

# Technical Note

Project:	HORSHAM WSCC ENTERPRISE PARK				
Subject:	REVIEW OF PHASE III SITE INVESTIGATION REPORT				
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## Document history

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## Client signoff

Client	WEST SUSSEX COUNTY COUNCIL (WSCC)
Project	HORSHAM WSCC ENTERPRISE PARK
Project No.	5197470
Client signature / date	

# 1. Introduction

West Sussex County Council (hereafter known as WSCC), current owners of the land known as Enterprise Park, have commissioned LEAP Environmental Ltd. (hereafter known as LEAP) to undertake a Phase III intrusive site investigation, with the aim to define the current baseline geoenvironmental and geotechnical conditions for the site, informing sale by WSCC to prospective developers. Atkins Ltd. (hereafter known as Atkins) have been appointed to provide oversight during the site investigation and a final report review.

The site was formerly occupied by Novartis Pharmaceuticals, with the earliest recorded structures on site labelled as 'laboratories' in the 1930's. Subsequent phases of site expansion are recorded in 1960's, 1980's and 1990's. The first indication of demolition is noted as 2013, with all structures on site, with the exception of two, having been removed to date.

The site has been subject of several former investigations, including for site characterisation, remediation and validation. It is understood that the Client (WSCC) does not have reliance on any of these previous reports, however, the full and partial information from these previous reports has been reviewed and considered in light of the findings from the LEAP Phase III investigation.

# 2. Review of Phase III report

Atkins' review of the LEAP Phase III report (LP2441, dated 16 March 2021) aims to provide commentary on adherence to current industry guidance requirements, report content and findings. The review is presented below in Table 2-1.

The review undertaken is impartial and does not seek to provide recommendations on future site works or instruction to LEAP on possible inclusions/omissions to their report. Should the Client want to share these comments with LEAP, it is undertaken at their discretion.

Atkins did not comment on the design of the ground investigation prior to LEAP commencing the site works, or on the selection of samples for geotechnical and geoenvironmental laboratory testing.

**Table 2-1 - Review of LEAP Phase III Report**

Section	Page	Commentary
Executive Summary	-	<p>General</p> <ul style="list-style-type: none"> <li>In light of the context of the site, a brief description of site and contamination history would aid in creating a more informed understanding for the reader.</li> </ul> <p>Geotechnical considerations</p> <ul style="list-style-type: none"> <li>No comment provided on site levels and cut/fill etc.</li> <li>No comment provided on material class (SHW Series 600) for re-use.</li> <li>No comment on anticipated allowable bearing capacity in western area.</li> <li>No comment on preliminary pavement recommendations (CBR value etc.)</li> </ul> <p>Geoenvironmental considerations</p> <ul style="list-style-type: none"> <li>Geoenvironmental assessment approach was non-targeted which is valuable information and should be provided.</li> <li>Elevated concentrations identified need to be qualified in further detail (residential/commercial end users etc.)</li> <li>Figure 11 showing locations of contamination identified should be referenced/linked in Executive Summary for ease of reading.</li> </ul>

Section	Page	Commentary
		<ul style="list-style-type: none"> <li>Recommendations to highlight the residual risk of land drains (3) underlying the site, and the unknown connections/discharge from the site into Horsham Lake, should be raised here.</li> <li>Anecdotal conversations by Atkins during the site walkover with the demolition contractor, indicated theft of old fixtures and fittings from the retained building took place over several months/years. It is understood that substantial damage to asbestos contained within the building took place during the theft which may have been transported outside, specifically to the north of the retained building where it is understood access and egress took place. Although access prevented investigation of this area, a residual risk remains, and should be highlighted here.</li> </ul>
2.0 Proposed development	1	The illustrative master plan MP001 rev C dated 14/12/18 is not provided, or not identified adequately in Appendix B.
5.1 Intrusive Investigation Scope	4	Note, the general requirements for a Ground Investigation Report are set out in Section 3.4 in EC7.
7.0 Site location and description	7	<ul style="list-style-type: none"> <li>Does the concrete retaining wall description pertain to the crib wall or another retaining structure? Reference to site photos?</li> <li>Building reference numbers alluded to throughout this report are not listed on any plan.</li> </ul>
9.1 QRA of Contaminant Linkages	11	Leachate from soil contaminants and mobile liquid contaminants entering the deep aquifer were identified as a risk, however there is no further comment provided in Section G Geoenvironmental Appraisal to qualify this risk? Furthermore, leachates from soil contaminants and mobile liquid contaminants entering the shallow groundwater and being transported offsite via surface water drains (notably to Horsham pond) needs to be raised as a residual risk.
12.5.3 Geotechnical Laboratory testing	21	Table 5 is confusing as it does not provide context with regards to the materials tested on site. Ideally, number of tests should be shown according to stratum encountered, not (assumed) grain-size/site characterisation. This information would be more useful tabulated alongside stratum results in Section 14.0, where an understanding of the test values against the number of samples tested, can be gained.
13.1 Western area	22 - 23	<ul style="list-style-type: none"> <li>Table 6 – ‘Reworked soil’ description summary includes concrete and fine to coarse brick as well as there is no indication this ‘reworked’ soil has been placed to any engineering specification. This would infer it is Made Ground.</li> <li>Figures 5 and 6 show geological cross-section for the west. All cross-sections are also given in m OD whereas depths are shown in m bgl in Table 6. Using m OD for all levels will normalise the site levels and underlying stratum providing more context, and link in with the geological cross-section.</li> <li>No average depths are provided for any of the strata encountered. It is difficult to gauge the extent of material present (e.g. Made Ground ranging from 0.5 to 2.9 m) when no average is given.</li> </ul>
13.1 Eastern area	23-25	<ul style="list-style-type: none"> <li>Table 6 – ‘Reworked soil’ description summary includes concrete and fine to coarse brick, as well as there is no indication this ‘reworked’ soil has been placed to any engineering specification. This would infer it is Made Ground. This would infer it is Made Ground.</li> <li>No average depths are provided for any of the stratum encountered. It is difficult to gauge the extent of material present (e.g. MG ranging from 0.5 to 2.9 m) when no average is given.</li> </ul>

