehensive listing of potential contamination sources over the whole of the airport site (summarised in Table 4.1 of the Entec 2011[1] report). The majority of these sources are outside the present areas of interest and are therefore not considered further in any detail, other than where they could affect the Proposed Development. The following assessment covers only the areas associated with the Proposed Development for the 12 mppa application.

Potential Contamination (Sources)

A review of the history and environmental setting of the BAL site has identified potential contaminant sources on the BAL site and the surrounding area, as summarised below in **Table 3.1**, based on a continued commercial site-use.

Table 3.1 Current and Historical Potential Contaminant Sources

Development Component	Area Reference	Details*	Potential Contamination Sources
West terminal extension (Phase 2a)	1	Four storey extension to the existing terminal building on the western side (total floorspace of 10,385m^2). This is an amendment to the second phase of the western terminal extension granted consent under the 10 mppa permission.	• Former WWII bulk oil compound and aviation petrol installation, within approx. 50m to the west. • Former substation and former WWII fuel compound within approx. 50m to the east. • Former Lulsgate Farm Quarry with approx. 100m to the south. • Collapse/void feature noted adjacent to the south. • Current fuel farm to the south.
South terminal extension including new arrivals vertical circulation cores	1	Two storey extension to the southern side of the existing terminal building (total floorspace 4,600m^2). New arrivals area with vertical circulation core for airside buses to be located to the south of the terminal.	• Former WWII bulk oil compound and aviation petrol installation, within approx. 50m to the west. • Former substation and former WWII fuel compound within approx. 50m to the east. • Former Lulsgate Farm Quarry with approx. 100m to the south. • Collapse/void feature noted adjacent to the south. • Current fuel farm to the south.

[6] Environment Agency (2004) Model Procedures for the Management of Land Contamination – Contaminated Land Report 11

Development Component	Area Reference	Details*	Potential Contamination Sources
East terminal extension (Phase 2)	1	Optional extension to the east of the terminal building (incorporating phase 2 of the east terminal extension permitted under the 10 mppa but with an amended design). This would be brought forward instead of the south terminal extension.	• Collapse/void feature noted within footprint of C2. Further collapse/void features within approx. 150m to the east, west and southwest. • Former substation and former WWII fuel compound within approx. 150m to the west. • Former Lulsgate Farm Quarry with approx. 250m to the southwest.
Canopy	10	New canopy over the forecourt of the main terminal building.	• Collapse/void feature noted within footprint of C2
Multi-storey car-park (MSCP)	3	New MSCP to be constructed in the northern area of the Airport site adjacent to the existing MSCP (currently under construction). To provide approximately 2.150 spaces over five levels (total footprint of 11,200m^2).	• Old lead working adjacent to the northeast.
Gyratory road	8	New, two lane (one way) gyratory within the northern area of the Airport site.	• Approximate location of former sewage farm within central area surrounded by proposed gyratory road.
Highway improvements	9	The design of the proposed scheme is currently subject to further work but is likely to comprise: Removal of pedestrian crossing from the Downside Road junction adjacent to the Airport Tavern. Addition of a dedicated right turn from the A38 northbound at the junction with West Lane. Signalised left turn from the West Lane junction onto the A38. Widening of the A38 to create an additional lane northbound. Footways/cycle links and speed limit reduction to 30mph.	• Within area of former Felton Hill Quarry. • Former area of landfill noted adjacent to the northeast of the A38 at the northeast of area KK. • Felton Common Local Nature Reserve adjacent to the east of the A38 at the northeast of area KK.
Stands 37 and 38	12	Change to the operation of Stands 37 and 38. Application will seek the use of mobile diesel power generators and aircraft auxiliary power units (proposed power units to be restricted between 23:00 and 06:00) and enable the use of aircraft engines for taxiing (as opposed to towing).	• N/A No new proposed development. • Proposed introduction of mobile diesel power generators and aircraft auxiliary power units noted.
Existing extension to the Silver Zone Car Park (Phase 1)	6	Removal of restrictions pertaining to the use of the Silver Zone Car Park extension outside the period 1 May to 31 October. This will require the provision of permanent (fixed) lighting.	• N/A No new proposed development other than fixed lighting. • See notes below for area HH.

