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FURTHER DESKTOP LEAD RISK ASSESSMENT

Allotments Site, Spittles Lane Lyme Regis, Weymouth

WPA ENVIRONMENTAL

For
Lyme Regis Town Council

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Draft V1

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EXECUTIVE SUMMARY

As authorised by Lyme Regis Town Council (LRTC), WPA Consultants Ltd, trading as WPA Environmental (WPA), has conducted a Desktop Lead Risk Assessment for an allotments site in close proximity to the former Spittles Lane Landfill Site, in Lyme Regis, West Dorset.

The aim of the risk assessment is to assess ground quality conditions at the existing allotments and to provide the Council with an opinion on the risk to human health posed by lead levels reported along the northern and eastern boundaries of the allotments site.

The works undertaken are based on instructions provided and agreed with the Council and includes the review of various reports, investigations and documentation available for lead and allotments land. The framework of the assessment included in this report is provided by a variety of statutory, non-statutory and technical guidance which have all been subject to various debate and interpretation since publication. The approach followed by WPA in the risk assessment reflects existing Environment Agency guidance and industry good practice. Guidance most pertinent to the risk evaluation stage is provided by DEFRA.

At the time of the preparation of this report there is no evidence to suggest that the allotments could be determined as contaminated under Part 2A of the Environmental Protection Act 1990. There is no evidence to suggest that the amount of lead, which users of the allotments and their families might ingest through different exposure pathways, would represent an unacceptable intake of the contaminant in addition to other likely environmental sources.

It is stressed that limited data have been obtained, and all samples were taken from soils along the boundaries of the allotments. No testing has been carried out for soils used for cultivation of fruit and vegetables. This risk assessment is based on the assumption that contaminant levels reported along the northern and eastern boundaries of the allotments could be an indicative of lead concentrations within areas used for cultivation. However, concentrations of lead within cultivation areas are unknown and can only be determined by intrusive sampling and testing.

There is also uncertainty about lead availability values and soil to plant concentration factors, which will be specific for the site conditions. To determine such parameters, specific investigation and testing will be required and as part of a site-specific risk assessment.

For the allotment’s users and their families, general recommendation should be followed including the appropriate washing and peeling of fruit and vegetables to remove any soil attached to the allotments produce prior to consumption. This should also remove any potential contamination on allotment produce arising from soil/dust atmospheric deposition. Appropriate washing of hands by the allotment users and their families, especially children, is important to further reduce soil intake after visiting the allotments.

The use of compost and organic fertilizers, to enhance carbon levels within cultivated soils, have been proven to reduce the fraction of lead available for uptake in the human body. However, allotments users should bear in mind that some of the fertilizers can contain contaminants, including lead. Careful decisions should be made when selected such soil enhancement products. Environmental awareness is crucial, to prevent contamination of the soils and produce by general allotment practices carried out by the allotment’s users.

1.0 INTRODUCTION

1.1 Background and Scope of Works

1.1.1 At the instruction of Lyme Regis Town Council (LRTC) a Desktop Lead Risk Assessment has been undertaken for an allotments site behind Charmouth Car Park, Lyme Regis, DT7 3DR.

1.1.2 The purpose of this risk assessment is to assess lead concentrations revealed within surface soils, along the northern and eastern boundaries of the allotments, by a Phase 2 Exploratory Site investigation undertaken by WPA in July 2020.

The allotments are in close proximity to the historic Spittles Lane (SL) Landfill Site and there were concerns of potential environmental impacts from this off-site historical land use to the existing allotments. Consequently, a Phase 2 investigation was carried out to assess ground conditions and to determine whether a pollutant linkage existed between the allotments and the former SL Landfill Site.

Based on the findings of the Phase 2 Site investigation, refined Conceptual Site Model (CSM) and Site-Specific Risk Assessment (SSRA), it was concluded that a contaminant linkage does not exist between the former landfill site and the allotments land. However, lead concentrations above the Generic Acceptance Criteria (GAC) for allotments land use were reported from surface soils along the northern and eastern boundaries. Further risk assessment has therefore been recommended for the lead occurrences within allotments land.

1.1.3 This report aims to assess human health risks to allotments users from lead concentrations reported along the boundaries of the allotments site. As part of this Desktop Lead Risk Assessment, desktop data for lead have been analysed, and various research papers reviewed to compare lead concentrations reported from allotment soils across the UK.

In addition, data related to soil lead bioavailability and soil concentrations factors have been appraised to further assess the likelihood of lead concentrations reported within surface soils becoming available to allotments produce and subsequently to allotment users and their families.

Based on the outcome of this Further Lead Risk Assessment, conclusions and recommendations for the site are provided in Section 7.0 of this report.

1.1.4 It is stressed that the surface soils reported to be contaminated with lead are along the boundaries of the allotments and are not used for production of fruit and vegetable. However, there is a possibility that the lead exceedances may extend to areas where fruit and vegetables are grown for human consumption, and such possibility is considered and assessed within this report.

1.2 Methodology

1.2.1 The approach followed in this assessment by WPA Consultants Ltd, trading as WPA Environmental (WPA), reflects existing Environment Agency guidance and industry good practice, and is structured as follows:

I. Identify the problem –This relates to the Phase 1 Desk Study Report, Final V1, December 2019.

II. Undertake site investigation works, to gather information on the ground conditions revealed at the site and/or its surroundings and assess potential contaminant linkages identified by the Phase 1 Assessment.

Assess contamination linkages to establish whether risks are negligible, low, medium or high, in the context of Part 2A of the EPA 1990, via comparison of reported soil contaminant concentrations with the appropriate Tier 1 Generic Acceptance Criteria for Allotments Land Use.

Provide conclusions and recommendations for the site based on the outcome of the Phase 2 Site Investigation and contaminated land risk assessment. This relates to the Phase 2 Site Investigation and Site-Specific Risk Assessment Report, Final V1, October 2020.

III. Carry out further desktop investigation to further assess lead contamination identified within surface soils of the allotments site.

Based on the outcome of the further risk assessment, provide conclusions and recommendations.

1.3 Sources of Information

1.3.1 As part of this desktop lead risk assessment, WPA has reviewed documentation available for lead in allotments land. Documentation referred to and reviewed for this report is listed below:

- Phase 1 Desk Study Report, Final V1, December 2019.
- Phase 2 Site Investigation and Site-Specific Risk Assessment Report, Final V1, October 2020.
- Cadmium and lead in vegetable and fruit produce selected from specific regional areas of the UK. Gareth J. Norton, Claire M. Deacon, Adrien Mestrot, Joerg Feldmann, Paul Jenkin, Christina Baskaran, Andrew A. Meharg. Accepted 29 June 2015.
- Contamination of allotment soil with Lead: Managing potential risks to health. Leonie R Prasad and Bernadette Nazareth. Accepted 6 March 2000.

