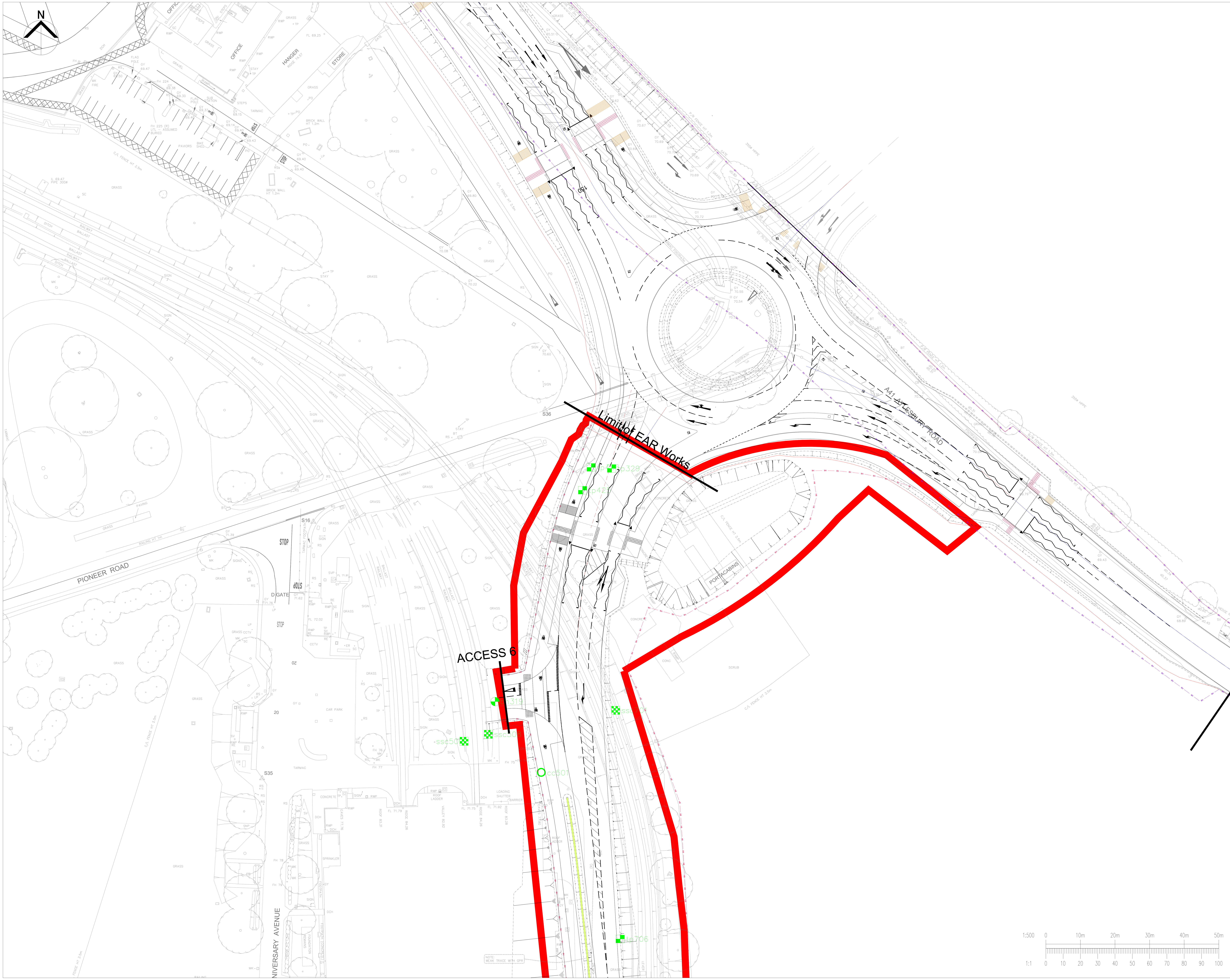

This drawing should not be scaled. Dimensions to be verified on site.
Any discrepancies should be referred to the Engineer prior to work being put in hand.

GENERAL NOTES

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5. ALL WORK IS TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT STATUTORY AUTHORITIES AND REGULATIONS.

tp706 TRIAL PIT LOCATIONS
rc502 ROAD CORE LOCATIONS
bh319 CABLE PERCUSSIVE LOCATIONS
ssc508 SWALE SEDIMENT CONTAMINATION TESTS
cc501 CONCRETE CORE LOCATIONS

LOCATIONS WITH RESULTS EXCEEDING GAC'S ARE SHOWN IN RED

RED LINE BOUNDARY

Rev	Date	Description	By
A02	19.10.21	CHANGES MADE FROM COMMENTS	JL
A01	08.07.21	LOCATIONS AND ECEEDANCES ADDED	TB

Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD (EAR)
COMMERCIAL GAC EXCEEDANCES
SHEET 8 OF 9