Development Component	Area Reference	Details*	Potential Contamination Sources
Extension to the Silver Zone Car Park (Phase 2)	7	Extension to the existing Silver Zone Car Park to accommodate 2,700 spaces. To be located immediately south of the existing car parking area on land known as 'Cogloop'.	• Old lead workings within south of area HH and adjacent to the southeast. • Former WWII machine-gun and cannon range approx. 100m to the northeast. • Former Broadfield Down Quarry approx. 100m to the north. • Former landfill within approx. 100m to the northeast.
New Service Yard	11	A new service yard, north of the western walkway and east of the current airside access security.	• Former WWII bulk oil compound within footprint of area E. • Former aviation petrol installation adjacent to the west. • Former substation and former WWII fuel compound within approx. 125m to the east. • Former Lulsgate Farm Quarry with approx. 100m to the southeast. • Current fuel farm approx. 75m to the southeast.
East pier with VCCs and 5 no. PBZs	2	A new pier connected to the eastern walkway for passenger access to the eastern stands. It will have vertical circulation cores and five pre-board zones. The ground floor footprint is approximately 1,900m^2. The first-floor footprint is approximately 1,900m^2.	• Collapse/void features noted within area H and adjacent to the south and west. • Old lead working noted approx. 50m to the southeast. • Former sewage farm located approx. 50m to the north. • Storage tank noted adjacent to the north.
New east taxiway	5	A new eastern taxiway link at the far eastern end of the runway to allow improved and efficient access to the runway for aircraft. This will be a continuation of the current surfacing. It should be noted that the proposed taxiway link is not an extension to the existing runway.	• Collapse/void features noted within approx. 50m to the west of area EE.
Taxiway widening and fillets	4	Taxiway widening to the southern edge of the northern most taxiway (Taxiway GOLF) to provide a parallel taxiway system for improved access and movement of aircraft.	• Old lead working noted within area LL. • Approximate location of the former Lulsgate Quarry located within area LL. • Collapse/void features noted within 50m (to the north).

Notes: * Details as outlined within the draft Planning Strategy for the 12 mppa application.

A list of potential contaminants associated with the potential contaminant sources identified in Table 3.1 and from natural sources are summarised in Table 3.2.

Table 3.2 Summary of Current and Historical Potential Contamination Sources

No.	Source	Potential Contaminants	Location	Proposed Development Area
1	Made Ground from previous use of the site (including former sewage works, ground works, level raising).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours.	Site-wide and within specific areas such as the former sewage works.	Site-wide (in particular the gyratory road).
2	Current and former use as an airfield (including former WWII / RAF site uses).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours, radiological contamination, UXO.	Site-wide and within specific area such as the former machine-gun and cannon range (rifle range).	Site-wide.
3	Current and historical bulk fuel storage and aviation fuel spillage / leakage.	Aviation fuel / petroleum hydrocarbons, volatile vapours.	Former "main site" now terminal area west and east of terminal building.	Terminal extensions and pier/walkway.
4	On-site and adjacent landfilling (excluding possible infilling of former quarries and voids).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours.	On-site at former rifle range and off-site to the northeast.	Cogloop and A38 improvements.
5	Natural geology / historical mining (including collapse features / voids, mining, quarrying and associated infilling).	Metals, metalloids, organic compounds, inorganic compounds, petroleum hydrocarbons, PAH's, asbestos, flammable gas (methane), carbon dioxide, depleted oxygen.	Site-wide collapse features / voids. Area-specific former quarrying. Historical mining at the north and south of the BAL site.	Site-wide. Terminal extensions, taxiway widening, Cogloop and service yard. Multi storey cat park and service yard.
6	Natural geology.	Radon gas.	Site-wide.	Terminal extensions, pier/walkway, and any occupied building/structures where radon gas could accumulate.