- Measurement of soil lead bioavailability and influence of soil types and properties: A review Article in Chemosphere · May 2017.

- Lead and cadmium in urban allotment and garden soils and vegetables in the United Kingdom. Ann M. Moir and lain Thornton. Environmental Geochemistry Research, Centre for Environmental Technology, Royal School of Mines, Imperial College.

- SP1010 Appendix H1 – Human Toxicological Data Sheet for Lead. Provisional C4SLS for Lead.

- Human Health Risk Assessment of Lead in Soil. The Key Issues, Of Brownfield Risk Assessment (SOBRA), March 2012. Society.

- Professional Practice Note: Reviewing human health risk assessment reports invoking contaminant oral bioavailability measurements or estimates. Chartered Institute of Environmental Health. June 2009.

1.4 Limitations

1.4.1 It should be understood this Desktop Report is a land quality assessment and does not purport to consider geotechnical engineering, ecological, flood risk or archaeological aspects of the proposed development which fall outside of the scope of this assessment and may require specific surveys.

1.4.2 The information contained in this report is intended for the use of Lyme Regis Town Council (LRTC). WPA takes no responsibility for the use of this information by any other party or for uses other than that described in this report.

1.4.3 It should be appreciated that whilst detailed references have been obtained and reviewed, there may be conditions at the site which could invalidate the conclusions and recommendations made in this report.

2.0 Site Description and Surrounding Areas

2.1 Site Description

2.1.1 The allotments site (Grid Reference 334405.81, 92505.62) is located to the east of Charmouth Road Car Park, east of Lyme Regis, at the border between Dorset and Devon in South West England. The postcode for the area is DT7 3DR. A site location plan is included as Drawing 1.

2.1.2 The allotments are accessed from a lane from Charmouth Car Park. The allotments generally slope down from north to south towards the cliffs and Lyme Bay to the south.

The allotments have 36 plots and are used to grow fruit and vegetables suitable for the UK climate including onions, leeks, tomatoes, courgettes, carrots, potatoes, cabbages, fruit trees, etc. Some small animals such as chickens can be found at the site. Drawing 2 shows the allotments layout and plots distribution.

2.1.3 The edge of the cliffs is approx. 100m south of the allotment's southern boundary. The cliffs and foreshore between Lyme Regis (west) and Charmouth (east) are actively eroding and are prone to coastal erosion and large-scale landslides. These processes are mainly due to the geology and soft rocks of the cliff that are prone to weathering, and to surface and toe erosion.

Photographic records of the allotments and surrounding areas are included in Appendix A.

2.2 Surrounding Areas

2.2.1 Generally, off-site surrounding areas include:

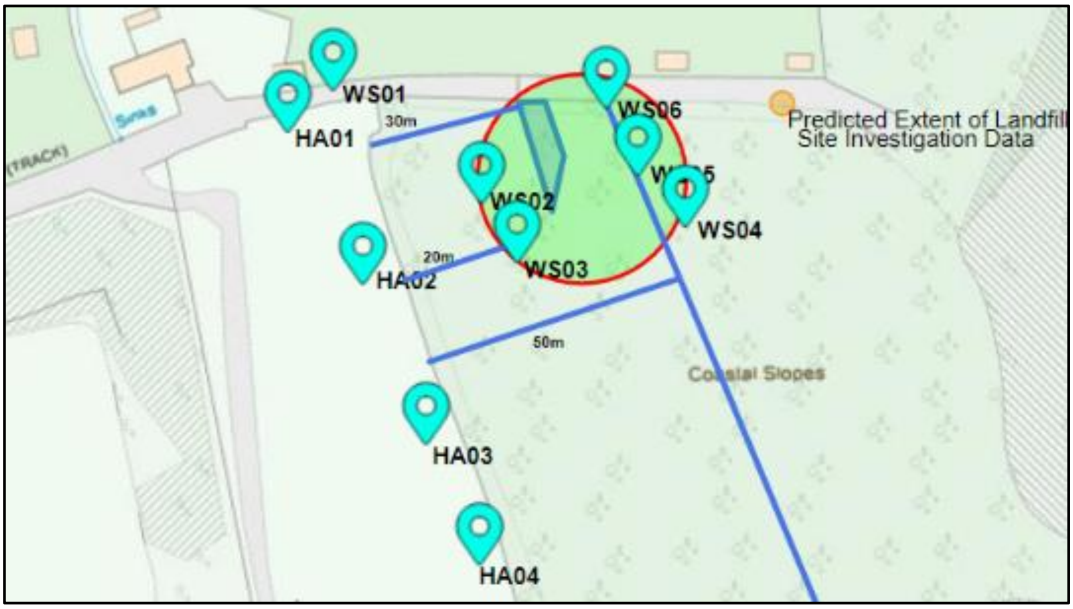
- North: Spittles Lane and agricultural ground further north.
- North-west: Football ground and Lyme Regis Football Club
- West: Charmouth Car Park and Skate park. Charmouth Road further west and residential areas.
- South: Coastal Cliffs, Lyme Bay.
- East: Spittles Lane Landfill Site and The Spittles Coastal Cliffs.

2.2.2 The allotments are in close proximity to the historical Spittles Lane (SL) Landfill Site. SL landfill is accessed from Spittles Lane which runs to the north of Lyme Regis Football Ground and the allotments site. Beyond the allotments, Spittles Lane becomes a track and then an overgrown footpath. The gate house of the former landfill (end of the track) is now derelict and covered by vegetation. There are signs of recent fly tipping at the site.

2.2.3 Various investigations and reports have been carried out to determine the proximity of the Allotments to the SL Landfill Site. Also, to determine whether a contaminant linkage exists between the former landfill site and the allotments.

2.2.4 The outcome of the exploratory site investigation indicates that infilled ground associated with the former SL Landfill Site is present 50-54m from the eastern boundary of the allotments, extending to the east. It was not possible to determine whether there are infilled soils between 21 and 50m from the allotment’s eastern boundary.

However, field observations suggest that infilled soils related to SL Landfill activities may commence 30m from this boundary, where an earth bank is present. The absence of infilled soils associated with the landfill activities is confirmed by boreholes at 18-21m from the eastern boundary of the allotments. Drawing 8 of the Phase 2 Report shows the predicted extend of the former landfill site to the west in its proximity to the allotments site.



Extract from Drawing 8 of the Phase 2 Site Investigation Report, WPA, October 2020.

In terms of the human health risk assessment, site data and Site-Specific Risk Assessment (SSRA) have determined that a contaminant linkage does not exist between Spittles Lane Landfill Site and the allotments Land.

2.2.5 No other off-site contaminated land uses have been identified within close proximity to the site, which could have an impact on the environmental conditions of the allotments site.