Client
Graven Hill Village Development Company Limited

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Drawing Status
PRELIMINARY

Designed by TB	Checked by PE	Project No WIE11386
Drawn by JL	Date OCT 2021	
Scales @ A1 work to figured dimensions only 1:500		Computer File No WIE11386-139-87-201-209 - EAR-Commerical Exceedances - A01.dwg

Publisher	Zone	Category	Number	Revision
WIE	EAR	87	208	A02

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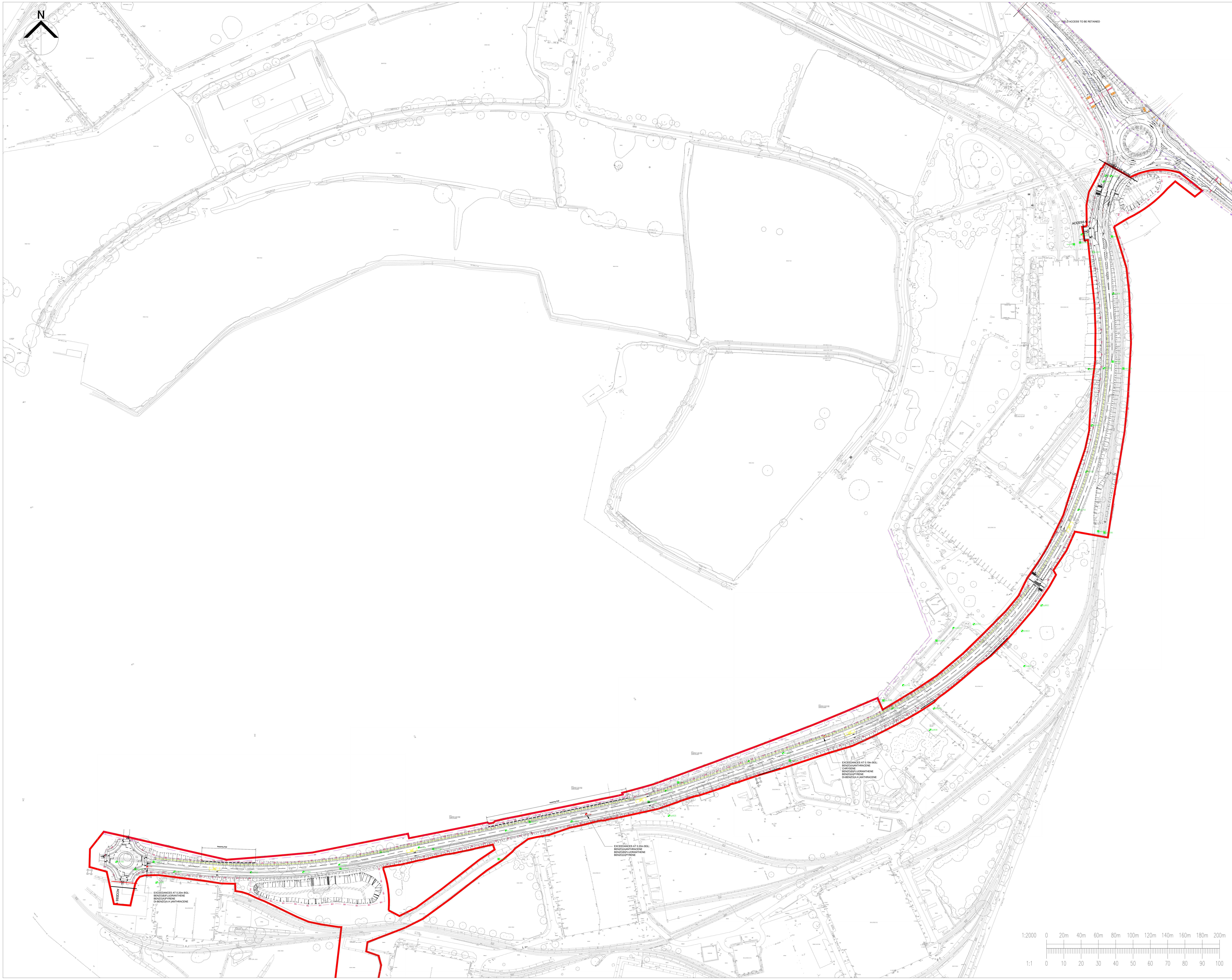

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KEY:

tp706 TRIAL PIT LOCATIONS
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Amendments

Project
GRAVEN HILL, BICESTER

Title
EMPLOYMENT ACCESS ROAD (EAR) COMMERCIAL GAC EXCEEDANCES SHEET 9 OF 9

Client

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Drawing Status
PRELIMINARY

Designed by TB	Checked by PE	Project No WIE11386		
Drawn by JL	Date OCT 2021			
Scales @ A1 work to figured dimensions only	1:2000	Computer File No WIE11386-139-87-201-209 - EAR-Commerical Exceedances - A01.dwg		
Publisher	Zone	Category	Number	Revision
WIE	EAR	87	209	A02