Potential Receptors and Exposure Pathways

The potential receptors and associated pathways that have been identified associated with the proposed future site use and proposed development are summarised in **Table 3.3**.

Table 3.3 Pathways and Receptors

Receptors	Potential pathways
Future Site Users (including during the development/construction phase)	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.
Off-Site Adjacent Future Site Users (including during the development/construction phase)	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.
Property: Buildings, Structures and Services	Direct contact, ingress and accumulation of gases. Damage from collapse and subsidence.
Controlled Waters: Principal Aquifer and Secondary A Aquifer (bedrock)	Leaching, migration.

3.2 Exclusions from Risk Assessment

Current Site Users

Users of the BAL site in its current configuration are not considered as part of this assessment. They were considered within the risk assessment completed for the Phase 1 Contaminated Land Desk Study, Entec 2011[1]. This Preliminary Phase 1 LQA has been written to support the 12 mppa application and the report covers the new development construction phase and post-development site users within the specified areas of interest.

Redevelopment Workers

The conceptual model does not consider risks to construction/ site maintenance workers on the basis that risks to workers will be dealt with under the Health and Safety at Work Act (1974) and regulations made under the Act. Site-specific contamination data obtained from all land quality assessments and site investigations should be included in the pre-construction information (requirement of Construction Design and management Regulations 2015) for the proposed works, to enable any contractors to address potential risk from contamination as necessary in their risk assessments and method statements. Moreover, as the exact details of the method adopted are not currently known, it is not considered appropriate to provide a wide ranging and speculative risk assessment for redevelopment workers.

Invasive Species

Invasive species (such as Japanese knotweed and giant hogweed) are not considered within the risk assessment for contamination.

Unexploded Ordnance (UXO)

A preliminary UXO assessment was been carried out by Zetica Ltd as part of the Entec 2011 report[1]. This assessment concluded that UXO risk to the majority of the BAL site is low.

An exception to this is the target end of the former cannon test butt, which is given a moderate risk rating, due to the possibility of guns undershooting leaving remnant rounds and the fact that this area of the BAL

site has not been developed since WWII. Because of the geology and relatively thin soil cover, Zetica consider the risk of UXO will be limited to a shallow depth. This area is identified on Figure 2.

The former cannon test butt is located approximately 100m to the northeast of the proposed extension to the Silver Zone car park (area HH). Due to the distance of the Proposed Development from the former cannon test butt, the risk to the Proposed Development is considered to be low. However, this assessment should be revised should actual ground conditions suggest the potential presence of UXO.

Radioactive Contamination

As noted in the Entec, 2011 report[1], former RAF bases sometimes have a legacy of radioactive contamination arising from ad hoc disposal of radium luminised cockpit instruments etc. dating from the mid-20th century. Many such items were incinerated on site at a 'burning ground'. The wartime site layout plans identify a "refuse destructor" within the area of the current sewage treatment plant, outside the current site boundary to the north of Downside Road. It is considered likely that if any luminised cockpit instruments were present and were burnt, it would have been within this area. As such, the likelihood of any radioactive contamination being present within the current site boundary is low. This this assessment should be revised depending on actual ground conditions, such as the presence artefacts or extensive burnt and ashy material within Made Ground.

3.3 Geotechnical Constraints

There may be localised ground stability issues at the site in general arising from natural solution cavities in the limestone and old lead mine workings. These could potentially affect deep excavations or piled foundations. The features that are identified on Figure 1 and Figure 2 are indicative only and the extent and depth of such hazards are unknown.

3.4 Preliminary Risk Assessment

Contaminant Linkages

In order for land contamination risk to be realised, a 'contaminant linkage' must exist[6]. A contaminant linkage requires the presence of a:

- source of contamination;
- receptor capable of being harmed; and
- pathway capable of exposing a receptor to the contaminant.