3.0 CONTAMINANTS OF CONCERN

3.1 **Lead:** The exploratory intrusive site investigation undertaken for the allotments and surrounding land (SL Landfill Site) in July 2020, identified lead levels above the Generic Acceptance Criteria (GAC) for allotments land use of 80mg/kg.

Lead concentrations ranging between 100mg/kg and 270mg/kg were reported from surface soil samples to depths up to 0.30m bgl. These concentrations were reported from hand auger pits excavated along the northern and eastern boundary of the allotments, within allotments land. The location of the sampling points is shown on Drawing 3 of this report.

The surface contaminated soils were described as TOPSOIL. Made ground was only encountered within the allotments at one location (HA05). The made ground sample reported the highest lead levels of 460mg/kg. Refer to table below.

Determinant	Units	Assessment Criteria	No. Exceedances	Maximum	Samples exceeding GAC
Lead	**mg/kg**	**80**	**6**	**270** **120** **100** **200** **460** **180**	**HA01 0.10-0.20m** **HA02 0.30m** **HA03 0.20m** **HA04 0.20m** **HA05 0.20-0.30m** **HA0.20m**

Indigenous soils (clay), below the topsoil and single made ground sample (HA05), reported very low levels of lead, with concentrations ranging between 16mg/kg and 27mg/kg.

3.2 **Other Contaminants**: Asbestos fibres described as Chrysotile- Loose Fibres below <0.001, were reported from a topsoil sample from HA01 at 0.10-0.20m. Asbestos fibres/Asbestos Containing Materials (ACMs) were not reported from any other soil sample and/or visually identified during the site works. Its single occurrence could be an anomaly, or a result (although not significant) of the various activities potentially undertaken at the allotments by its users.

Based on field observations and due to the trace levels of asbestos reported by the chemical testing (<0.001), a significant risk of significant harm is not perceived from asbestos to allotment users. No further action is recommended in this regard unless new information indicating the presence of asbestos comes to light.

All other inorganic and organic contaminant concentrations from topsoil/made ground samples were low and below their respective GAC for allotments land use.

3.3 **Recommendation**: Although the surface soils reported to be contaminated with lead are along the boundaries of the allotments, and this area is not used for the production of fruit and vegetables, there is a possibility that the lead exceedances may extend to areas where fruit and vegetables are produced for human consumption.

WPA has therefore recommended that further consideration and risk assessment is undertaken to assess potential risk from lead levels reported at surface level to current users of the allotments.

4.0 CONCEPTUAL SITE MODEL & RISK ASSESSMENT

4.1 Preamble to the risk assessment

4.1.1 Within the Desktop Lead Risk Assessment, the Source-Pathway-Receptor methodology was utilised to identify potential sources of the lead contamination, the routes or means via lead may migrate, and the potential humans, properties and/or controlled waters receptors, that may be affected by this contaminant if a suitable pathway were to exist.

4.1.2 The normal procedure for assessing land dictates that identified Potential Contaminant Linkages (the Source-Pathway-Receptor methodology) should be assessed and that an evaluation of the risks associated with each linkage should drive decisions regarding the status of the land as contaminated, unaffected by contamination or requiring further investigation.

Under Part 2A, the starting point should be that land is not contaminated land unless there is reason to consider otherwise. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with the Statutory Guidance, should be considered as meeting the Part 2A definition of contaminated land.

4.1.3 Under Part 2A, risks should be considered only in relation to the current use of the land. “Current use” means:

A. The use which is being made of the land currently.

B. Reasonably likely future uses of the land that would not require a new or amended grant of planning permission.

C. Any temporary use to which the land is put, or is likely to be put, from time to time within the bounds of current planning permission.

D. Likely informal use of the land, for example children playing on the land, whether authorised by the owners or occupiers, or not

4.1.4 Sites subject to Detailed Inspection under Part 2A by Local Authorities should be classified as Categories 1 to 4.

Category 1: Human Health Cases. A significant possibility of significant harm exists in any case where a Local Authority considers there is an unacceptably high probability, supported by robust science-based evidence that significant harm would occur if no action is taken to stop it.

Category 2/3: Human Health Cases. For land that cannot be placed into Categories 1 or 4, the local authority should decide whether the land should be placed into either: (a) Category 2: Human Health, in which case the land would be capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health. This includes land where there is little or no direct evidence that similar land, situations or levels of exposure have caused harm before, but nonetheless the authority considers on the basis of the available evidence, including expert opinion, that there is a strong case for taking action under Part 2A on a precautionary basis; or (b) Category 3: Human Health, in which case the land would not be capable of being determined on such grounds. This can include land where the risks are not low, but nonetheless the authority considers that regulatory intervention under Part 2A is not warranted.

Category 4: Human Health Case. Occur where there is no risk or that the level of risk posed is low. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages.

4.1.5 To build the initial conceptual model, the Desktop Lead Risk Assessment uses data to identify all the Lead Sources, Pathways and Receptors present on site. The elements of the conceptual model contained in Table 4/3 consider Potential Contaminant Linkages, their significance and the acceptability of risk for allotments land use.

4.1.6 When considering the Contaminants, Receptors and Pathways relevant to the Site, WPA has been mindful that the current and future land use are allotment gardens.

The risk assessment examines the consequence of a hazard to a receptor against the likelihood of its occurrence. The likelihood is rated accordingly:

- **Certain:** > 90% of hazard receptor linkage
- **Likely:** 60-90% of hazard receptor linkage
- **Possible:** 40-60% of hazard receptor linkage
- **Unlikely**: 10-40% of hazard receptor linkage
- **Negligible:** <10% of hazard receptor linkage

4.1.7 Using this information, a risk classification is then attached to each of the potential hazard sources in accordance with Table 3/1. The risk classifications are:

- **Severe**: it is likely that the hazard source could cause harm to a designated receptor and harm would be significant.

- **Moderate**: it is possible that the hazard source could cause harm to a designated receptor, but it is unlikely that the harm would be significant.

- **Mild**: it is possible that the hazard source could cause significant harm to a designated receptor, however it is likely to be mild.

- **Negligible**: the potential hazard source cannot cause significant harm to the receptor.

Tables 4/1 and 4/2 set out the potential consequences of that correspond to each classification of risk and the risk classification

Table 4/1
Potential Consequence of Hazard Linkage

Classification	Human Health	Controlled water	Built Environment	Ecosystems
Severe	Irreversible damage to human health	Significant pollution to a sensitive or important controlled water	Damage to a building or structure that would require repair or remedial measures in excess of £20,000.	Irreversible change to an existing ecological species, habitat or ecosystem. Prohibit proposed growth of species, ecosystem or habitat
Moderate	Reversible long-term damage to human health	Pollution to a non-sensitive controlled water	Damage to a building or structure that would require repair or remedial measures below £20,000.	Will impair the development of an existing species, ecosystem or habitat. Permit limited growth of a proposed species, ecosystem or habitat
Mild	Reversible but short-term damage to human health	Minor pollution to a non-sensitive controlled water	Repairable damage to building or structures which would not require excessive cost	Minor change or effects of development on species or habitat but does create long term effects on ecosystem.
Negligible	No discernible damage to human health	No discernible pollution likely to a non-sensitive controlled water	Insubstantial damage not requiring repair	No significant effects on existing or proposed species, habitats or ecosystems.