Section	Page	Commentary
13.5 Other observations	31	For Table 13 to be of any use, the locations of the historical exploratory hole positions would need to be plotted on a plan, or as a minimum, all historical reports should be appended to this Phase III report.
14.0 Strata Encountered	32 - 35	<ul style="list-style-type: none"> <li>The SPT N values have been left as uncorrected, and no comment provided to justify this.</li> <li>There are no averages provided for test results and parameters.</li> <li>The Cu range of 55 – 495 kPa would be considered firm to hard, not firm to very stiff.</li> <li>There are no SPT N vs Level or Undrained Shear Strength vs Level plots to show strength variation across the site and with depth.</li> </ul>
16.0 Sulphates	37	<ul style="list-style-type: none"> <li>Environmental groundwater samples tested for pH and sulphate have not been included in the BRE Special Digest 1 soil aggressivity assessment and consequent site classification.</li> <li>In accordance with the definition of a Brownfield site as set out in BRE Special Digest 1, the sulphate laboratory test results appear to be in accordance with test Suite A – Greenfield (pyrite absent) and not Suite C – Brownfield (pyrite absent) (as defined in ICE Specification for Ground Investigation).</li> </ul>
17.0 Groundwater	37	<ul style="list-style-type: none"> <li>Using m OD opposed to m bgl for all levels will normalise the site levels and underlying stratum providing more context for the site, and link in with the geological cross-section.</li> <li>There are no averages provided.</li> </ul>
Section F – Geotechnical Appraisal	36 - 44	No characteristic material parameters for soils are provided for drained conditions (angle of shearing resistance, bulk density, effective cohesion etc.).
26.0 Settlement	44	It is stated that site levels are not anticipated to be raised, however further detail on remedial options to mitigate the effects of immediate settlement (Made Ground in eastern portion of the site) and consolidation settlement (underlying soft clays and silts combined with shallow groundwater table) would be beneficial should a change in anticipated development take place..
27.0 Conceptual Site Model	45	A statement is made regarding the identification of hydrocarbons in areas of storage and use, with only some of these areas being remediated through excavation and removal from site. Were the remaining areas of concern identified and investigated?
28.1 Soil sampling	46	<ul style="list-style-type: none"> <li><i>'Samples have been tested for the presence of the identified contaminants of concern (heavy metals, PAH compounds, petroleum hydrocarbons, SVOCs, VOCs and asbestos as detailed in the table above' - Table reference not provided.</i></li> <li>The first paragraph speaks of a 'non-targeted approach' to geoenvironmental sampling, however the last paragraph speaks about restrictions preventing all potential sources of contamination being targeted (notably access) – This is confusing and should be clarified.</li> </ul>
28.3	47	The Conceptual Site Model (27.0) indicates a risk posed by identified off-site backfill. Has this risk been investigated/accommodated in the placement of ground gas monitoring wells?
31.0 Analytical Test Results - Water	55 - 56	<ul style="list-style-type: none"> <li>Table 24 does not indicate whether the samples taken from BH101 - BH106 were from shallow or deep wells, and therefore whether the bedrock aquifer has been impacted.</li> <li>Phenols identified in groundwater can be due to discharge from industrial, domestic and wastewater activities. Given elevated levels</li> </ul>

Section	Page	Commentary
		were measured in both monitoring visits, can this comment be qualified further.
36.0 Recommendations for Remediation	63	No industry accepted standard is referenced for the capping/clean cover thickness recommendations provided.
Further comments	-	Check spelling and grammar throughout the document.