Preliminary Risk Assessment

A preliminary risk assessment has been undertaken for these potential contaminant linkages to identify potentially unacceptable risks on a qualitative basis. Risk is therefore based on a consideration of both:

- The likelihood of an event (probability – takes into account both the presence of the hazard and receptor and the integrity of the pathway); and
- The severity of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

Further information on the risk assessment methodology used is given in Appendix C. The method of dealing with identified risks and the level of significance of those risks will be a function of site use. The risk assessment

is based on the Proposed Development and the future proposed land use and assumes no control measures to manage the risk (e.g. source removal or capping) have been incorporated in the development.

The preliminary risk assessment is based on the information that has been made available. The risk assessment should be revised as more information becomes available. Where a Moderate or greater risk has been identified, further investigation is normally required to clarify the risk and to determine the potential liability. Remediation work may be required and there may be a requirement for mitigation measures may need to be employed.

The preliminary risk assessment is presented in Table 3.4.

Summary of Preliminary Risk Assessment

Given the history of the site, Made Ground is considered likely to be present throughout, and no specific investigation information is available to identify or quantify potential contaminants within the Proposed Development areas. The preliminary risk assessment has identified risks to future site users associated with Made Ground from previous site uses as Moderate.

A draft briefing note that has been provided by BAL (full title: Bristol Airport, Eastern Terminal Ground Investigations: Briefing Note. Cascade Consulting, December 2014. Draft - Interim Technical Note for Information Only) gives a summary of investigations to the east of the terminal building where kerosene contamination has been identified. Specific detailed information has not been provided; however, the note states that "steps are necessary to determine the scope of the remedial options if that is required". It is not known whether any further measures have been implemented, and in the absence of any such information risks to future site users and groundwater have been assessed as Moderate.

The presence of collapse features and voids has been noted at the BAL site. It is not known whether any investigation of potential voids and collapse features has been carried out within the Proposed Development, and in the absence of such information the risk to property has been assessed as Moderate.

The Envirocheck Report[2] identifies that the HPA places the BAL site within a higher probability radon area, such that 10 – 30% of homes are above the Action Level. In the absence of any site-specific information to indicate otherwise, the risk to future site users has been assessed as Moderate.

All other potential risk at the site have currently been assessed as either Low or Low to Moderate. The risk assessment should be revised as more information becomes available.

It should be noted that risks to current site users and re-development workers has been excluded from this assessment for the reasons outlined in Section 3.2.

Table 3.4 Preliminary Risk Assessment – Risks to Future Site Users, Property and Environment

Potential Source	Potential Contaminants	Potential Receptors	Proposed Development Area	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
Made Ground from previous use of the site (including former sewage works, ground works and level raising).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours.	Future Site Users (including during the development/ construction phase)	Site-wide (in particular the gyratory road)	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.	Health Hazard [Severe]	Low	Moderate (Made Ground is likely to be present. No investigation information is available and potential contaminants within proposed development areas is unknown)
		Off-Site Adjacent Future Site Users (including during the development/ construction phase)	N/A	Inhalation of dusts, vapours, fibres and accumulated gases. Ingestion, including of contaminated potable water,	Health Hazard [Medium]	Unlikely	Low
		Property: Buildings, Structures and Services	Site-wide (in particular the gyratory road)	Direct contact, ingress and accumulation of gases. Damage from collapse and subsidence.	Damage to Property [Medium]	Low	Low to Moderate
		Controlled Waters: Principal Aquifer, Secondary A Aquifer (bedrock) and SPZs.	Site-wide	Leaching, migration.	Pollution of Controlled Waters [Mild]	Low	Low