Table 4/2
Risk Classification

		Potential consequence of hazard linkage			
		Severe	Moderate	Mild	Negligible
Likelihood of hazard receptor linkage	Certain	High	High	Medium	Low
	Likely	High	High	Low	Low
	Possible	High	Medium	Low	Negligible
	Unlikely	Medium	Low	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

4.2 Contaminant Source

4.2.1 **Background**: As previously described, intrusive site investigation works has identified within allotments land, lead levels above the Generic Acceptance Criteria (GAC) for allotments land use of 80mg/kg.

Lead concentrations ranging between 100mg/kg and 270mg/kg were reported from topsoil samples from surface levels up to 0.30m bgl, from soils along the northern and eastern boundaries of the allotments site.

A single lead concentration of 460mg/kg was also reported from soils described as made ground. Made ground was only encountered at one location (HA05), within an area reported as likely to have imported soils related to a new cut off drain installed as part of the ground stabilization works completed in 2016.

The outcome of the intrusive site investigation and Site-Specific Risk Assessment (SSRA) undertaken for the site indicates that the lead concentrations reported at the allotments site are most likely to originate from activities carried out at the allotments, rather than resulting from contaminant migration from off-site areas. For further information, refer to the Phase 2 Site Investigation and Site-Specific Risk Assessment Report.

Testing results indicate that the lead impaction is only present within surface soils up to 0.30m with the possible exception of the identified made ground. Indigenous soils described as stiff to very stiff CLAY were encountered from 0.20-0.30m bgl up to 1.2m bgl. Lead concentrations within these soils were very low with concentrations ranging from 16mg/kg to 27mg/kg.

4.2.2 **Sources of Lead:** Allotments can typically contain contaminant species for a variety of reasons closely associated with the use of the allotments themselves, as opposed to contamination migrated from neighbouring land.

Examples include the informal import of a wide variety of soils and materials for fertilising/soil improvement. These may include sewage sludge, livestock manures and inorganic fertilisers. Additionally, ash and clinker were often used in the past to create pathways between allotments and as fertilizers.

Other sources of lead may include atmospheric urban deposition and particles (dust/flakes) of lead from painted wood, sheds, etc. Various research papers indicate that the main route of lead in agricultural land in England and Wales is through atmospheric deposition, e.g., lead emissions into air from vehicle exhausts (leaded petrol) and industrial chimneys stacks.

Lead is relatively immobile in soil and so soil acts as a significant sink for anthropogenic sources of the metal, being mainly retained at surface level.

4.2.3 **Imported Soils:** Following a major landslip in 2008, major improvements to Lyme Regis Coastal Defence have been carried out. Some of the cliff improvements included a continuous pile wall from the southern part of Charmouth Car Park towards the east and into the southern part of the allotments. As part of the works, a new drain was put through the allotments to collect rainwater and prevent further erosion of the cliffs.

The piling and drainage work were carried out by West Dorset District Council and included the excavation and replacement of soils. Drawing 4 shows the improvement ground works and approximate areas of the allotments where soils were excavated and replaced with imported materials.

There is a low probability that imported soils could be also a potential source of the higher lead concentrations reported within some areas of the allotments.

Information obtained from Dorset Council indicates that the imported topsoil used at the allotments was from agricultural land in Ottery St. Mary, East Devon. A laboratory testing certificate, reference 14-07065 Issue 1, dated 8 August 2014, has been provided by Dorset Council.

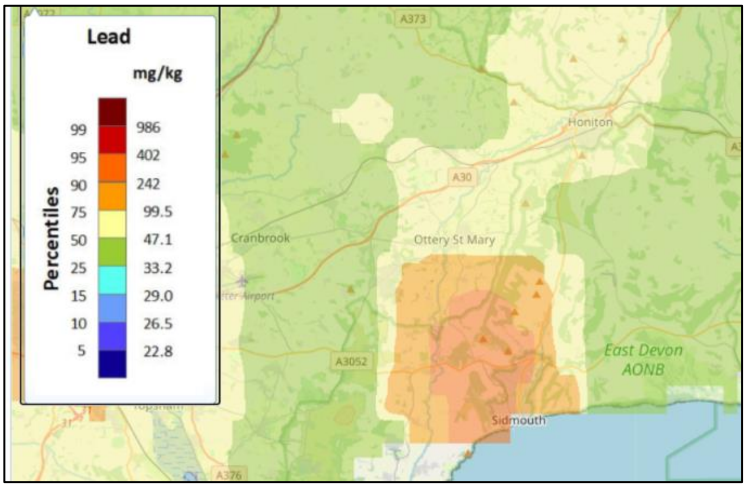
WPA understands that the report relates to soils imported to the allotments site. The laboratory certificate indicates that the soils match topsoil parameters. However, the certificate does not include contaminant testing and it is not possible to determine likely levels of lead within the imported materials. The laboratory testing certificate is included in Appendix B of this report.

For the single highest lead concentration of 460mg/kg, a metal tank was identified next to the sampling location and leaching of lead from this metal container should also be considered as a potential contaminant source.

4.2.4 **Background Contaminant Levels:** Background concentrations of contaminants of concern (CoC), in this case lead, should be considered within any risk assessment. Defra's proposals for revising the Statutory Guidance on Part 2A of the Environment Protection Act 19903 envisage that 'normal' background contaminant concentrations should generally be excluded from the Part 2A regime and considered within any contaminated land risk assessment.

The British Geological Society (BGS) has undertaken soil geochemical baseline surveys and have identified the distribution of some natural and anthropogenic contaminant such as lead.

As can be seem from the figure above, background lead levels for Lyme Regis generally ranged between 33.2 mg/kg and 47.1mg/kg. From Figure below, background lead levels for Ottery St Marys, range between 47.1mg/kg to 99.5mg/kg and from 99.5mg/kg to 242mg/kg. Some of the natural background levels for lead for the Ottery St Marys exceed the GAC for allotments land use of 80mg/kg, and match lead concentrations reported from some of the surface soils at the allotments.



There is therefore a possibility that background levels within imported soils could be a potential source of the higher lead concentrations reported within some areas of the allotments. The above should therefore be considered within the CSM and risk assessment undertaken for the allotments site.