## 3. Comparison between findings from Phase III LEAP report and previous investigations

### 3.1 Introduction

A high-level comparison between the findings of the existing reports in light of the findings presented in the Phase III LEAP report has been undertaken. Only those reports which present findings based on site investigation information have been compared with the Phase III LEAP report findings, with all Phase 1 reports (Conceptual Site Model) leading to Phase 2 site investigation, omitted. The reports have been itemised below and a brief summary of the pertinent findings of each follows.

All reports, (or part thereof) which have been reviewed are listed below:

1. Historical Land Quality Investigations Data Review and Preliminary Risk Assessment, Ref.01140 KDC, March 2016, Rev. V1
2. Phase 2 Environmental Investigation, Ref:01140, KDC, June 2016, Rev 0
3. Phase 1 Geoenvironmental Site Assessment, 1CO105712/P1/R0, REC, June 2018, Rev 0
4. Asbestos risk assessment in demolition material, Letter report, OA/20/LP2309, LEAP Environmental Ltd., 18<sup>th</sup> September 2020, Rev. 0
5. Phase 2 Land Quality Investigation, 12<sup>th</sup> July 2013, SKM Enviros, Rev. 1
6. Further Land Quality Investigation, 17<sup>th</sup> October 2014, JACOBS, Rev. 1B
7. Phase 2 Site Investigation, March 2008, NO0740005, Enviros Consulting Ltd., Rev. 1
8. Drainage Works Site Investigation, October 2008, NO0740007, Enviros Consulting Ltd., Rev. 1.

It should be noted that the exceedance limits referenced for comparison for all geoenvironmental testing (soil and groundwater) within the reports may differ due to the date of production and industry guidance revision.

### 3.2 Historical Reports Review

This section outlines the information provided in each of the aforementioned reports:

#### 1. Historical Land Quality Investigations Data Review and Preliminary Risk Assessment, Ref.01140 KDC, March 2016, Rev. V1

No intrusive ground investigation was undertaken to inform this report.

#### 2. Phase 2 Environmental Investigation, Ref:01140, KDC, June 2016, Rev 0

Findings indicate that a significant risk to human health for a residential end use persists driven by oral and inhalation pathways.

No significant possibility of significant harm is identified for a commercial end use.

Asbestos was identified in several locations.

Localised risks to the water environment identified from hydrocarbons, and site wide risk identified from metals. Made ground is identified as contributing to groundwater contaminant loading.

Site classified as CS1 in terms of ground gas characterisation.

Design Sulphate Class is DS-2 and the ACEC Class AC-4z.

Predominant area of contamination identified to the south of retained building with predominant remedial recommendation to excavate and remove with localised pumping.

#### 3. Phase 1 Geoenvironmental Site Assessment, 1CO105712/P1/R0, REC, June 2018, Rev 0

No intrusive ground investigation was undertaken to inform this report.

4. Asbestos risk assessment in demolition material, Letter report, OA/20/LP2309, LEAP Environmental Ltd., 18th September 2020, Rev. 0

No asbestos was identified during the investigation, however there is a relatively low risk that asbestos may be encountered in all Made Ground soils found on site.

5. Phase 2 Land Quality Investigation, 12th July 2013, SKM Enviros, Rev. 1

Moderate/ low risk of localised elevated concentrations of ground gas, methane and carbon dioxide, identified. Clean cover recommended for all open areas and supplementary testing required post-demolition.

Moderate/low risk reflecting marginally elevated concentration of organic contamination within Made Ground in areas identified as sources. No contamination identified in areas associated with fuel storage, electricity substation facilities and where existing drainage is to be removed, however the potential for residual contamination remains.

6. Further Land Quality Investigation, 17th October 2014, JACOBS, Rev. 1B

Widespread marginally elevated hydrocarbons and localised asbestos and lead contamination were identified within the Made Ground.

Risk posed by Made Ground to construction works and future residential end users considered moderate, with localised high risk.

7. Phase 2 Site Investigation, March 2008, NO0740005, Enviros Consulting Ltd., Rev. 1

Investigation is noted as limited due to the site being active and identification of buried services, however findings indicate no significant contamination of soils or groundwater.