Potential Source	Potential Contaminants	Potential Receptors	Proposed Development Area	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
Current and former use as an airfield (including former WWII / RAF site uses).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours.	Future Site Users (including during the development/ construction phase)	Site-wide	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.	Health Hazard [Severe]	Unlikely	Low to Moderate
		Off-Site Adjacent Future Site Users (including during the development/ construction phase)	N/A	Inhalation of dusts, vapours, fibres and accumulated gases. Ingestion, including of contaminated potable water,	Health Hazard [Medium]	Unlikely	Low
		Property: Buildings, Structures and Services	Site-wide	Direct contact, ingress and accumulation of gases. Damage from collapse and subsidence.	Damage to Property [Medium]	Low	Low to Moderate
		Controlled Waters: Principal Aquifer, Secondary A Aquifer (bedrock) and SPZs.	Site-wide	Leaching, migration.	Pollution of Controlled Waters [Mild]	Low	Low
Current and historical bulk fuel storage and fuel spillage / leakage.	Aviation fuel / petroleum hydrocarbons, volatile vapours.	Future Site Users (including during the development/ construction phase)	Terminal extensions and pier/walkway.	Dermal contact, ingestion (including of contaminated potable water), inhalation of vapours, and accumulated vapours.	Health Hazard [Severe]	Low	Moderate (Evidence of kerosene in groundwater within area of 1)
		Off-Site Adjacent Future Site Users (including during the development/ construction phase)	N/A	Inhalation of vapours. Accumulated vapours. Ingestion of contaminated potable water,	Health Hazard [Severe]	Unlikely	Low to Moderate
		Property: Buildings, Structures and Services	Terminal extensions and pier/walkway.	Direct contact, ingress and accumulation of vapours.	Damage to Property [Medium]	Low	Low to Moderate

Potential Source	Potential Contaminants	Potential Receptors	Proposed Development Area	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
		Controlled Waters: Principal Aquifer, Secondary A Aquifer (bedrock) and SPZs.	Site-wide	Leaching, migration.	Pollution of Controlled Waters [Medium]	Likely	Moderate (Evidence of kerosene in groundwater within area of 1)
On-site and adjacent landfilling (excluding possible infilling of former quarries and voids – assessed below).	Metals and metalloids, asbestos, organic and inorganic compounds, polyaromatic hydrocarbons, flammable gas (methane), carbon dioxide, depleted oxygen, volatile vapours.	Future Site Users (including during the development/ construction phase)	Cogloop and highway improvements	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.	Health Hazard [Severe]	Unlikely	Low to Moderate
		Off-Site Adjacent Future Site Users (including during the development/ construction phase)	N/A	Inhalation of dusts, vapours, fibres and accumulated gases. Ingestion, including of contaminated potable water,	Health Hazard [Medium]	Unlikely	Low
		Property: Buildings, Structures and Services	Cogloop and highway improvements	Direct contact, ingress and accumulation of gases. Damage from collapse and subsidence.	Damage to Property [Medium]	Unlikely	Low
		Controlled Waters: Principal Aquifer, Secondary A Aquifer (bedrock) and SPZs.	Site-wide	Leaching, migration.	Pollution of Controlled Waters [Mild]	Low	Low