4.3 CONTAMINAT MIGRATION PATHWAYS

4.3.1 **Migration Pathways**: Principal exposure pathways for lead for the allotments land use are consumption of homegrown produce and attached soils, direct soil and dust ingestion and inhalation of dust (outdoor).

Ingestion of lead contaminated soils by children is of particular concern due to their hand-to-mouth activities and higher metabolic system, which will result in a permanent influence on children’s development of neuronal systems, cell function and a decrease of children’s intelligence quotient (IQ).

Even at a low blood lead level, a range of neurocognitive, behavioural and other specific health issues such as hypertension and renal toxicity in adults, have been reported as being linked to lead exposure.

4.3.2 **Pathways and GAC Considerations**: The current Generic Acceptance Criteria (GACs) for Lead for allotments land use addresses new toxicity data, resulting in the conservative C4SLs for allotments land use of 80mg/kg. For comparison the previous GAC for allotments land use was 450mg/kg (SGV).

However, there is uncertainty over how the soil and dust ingestion rates used for the C4SL modelling for lead relate to UK receptors and average annual conditions (i.e., winter and summer). It is also recognised that the estimates for children do not just relate to soil and dust they ingest from their own property, or allotment gardens in this case, but also includes soil and dust ingested outside the home, in the nursery/school, play park, etc. It is therefore considered possible that the C4SL modelling could over-estimate average annual ingestion of soils from UK by a factor of 2, although this could be much greater at specific locations (SP1010, Appendix H-Lead).

There have been suggestions that exposure modelling parameters should be revised such as reduction of the soil ingestion rate for a child of 80mg/kg rather than 100mg/kg. This would result in a C4SLs for lead for allotments of 140mg/kg rather than 80mg/kg (SP1010, Appendix H-Lead).

For the outdoor soil exposure pathways, the exposure frequencies outdoors is based on children accompanying adults to the allotments for a percentage of time that the adult visits the allotments. The percentages are based on those in the SR3 report. The adult exposure frequency is based on a 1993 survey and may be weighted towards retired adults who regularly visit the allotment but rarely bring children. Thus, the Probability Density Function (PDF) for exposure frequencies is considered more likely to over- than under-estimate exposure, possibly by a significant amount at specific locations. (SP1010 Appendix H-Lead)

For the Spittles Allotments Site, further research would be necessary to assess site specific exposure pathways and exposure contaminant rates from contaminated soil to the most sensitive human health receptors, in this case, children.

4.3.3 **Lead Bioavailability:** An increasing number of investigations have indicated that using total lead concentrations may overestimate the risks from lead exposure, since only a fraction of lead in ingested soil can cause adverse effects to human health due to the influence from soil properties and sources, lead distribution and metabolism of lead in organisms (Kaihong Yan, 2017).

Usage of the ‘effective’ fraction of total ingested lead is recommended to assess risks and adverse effects from lead exposure to humans especially. Relative Bioavailability (RBA), as a linkage parameter between total concentration and the ‘effective’ fraction for exposure assessment, which provides a more realistic basis for environmental risk assessment and remediation.

Calculations of current GACs for Lead for allotments land use (C4SLs of 80mg/kg) is based on the assumption that the bioavailability of lead in soils is 60%. However, the bioavailability of lead in soils is likely to be highly variable, depending on soil mineralogy and the source of lead. As a result of this uncertainty, exposure is judged to have been potentially underestimated by a factor of 0.5x or over-estimated by a factor of up to 5x (SP1010 Appendix H-Lead).

The U.S. EPA has also established that relative bioavailability (RBA) of lead in soil is 60% in the Integrated Exposure Uptake Biokinetic (IEUBK) model. However, lead RBA has been reported to be wide-ranging.

The form of lead in soil has a large influence on its mobility and bioavailability and is dependent on the nature of the source. Releases of lead associated with combustion is typically in the form of lead oxides and halides. Lead in paints includes lead oxides, carbonates and sulphates, calcium plumbate, basic lead silicate, lead chromate and lead molybdate.

Once in soil, the fate of lead will vary according to its form. For example, lead halides from combustion are generally far more soluble than lead oxides and sulphates.

Weathered lead is generally strongly adsorbed onto clays and organic matter and as a result is sparingly soluble and has low bioavailability. Soil pH is also expected to have a strong influence on the mobility of lead, with a decrease in pH leading to an increase in lead bioavailability (SOBRA, 2012).

Significant research has been undertaken for lead bioavailability. Results from studies suggest that carbon-rich soils may bind lead more effectively, likely due to insoluble lead complexes formed with organic matter that reduce the fraction of lead available for uptake in the human body.

Surface soils at the allotments site, reported as contaminated with lead, have been described as TOPSOIL (sandy and gravelly organic CLAY/SILT). The only location where made ground was encountered, was at HA05. The surface made ground was described as sandy gravelly CLAY. Stiff to very stiff soils were described under the TOPSOIL and Made Ground.

Organic matter content from the TOPSOIL and MADE GROUND were reported to range between 3.6% and 6.1%. Ph levels were reported 7 to 7.7 for surface soils and 7.8 to 8.0 for indigenous soil beneath.

Considering the above, it may be possible to assume that lead reported along the northern and eastern boundary of the allotments may have low bioavailability and likely to be retained within the soil matrix, rather than becoming significantly available for uptake within the human body. However, this hypothesis can only be confirmed by soil bioaccesibility testing and related bioavailability risk assessment.

4.3.3 **Soil to plant concentration factors:** Other significant factor for the allotments land use risk assessment is the soil to plant concentration factors, homegrown fraction and consumption rates. For families with allotments who consume a large amount of fruit and vegetables and are mostly self-sufficient in these produce types and where the nature of the soils is such that soil to plant concentration factors are high, exposure could be more than order of magnitude above median exposure.

In terms of the soil to plant concentration factor (CF), the CFs used for the Lead GAC probabilistic modelling are based on empirical measurements of the concentration of lead in fruit and vegetables and the soil they have been grown in. These empirical measurements have been obtained from studies in the UK and abroad from field and lab-based studies. The use of all these data may lead to an over-estimation in the variability of soil to plant concentration factors and this could lead to both an over- and under-estimation of exposure (SP1010 Appendix H-Lead).

It is noted that geomean soil to plant concentration factors from a crop survey conducted in Devon and Cornwall are up to an order of magnitude below those assumed for the PDF modelling. On this basis it is considered more likely that the modelling calculations tend towards an over-estimation than an under-estimation of exposure. (SP1010 Appendix H-Lead).

For the produce consumption rates, modelling for fraction of consumed produce grown is based on UK Expenditure and Food Survey 2004/5. It was beyond the scope of the C4SLs project to re-assess the raw data from this survey and so the beta shaped PDF is based on information presented in SR3 and the former CLR10 report

(EA, 2002). It is possible that PDF attributes over- or under-estimate exposure by a factor of up to 2, although this could be much greater at specific locations. (SP1010 Appendix H-Lead).