8. Drainage Works Site Investigation, October 2008, NO0740007, Enviros Consulting Ltd., Rev. 1

Investigation undertaken to determine whether radioactivity derived from drain leakage was present within soils and groundwater to which drainage works may be exposed.

Findings indicate that none of the soils analysed exceeded concentration limits for organic or inorganic determinands, and all measured radioactivity was below detection limits.

Inhouse Enviros Screening Values were used for data comparison.

### 3.3 Comparison to LEAP Report

A comparison of the findings of the LEAP Phase III report and the historical reports is provided below:

#### General

- The LEAP report adopted a broadly non-targeted geoenvironmental approach with the aim to allow for a statistical assessment if required. The majority of the historical reports targeted known or anticipated sources of contamination.
- The LEAP report did not carry out any testing north and south of the retained building and recommended further intrusive investigation and testing. The historical reports identified substantial contamination sources north and south of the retained building.

#### Ground Conditions

- The LEAP report summarised the ground conditions by splitting the site into two distinct areas, the central and eastern area, and the western area.
- The central and eastern area contained Made Ground characterised by building rubble with a thickness extending up to 4 m in depth, followed by the weathered horizon of the Upper Tunbridge Wells Sand Formation outside of demolished building footprints extending to depth of ~3.7 m, grading into very weak to weak mudstone, siltstone and sandstone bedrock.
- The western area was also found to contain Made Ground, although in limited quantities and differing composition. Made Ground was generally encountered beneath pavements and in the footprints of demolished buildings, extending down to between c. 0.4 and 1.0 m. Weathered Upper Tunbridge Wells Sand Formation was found beneath the Made Ground to depths of up to ~3.1 m, grading into very weak to weak mudstone, siltstone and sandstone bedrock.



- The ground conditions reported by the historical reports are in general agreement with the LEAP report, with the exception that various phases of demolition works have subsequently taken place over the site.

#### Groundwater

- The LEAP report found that shallow and deep groundwater tables were not considered to be in hydraulic connectivity. Historical reports generally did not distinguish between shallow and deeper groundwater tables. A shallow groundwater level was encountered at the interface between the Made Ground and underlying weathered silts and clays of the Upper Tunbridge Wells Sand Formation, and a deeper groundwater table within the Upper Tunbridge Wells Sand Formation bedrock at ~9 to 10 m depth.

#### Laboratory Test Results

- The LEAP report did not undertake any radioactivity testing, however the historical reports concluded that the soils tested did not exceed natural levels of radioactivity.
- The LEAP report reported a Design Sulphate Class of DS-1 and ACEC Class of AC-1 for sandy silty clays. Historical reports (2) reported a Design Sulphate Class of DS-2 and ACEC Class of AC-4z site wide, although sample locations are unknown and may constitute contaminated untested areas north and south of the retained building. These results are different and may be associated with different ground conditions; however further analysis of the results would be recommended.
- The LEAP report has stated that the ground gas monitoring is yet to be completed and therefore has not provided a Characteristic Situation (CS) classification. Historical reports generally concluded a Characteristic Situation of CS1 for the site.
- The LEAP report concluded that asbestos, arsenic, lead, nickel and benzo(a)pyrene was identified within Made Ground in the central and eastern portions of the site and pose a risk to human health in critical areas such as gardens and areas of soft landscaping. Historical reports generally concluded similar contaminants of concern elevated above acceptable levels (at the time of historical report issue) for risks posed to human health.

#### Conclusions and Recommendations

- The LEAP report concluded that for commercial land end use, the existing soils were not considered to pose an unacceptable level of risk, which was generally shared by the historical report findings. Notably, the LEAP investigation did not undertake any testing north and south of the retained building where substantial contamination was reported by historical reports.
- The LEAP report did not undertake any investigation of sub-surface drains. Historical reports generally concluded that the risk posed to offsite sources (ground and surface water) by the land drains should be investigated and quantified.
- The LEAP report recommended a capping solution to remediate contamination in areas of soft landscaping, with no remediation required where natural soils are encountered. The historical reports were in general agreement with these findings with the exception of the areas north and south of the retained building.



## 4. Conclusion

The LEAP report has been reviewed by Atkins as part of this technical note. The report is considered to meet the broad requirements of a GIR as outlined in EC7 , with minor comments and clarifications presented in Table 2-1. The review undertaken is impartial, therefore should the Client want to share these comments with LEAP, it is undertaken at their own discretion.

The comparison undertaken of the LEAP report to historical reports suggests that the LEAP report is in general accordance with the findings of the previously undertaken investigations, with no major discrepancies identified. It is noted, however, that the LEAP investigation did not cover the full site covered by the historical investigations, notably the northern and southern sections and therefore location specific discrepancies might have been missed.