Potential Source	Potential Contaminants	Potential Receptors	Proposed Development Area	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
Natural geology / historical mining (including collapse features / voids, mining, quarrying and associated infilling).	Metals, metalloids, organic compounds, inorganic compounds, petroleum hydrocarbons, PAH's, asbestos, flammable gas (methane), carbon dioxide, depleted oxygen.	Future Site Users (including during the development/ construction phase)	Site-wide (collapse features / voids); Terminal extensions, taxiway widening, Cogloop and service yard (area-specific former quarrying); and Multi storey car park and Cogloop (historical mining at the north and south of the BAL site).	Dermal contact, ingestion (including of contaminated potable water), inhalation of dusts, vapours, fibres and accumulated gases.	Health Hazard [Severe]	Unlikely	Low to Moderate
		Off-Site Adjacent Future Site Users (including during the development/ construction phase)	N/A	Inhalation of dusts, vapours, fibres and accumulated gases. Ingestion, including of contaminated potable water,	Health Hazard [Medium]	Unlikely	Low
		Property: Buildings, Structures and Services	Site-wide (collapse features / voids); Terminal extensions, taxiway widening, Cogloop and service yard (area-specific former quarrying); and Multi storey car park and Cogloop (historical mining at the north and south of the BAL site).	Direct contact, ingress and accumulation of gases. Damage from collapse and subsidence.	Damage to Property [Severe]	Low	Moderate (Collapse features and voids associated with natural geology have been reported at the site. No investigation information is available and potential voids may exist within proposed development areas)
		Controlled Waters: Principal Aquifer, Secondary A Aquifer (bedrock) and SPZs.	Site-wide	Leaching, migration.	Pollution of Controlled Waters [Mild]	Low	Low

Potential Source	Potential Contaminants	Potential Receptors	Proposed Development Area	Potential Pathways to Receptors	Associated Hazard [severity]	Likelihood of Occurrence	Risk/ Significance
Natural geology	Radon gas.	Future Site Users (including during the development/ construction phase)	Terminal extensions and pier/walkway, and any occupied building/structures where radon gas could accumulate.	Accumulation and inhalation of naturally occurring radon gas.	Health Hazard [Severe]	Low	Moderate (The HPA indicates that the BAL site is within a higher probability radon area and that 10 – 30% of homes are above the Action Level)

4. Conclusions and Recommendations

4.1 Conclusions

Where Moderate or greater risks are identified, further investigation is normally required to clarify the risk and to determine the potential liability. The preliminary risk assessment has identified Moderate risks to future site users within the Proposed Development associated with Made Ground from previous site uses; spillage / leakage associated with bulk fuel storage and use; and radon gas from the natural geology underlying the site. In addition, the presence of collapse features and voids has been documented at the BAL site and a Moderate risk has been assessed to property. All other potential risk at the site have currently been assessed as either Low or Low to Moderate.

Following development, it is anticipated that the majority of the Proposed Development will be occupied by either buildings or hard surfacing, which will effectively break potential contaminant pathways to human receptors, such as dermal contact and ingestion pathways and will limit infiltration to underlying ground.

It should be noted that risks to current site users and redevelopment workers has been excluded from this assessment for the reasons outlined in Section 3.2. This does not mean that associate risks are not present and potential risks should be addressed accordingly.

Should further information become available, or further investigation be completed to clarify risks and potential liabilities, the risk assessment should be revised. This may decrease or increase the assessed risk depending on the information.

4.2 Recommendations

The following specific actions are recommended to permit refinement of the risk assessment and Conceptual Model, and to determine whether or not any remedial action is required in advance of the construction phase:

- Confirm whether any further baseline information is held by the Environment Agency and North Somerset Council, to supplement that reviewed in this report;
- Confirm whether any further information is held by BAL that has not previously been made available for this report. In particular this includes any further information regarding the reported kerosene contamination in the vicinity of the eastern terminal extension;
- Acquire further information regarding potentially contaminated ground conditions within and adjacent to the footprint of the Proposed Development. This may include ground investigations where information is unavailable;
- Acquire further information regarding possible voids, collapse features, infilled solution cavities, and historical limestone quarrying and lead workings within the footprint of the Proposed Development. This may include geophysics and/or targeted ground investigation where supplementary information is unavailable; and

- Consideration should be given to commissioning a site-specific radon assessment report. Where required, radon protection measures should be installed in accordance within The Building Regulations 2010 England[7].