In summary, the above qualitative evaluation of uncertainty has indicated that the exposure estimates derived by the probabilistic modelling used for the determination of C4SLs for lead are likely to be over-estimates.

Various research papers have been reviewed as part of this risk assessment and something in common between the various documentation is that there is a lack of observed correlations between soil and plant heavy metal concentration within allotments sites (Gareth J. Norton, 2015).

This may be attributed to a number of factors, including cultivar variation and atmospheric deposition within different locations. Also, it is expected that the soil properties, which affect the availability and uptake of metals from soils will be different at different sites. Other important soil factors include organic carbon content, cation exchange capacity, clay content, Ph as well as the oxide content of Fe, Al, and Mn.

The various research papers considered in this report did not identify a constant link between lead soil concentrations and elevated concentrations of lead in homegrown produce. Some of the case studies were for urban allotments which reported soil lead concentrations above 1000 mg/kg and up to 4440mg/kg.

The above is discussed further in section 5.0 of this report.

4.4 RECEPTORS

Identified receptors associated with the allotments are:

- Allotment Tenants/Site Users
- Allotment Site workers
- Families, particularly children, visiting the allotments and consuming allotments produce

Those that are not considered present are excluded from further assessment, although decisions taken at this time should be reviewed as and when the conceptual model is revisited.

Table 4/3 below summarises where potentially unacceptable risks that require further consideration have been identified.

Table 4/3 –Refined CSM Risk Summary

Use	Potential Sources	Likely Contaminants	Pathways	Receptors	Hazard Receptor Significance	Likelihood of Contaminant Linkage		Consequence	Risk Prior to Mitigation
Allotments gardens since before 1928 to present time.	Atmospheric urban deposition Paint from leaded painted wood, sheds Bonfires and ashes Herbicides/ Pesticides	Lead	Direct contact with soils (dermal contact and soil ingestion)	Allotment tenants/ site users	Toxic, carcinogenic or hazardous to human health.	Unlikely	Lead concentrations above the GAC for allotments land use of 80mg/kg were reported from surface soil samples along the northern and eastern boundaries of the allotments Although the investigated soils are not use for production of fruit and vegetable, there is a possibility that the lead exceedances may extent to areas where fruit and vegetables is undertaken for human consumption. Should soils contaminated with lead, at the reported concentration to date, be present within areas of the allotments used for production of fruit and vegetables, a Low Risk to human health will be perceived. The above considers average contaminant concentrations reported by the Phase 2 Exploratory Site investigation undertaken for the site in July 2020, background contaminant levels for lead for imported soils and other parameters such as lead bioavailability, soil to plant concentration factors and soils properties at the site such as content of carbon in the investigated soils, clay content and Ph. The above have been discussed in section 4.0 and is discussed further in section 6.0 of this report.	Moderate	**Low**
			Inhalation of dust	Allotment tenants/site users	Asphyxiation risk and risk of explosion.	Unlikely		Moderate	**Low**
			Consumption of contaminated fruit and vegetables.	Allotment tenants and families/site users	Toxic, carcinogenic or hazardous to human health.	Unlikely		Moderate	**Low**
			Consumption of contaminated soil attached to fruit and vegetables	Allotment tenants and families/site users	Toxic, carcinogenic or hazardous to human health.	Unlikely		Moderate	**Low**
			Migration and Impaction of Controlled waters	Controlled Waters (Lyme Bay)	Toxic, carcinogenic or hazardous to human health and environment	Unlikely	Risk assessment to controlled waters indicate a negligible risk from the reported contaminant concentrations to Lyme Bay. No further action is necessary	Mild	Negligible

5.0 COMPARISON OF SOIL LEAD LEVELS IN ALLOTMENTS AND AGRICULTURAL SITES ACROSS THE UK

5.1 Various research papers have been published which assess lead levels within soils in allotment sites and agricultural land across the UK.

5.2 Research paper "Cadmium and lead in vegetable and fruit produce selected from specific regional areas of the UK, 2015", assessed cadmium and lead levels in fruit and vegetable produce, with 1300 samples collected from a field and market basket study of locally grown produce from the South-West of Britain (Devon and Cornwall).

Locally produced fruit and vegetables in retail outlets from the SW of England and NE England, as well as field crops and soil from the SW, were sampled. A total of 174 soil samples were analysed along with corresponding crops, as well as 56 alternative preparations for produce eaten either peeled or unpeeled.

These were compared with similarly locally grown produce from the North-East of Britain (Aberdeenshire). The concentrations of cadmium and lead in the market basket produce were compared to the maximum levels (ML) set by the European Union (EU). For lead, a total of 5 samples (0.6% of the total samples) exceeded the ML for their class of produce across the two basket surveys. A previous fruit and vegetable survey in the UK reported that of the 251 produce samples they collected none exceeded the ML for lead.

The correlation between produce and soil lead concentrations was assessed. Soil lead concentration ranged from 9.2mg/kg to 916 mg/kg for the field samples collected in the SW of England. Correlation between produce lead concentrations and soil lead concentrations was only found in root vegetables (peeled and unpeeled). No correlation between soil lead and soft fruit lead content could be assessed as all the soft fruit lead concentrations were below the LOD.

The lack of observed correlations between soil and plant lead concentrations have also been observed in a number of other studies. This may be due to various factors including the cultivar variation and atmospheric deposition on produce. Other important soil factors include organic carbon content, cation exchange capacity, clay content, Ph as well as the oxide content of Fe, Al, and Mn. As these factors would vary across the different sampling locations, this may be a reason for the lack of correlations between soil and plant metal concentration.

The research further suggested that produce is susceptible to elemental contamination arising from soil/dust deposition. This may have increased concentrations of lead levels reported from produce, particularly in urban areas.

More washing of the produce may help in removing some metal contamination. The issue of atmospheric deposition could also in some part explain the lack of correlations between the soil heavy metal concentration and plant concentration, as soil/dust deposition may have a large influence on the final measured concentration.

The report concluded that concentrations of cadmium and lead found in fruits and vegetables sampled during the study do not increase concern about risk to human health. The small number of samples that exceed the ML indicate a need to continue monitoring the concentration of cadmium and lead (and other potentially harmful heavy metals) in produce, but do not indicate a systemic issue with the concentrations of these elements in produce.

5.2 Article "Contamination of allotment soil with lead: managing potential risks to health" Journal of Public Health Medicine Vol 22, 2000. For the research, soil and produce analyses was undertaken. A questionnaire survey was carried out for individuals who either worked on the allotment or ate significant amounts of produce grown on it. The allotment users were offered blood lead tests.

Soil samples were taken from the allotment. Two vegetables, one leaf and one tuber, were also sampled from some of the plots.