The following recommendations pertain to the construction phase of the Proposed Development:

- The preliminary risk assessment does not consider risks to construction /site maintenance workers on the assumption that workers' health and safety will be covered by regulations under the Health and Safety at Work Act 1974. Site-specific contamination data obtained from all land quality assessments and site investigations pertinent to the Proposed Development areas should be included in the pre-construction information (a requirement of Construction Design and Management Regulations 2015) to enable any contractors to address as necessary in their risk assessments and method statements, and prepare a Construction Phase Health and Safety Plan for the proposed works;
- A number of interceptors and soakaways are present within the northern area of the BAL site associated with surface water drainage within this area. During the construction phase it is important that the integrity of this system is maintained as it represents a potential pathway for pollutants to enter groundwater;
- Earthworks should be managed appropriately to avoid exacerbating risks associated with any contaminated soils or liquids encountered, including potentially increased risk from mobilisation of contamination as windblown dust, run off to surface water and leaching to groundwater; and
- The Construction Phase Health and Safety Plan should include provision for dealing with any unforeseen contamination that may be encountered during site works.

It is recommended that the risk assessment should be reviewed and revised should any further information become available, or further investigation be completed to clarify risks and potential liabilities.

[7] Department of Communities and Local Government (DCLG). The Building Regulations 2010 England. Approved Document C. *Site preparation and resistance to contaminants and moisture.* (2004 edition incorporating 2010 and 2013 amendments) London, NBS, 2013.

Appendix A
Figures

350500
351000
351500
166000
165500
165000

Lulsgate Bottom

Potters Hill

Downside Road

Garage and car valeting

Approximate location of WWII M.T. Garage

Approximate location of WWII armoury

Approximate location of WWII aviation petrol installations (1,000 gal)

Approximate location of WWII bulk oil compound

Approximate location of WWII lubricants and inflammables store

Approximate location of WWII fuel compound

Approximate location of former Felton Hill Quarry

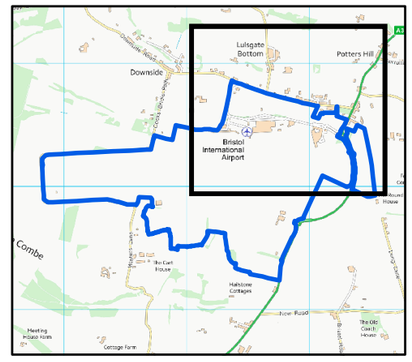
Approximate location of former sewage farm, demolished by 1964

Approximate location of WWII field compound

Approximate location of demolished sub-station

Key

- Bristol Airport Ownership Boundary
- Possible extent of kerosene contamination as per Cascade briefing note December 2014
- Former landfill
- Potentially contaminative land
- Possible areas of Made Ground
- Storage tank
- Approximate location of former substation / transformer
- Collapse features and voids
- Old lead workings (dots indicative not accurate)



0 100 200 300 m

Scale at A3: 1:5,000

Client

Bristol Airport
Amazing journeys start here

Development of Bristol Airport to Accommodate 12 Million Passengers Per Annum
Scoping Report

Figure B1
Geo-environmental constraints plan - Northern area

June 2018

wood.

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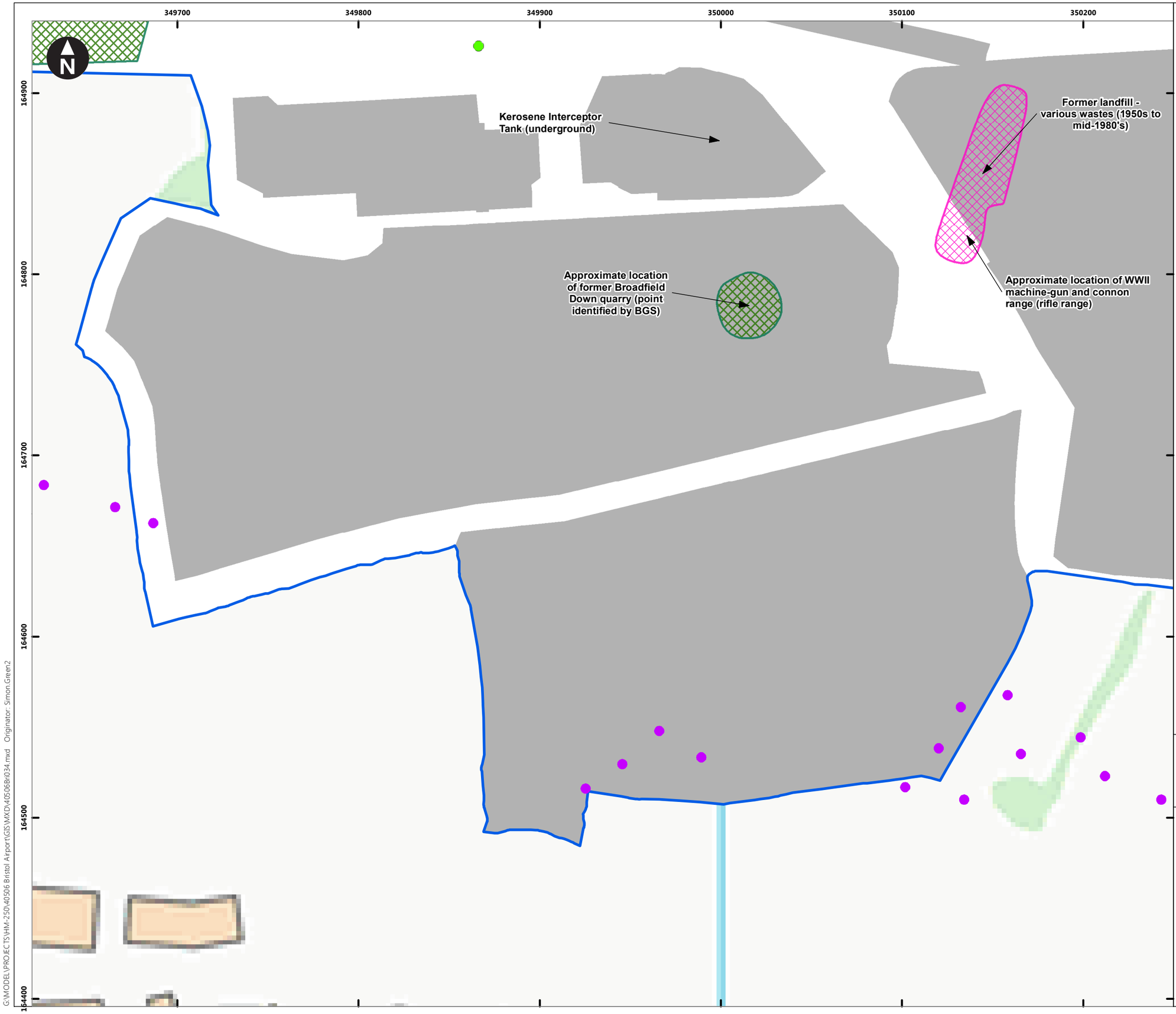
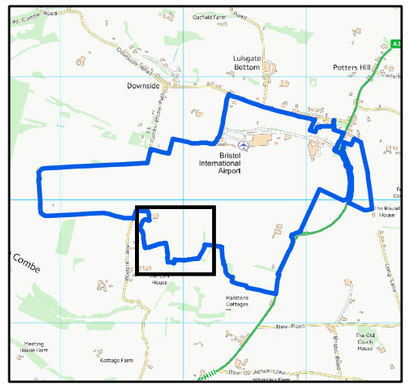


Key

- Bristol Airport Ownership Boundary
- Former landfill
- Possible areas of Made Ground
- Approximate location of former substation / transformer
- Old lead workings (dots indicative not accurate)



0 20 40 60 80 100 120 m

Scale at A3: 1:2,000

Client

Bristol Airport
Amazing journeys start here

Development of Bristol Airport to Accommodate 12 Million Passengers Per Annum
Scoping Report

Figure B2
Geo-environmental constraints plan - Southern area

June 2018

wood.

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