Initial soil testing reported lead levels between 1110mg/kg to 4440mg/kg. Further testing reported lead levels ranging between 513mg/kg to 1540mg/kg. The significantly elevated lead concentrations were attributed to a joinery workshop that existed on the allotments site and burned windows and framing containing lead-based paint and putty.

The outcome of the vegetable testing indicated raised lead levels in leeks and some concentrations in potatoes. The lead levels in the produce were much higher than expected based on data for lead plant uptake, known to be low, except at acidic conditions. However, it was noted that titanium testing (titanium is present in soil but its uptake by plants is nil) suggested that the produce samples that reported the high lead concentrations above the Lead in Food Regulations contained titanium, suggesting soil contamination when the produce was tested.

The presence of adhering soil, therefore, may have resulted in the elevated lead concentrations reported in the produce. MAFF's routine advice to consumers is that produce should always be appropriately washed and peeled before consumption. This was expected to reduce both soil contamination and lead content in vegetables. This meant that the concentrations in the produce as consumed were likely to be lower than those reported.

Despite some of the allotment holders working on the land for up to 20 years and a significant proportion of their diet coming from the allotments, none of them indicated that they were suffering any ill health related to lead. In addition, their blood lead levels were within the normal range. However, due to the extremely high soil lead levels in the allotments, it was considered that the removal of adhering soil would need to be extremely efficient to ensure that the lead intake was sufficiently low not to represent a risk to consumers of produce from the allotments.

Ultimately, it was concluded that the high levels of lead within the soils was sufficient to trigger remediation of the site.

5.3 Research paper "Lead and cadmium in urban allotment and garden soils and vegetables in the United Kingdom", 1988.

In order to assess the intake of lead and cadmium by consumers of homegrown vegetables in urban areas, replicated experimental plots of uniform size, comprising summer and winter crops, were established in 94 gardens and allotments in nine towns and cities in England.

The geometric mean lead concentration for the soils (n = 94) was 217 mg/kg, (ranging from 27 to 1,676 mg/kg). Compared with agricultural soils, the garden and allotment soils contained elevated levels of lead. Table below shows the soil lead concentrations reported by the investigation

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Table 2 *Soil lead concentrations (µg g^{-1} dry weight) in present study and National Reconnaissance Study database*[a].

Town/city	*Present study*			*National study*
	N	*GM*	*Range*	*GM*
Birmingham	9	143	69-299	278
Brighton	8	255	48-713	485
Darlington	10	221	79-435	173
Guildford	10	137	47-280	-
Leeds	10	125	27-314	243
[illegible]n:				
Hammersmith/Fulham	8	526	235-1,525	1,201
Richmond	10	358	144-1,044	516
Nottingham	10	198	59-1,079	239
Shrewsbury	10	216	79-1,676	174
York	9	226	166-335	247
All towns/cities	94	217	27-1,676	266[b]

[a] Surface soil samples: present study 0-15 cm;
National Reconnaissance Study 0-5 cm.
[b] Geometric mean for all study locations excluding "geochemical hotpots"
N = Number of samples
GM = Geometric mean

Lead concentrations in the vegetables ranged from <0.25mg/kg to 16.7 mg/kg dry weight. The highest lead concentrations for each vegetable type, with the exception of broccoli, were found in the London boroughs which also had the highest soil lead concentrations.

It was concluded that although lead concentrations in vegetables were higher than reported "background" levels, only <1% exceeded the statutory limit for saleable food in the UK (1ug/g) fresh weight.

6.0 DISCUSSION OF RESULTS

Under Part 2A of the Environmental Protection Act 1990, Local Authorities (LA) are given a duty to determine land as “contaminated land” where there exists “significant harm...or...the significant possibility of such harm” arising from the intake of chemicals or other substances in, on or under the land (an “unacceptable intake”).

Surface soils along the allotment boundaries have been reported to have lead levels above GAC for allotments land use. Although the lead contaminated areas are not used for the production of fruit and vegetables, there is a possibility that the reported lead levels may extend to areas where fruit and vegetables are produced for human consumption.

Therefore, further consideration and assessments have been undertaken to evaluate the human health risk from the lead contaminated soils to the users of the allotments site. WPA has assessed desktop and site investigation data to determine whether a Significant Possibility of Significant Harm (SPOSH) is currently present at the allotments site, and to assess steps to follow this risk assessment.

It is noted that the exceedance of the lead GAC for allotments land use of 80mg/kg, does not necessarily mean that a Significant Possibility of Significant Harm (SPOSH) is present at the allotments site. GACs are part of the generic and initial human health risk assessment. They are useful tools for the screening and preliminary assessment of contaminant levels within soils. However, further risk assessment and investigation is normally required to stablish whether SPOSH exists.

The GAC for allotments land use (C4SL for lead) use conservative assumptions and the parameters used in the probabilistic modelling are likely to be conservative. In addition, reliance on total lead concentrations for a risk assessment and direct comparison with GACs is likely to overestimate risks from lead exposure, resulting in unnecessary determinations and remediation when exceedances are moderate.

The assessment of parameters such as contaminant bioavailability and soil to plant concentrations factors are known to be crucial in establishing the significance of the human health risk from a specific contaminant.

Base on desktop data analysed for this risk assessment, it is considered that lead levels revealed along the northern and eastern boundaries of the allotments are unlikely to represent a Significant Possibility of Significant Harm (SPOSH) to identified receptors. This considers various paraments that are discussed below.

Lead levels reported from surface soils, range between 100mg/kg to 270mg/kg. Comparison of these concentrations with concentrations of lead reported from other allotments sites and agricultural sites across the UK, indicate that such levels are not significantly elevated. It should be further considered that the above concentrations are within the range of the Normal Background Concentrations (NBC) derived for lead by the BGS for England and Wales. In England the NBCs are 180 mg/kg for the “principal” domain.

Whilst the BGS reports lead background levels for Lyme Regis generally between 33.2 mg/kg and 47.1mg/kg, for the area of Ottery St Marys, East Devon, lead background levels range between 47.1mg/kg to 242mg/kg. There is therefore the possibility that background levels within imported soils could be a potential source of the higher lead concentrations reported within some areas of the allotments.

For the single higher lead concentration of 460mg/kg, a metal tank was identified next to the sampling location. Leaching of lead from this metal container may be the source of the lead levels at this specific location.

Defra's proposals for revising the Statutory Guidance on Part 2A of the Environment Protection Act 1990 envisage that 'normal' background contaminant concentrations should generally be excluded from the Part 2A regime and considered within any contaminated land risk assessment.

It is further noted that the lead C4SL for allotments is below the limit for lead in sludge amended soil of 300 mg/kg as defined under Schedule 2 of "The Sludge (Use in Agriculture) Regulations 1989". In addition, the limit for lead in compost for general use of 200 mg/kg as defined in the Publicly Available Specification (PAS) 100:2011 (BSI, 2011). It is therefore known to be difficult for a Local Authority to threshold and regulate levels of lead in allotment sites, when fertilizers used by allotment users can exceed the GAC for lead (C4SLs) of 80mg/kg.

In terms of lead bioavailability and soil to plant concentration factors, results from studies suggest that carbon-rich soils may bind lead more effectively, due to insoluble lead complexes formed with organic matter that reduce the fraction of lead available for uptake in the human body. Other important soil factors include organic carbon content, cation exchange capacity, clay content, Ph as well as the oxide content of Fe, Al, and Mn.

The various research papers further conclude that a constant link between lead soil concentrations and elevated concentrations of lead in produce is uncertain. This due to parameters mentioned above, plus variation in cultivation techniques and soil/dust deposition of lead in different locations. Some of the case studies were undertaken for urban allotments which reported soil lead concentrations above 1000 mg/kg and up to 4440mg/kg. These concentrations are significantly elevated in comparison with average lead levels within surface soils at the allotments of 174mg/kg, or even the single lead concentration from made ground of 460mg/kg.

Surface soils at the allotments site have been described as TOPSOIL with high percentage of CLAY. Made ground (only at one location) was also described as sandy gravelly CLAY. Organic matter content from the TOPSOIL and MADE GROUND, ranged between 3.6% and 6.1%. Ph levels were reported neutral to basic (alkaline) ranging between 7 to 8.0.

Considering the above, it may be possible to assume that lead reported along the northern and eastern boundary of the allotments may have low bioavailability and is likely to be retained within the soil matrix, rather than becoming significantly available for uptake by the human body.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on contaminant concentrations reported along the allotments boundaries and desktop data assessed by this risk assessment, it is considered that there is no evidence to suggest that the amount of lead, which users of the allotments and their families might take through different exposure pathways, would represent an unacceptable intake of the contaminant. A significant Possibility of Significant Harm (SPOSH), under Part 2A of the EPA 1990, has therefore not been identified for the allotments site.

It is stressed that limited data have been obtained for the allotments, and all samples (6 samples) were taken from soils along the boundaries of the allotments. No testing has been carried out for soils used for cultivation of fruit and vegetables.

The above conclusion is based on the assumption that contaminant levels reported along the northern and eastern boundaries of the allotments could be indicative of lead concentrations which could be present within areas used for cultivation. However, concentrations of lead within cultivation areas are unknown and can only be determined by intrusive sampling and testing.

There is also uncertainty about lead availability values and soil to plant concentrations factors, which will be specific for the site conditions. To determine such parameters, specific investigation and testing will be required and be part of a site-specific risk assessment, should this be determined to be required for the site.

For the allotment’s users and their families, general recommendation should be followed including the appropriate washing of fruit and vegetables to remove any soil attached to the allotments produce prior to consumption. MAFF’s routine advice to consumers is that produce should always be appropriately washed and peeled before consumption.

This should also remove any potential contamination of allotment produce arising from soil/dust atmospheric deposition (atmospheric deposition of lead into produce, particularly vegetable with a long leaf surface such as spinach). Appropriate washing of hands by the allotment users and their families, especially children, is important to further reduce soil intake after visiting the allotments.

The use of compost and organic fertilizers, to enhance carbon levels within cultivated soils, have been proven to reduce the fraction of lead available for uptake in the human body. However, allotments users should bear in mind that some of the fertilizers can contain contaminants, including lead. Careful decisions should be made when selecting such soil enhancement products.

It is recognised that allotment land generally can contain significant and measurable levels of a wide variety of contaminants, due to the range of materials brought to the land, for example by allotment owners or holders themselves. Environmental awareness is crucial, to prevent contamination of the soils and produce by general allotment practices carried out by the allotment’s users.

The information reported herein is based on the interpretation of data collected by a Phase 2 Exploratory Site Investigation and review of desktop data, pertaining specifically to the identification of potential contamination, which may have arisen from previous activities within and around the site. Information provided to WPA's staff regarding the subject site has been accepted as being accurate and valid.

The evaluation and conclusions do not preclude the existence of soil or groundwater contamination, which could not reasonably have been revealed by a desk study review. Hence, this report should be used for information purposes only and should not be construed as a comprehensive characterisation of all site conditions.

It should be understood this report is a land quality assessment and does not purport to consider geotechnical engineering, ecological, flood risk or archaeological aspects of the proposed development which fall outside of the scope of this assessment and may require specific surveys.

It is stressed that this report is in pursuit of the Local Authority's role as an owner of land containing the allotments. It is widely acknowledged that allotment land generally can contain significant and measurable levels of a wide variety of contaminants, due to the range of materials brought to the land, for example by allotment owners or holders themselves. Therefore, great care would need to be exercised in interpreting the results of any future intrusive investigation.

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WPA March 2021

8.0 REFERENCES

Reference has been made to the following publications and government guidance in the execution of this investigation and in writing this report.

CIRIA Report C659 Assessing Risks Posed by Hazardous Ground Gases to Buildings, 2006, Wilson, S. Oliver, S. Mallett, H & Card, G.

CLEA documentation (CLR7-10, TOX and SGV reports).

Contaminated Land Research Document 7 – Assessment of Risks to Human Health from Land Contamination: An overview of the development of the soil guideline values and related research.

Contaminated Land Research Document 8 – Potential Contaminants for the Assessment of Contaminated Land.

Contaminated Land Research Document 9 – Contaminants in Soil: Collation of toxicological data and intake values for humans.

Contaminated Land Research Document 10 – The Contaminated Land Exposure Assessment (CLEA) Model: Technical basis and algorithms.

DEFRA and the EA Toxicological Reports 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 20

DEFRA and the EA Soil Guideline Values 1, 3, 4, 5, 7, 9, 10

Contaminated Land Research Report CLR 11, Environment Agency (2004). Model Procedures for the Management of Contaminated Land: Risk Assessment Procedure.

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Department of the Environment (1993). Waste Management Paper No 26A, Landfill Completion, A technical memorandum providing guidance on assessing the completion of licensed landfill sites. HMSO, 47pp, ISBN 0-11-752807-2

Department of the Environment (1991). Waste Management Paper No 27, Landfill Gas, A technical memorandum providing guidance on the monitoring and control of landfill gas. HMSO, 82pp, ISBN 0-11-752488-3

The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in soils, 2005 Science Report P5-080/TR3

CLR Publications 1-6

DRAWINGS AND APPENDICES

Drawing 1 Site Location Plan

Drawing 2 Allotments Layout Plan

Drawing 3 Site Investigation Plan

Drawing 4 Lyme Regis Coastal Defence Works – Charmouth Car Park and Allotments

Appendix A Photographic Records

Appendix B Chemical Testing Results