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Appendix F Environmental Receptors

The Contaminated Land Statutory Guidance has a four category system that considers harm to human health, controlled waters, flora and fauna, property, livestock and crops. The Categories are broadly defined as follows:

1 Contaminated Land – similar to land where it is known that significant harm has been caused or significant harm is being caused

2 Contaminated Land – no significant harm being caused but there is a significant possibility for significant harm to be caused in the future

3 Not Contaminated Land – there may be harm being caused but no significant possibility for significant harm to be caused in the future

4 Not Contaminated Land – no contaminant linkage, normal levels of contaminants and no significant harm being caused and no significant possibility for significant harm to be caused in the future.

Table F.1: Significant pollution to controlled waters

Pollution of controlled waters

Under Section 78A(9) of Part 2A the term "pollution of controlled waters means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term "controlled waters" in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that "groundwaters" does not include water contained in underground strata but above the saturation zones. (Paragraph 4.36)

Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment. (Paragraph 4.37)

Significant pollution of controlled waters

Paragraph 4.38 states that "The following types of pollution should be considered to constitute significant pollution of controlled waters:

(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.

(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.

(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.

(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5)".

Paragraph 4.39 states that "In some circumstances, the local authority may consider that the following types of pollution may constitute significant pollution: (a) significant concentrations6 of hazardous substances or non-hazardous pollutants in groundwater; or (b) significant concentrations of priority hazardous substances, priority substances or other specific polluting substances in surface water; at an appropriate, risk based compliance point. The local authority should only conclude that pollution is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 (of the Contaminated Land Statutory Guidance). This would normally mean that the authority should conclude that less serious forms of pollution are not significant. In such cases the authority should consult the Environment Agency".

The following types of circumstance should not be considered to be contaminated land on water pollution grounds:

(a) The fact that substances are merely entering water and none of the conditions for considering that significant pollution is being caused set out in paragraphs 4.38 and 4.39 above are being met.

(b) The fact that land is causing a discharge that is not discernible at a location immediately downstream or down-gradient of the land (when compared to upstream or up-gradient concentrations).

(c) Substances entering water in compliance with a discharge authorised under the Environmental Permitting Regulations.

Significant pollution of controlled waters is being caused

In deciding whether significant pollution of controlled waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes ongoing pollution. For these purposes, the local authority should:

(a) Regard substances as having entered controlled waters where they are dissolved or suspended in those waters, or (if they are immiscible with water) they have direct contact with those waters on or beneath the surface of the water.

(b) Take the term "continuing to enter" to mean any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.

(c) Take the term "likely to do so again" to mean more likely than not to occur again.

Land should not be determined as contaminated land on grounds that significant pollution of controlled waters is being caused where: (a) the relevant substance(s) are already present in controlled waters; (b) entry into controlled waters of the substance(s) from land has ceased; and (c) it is not likely that further entry will take place.

Significant Possibility of Significant Pollution of Controlled Waters

In deciding whether or not a significant possibility of significant pollution of controlled waters exists, the local authority should first understand the possibility of significant pollution of controlled waters posed by the land, and the levels of certainty/uncertainty attached to that understanding, before it goes on to decide whether or not that possibility is significant. The term "possibility of significant pollution of controlled waters" means the estimated likelihood that significant pollution of controlled waters might occur. In assessing the possibility of significant pollution of controlled waters from land, the local authority should act in accordance with the advice on risk assessment in Section 3 and the guidance in this sub-section.

In deciding whether the possibility of significant pollution of controlled waters is significant the local authority should bear in mind that Part 2A makes the decision a positive legal test. In other words, for particular land to meet the test the authority needs reasonably to believe that there is a significant possibility of such pollution, rather than to demonstrate that there is not.

Before making its decision on whether a given possibility of significant pollution of controlled waters is significant, the local authority should consider:

(a) The estimated likelihood that the potential significant pollution of controlled waters would become manifest; the strength of evidence underlying the estimate; and the level of uncertainty underlying the estimate.

(b) The estimated impact of the potential significant pollution if it did occur. This should include consideration of whether the pollution would be likely to cause a breach of European water legislation, or make a major contribution to such a breach.

(c) The estimated timescale over which the significant pollution might become manifest.

(d) The authority's initial estimate of whether remediation is feasible, and if so what it would involve and the extent to which it might provide a solution to the problem; how long it would take; what benefit it would be likely to bring; and whether the benefits would outweigh the costs and any impacts on local society or the environment from taking action

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Table F.2: Significant harm to human health, ecological systems and property

Relevant types of receptor	Significant harm	Significant possibility of significant harm
Human beings	The following health effects should always be considered to constitute significant harm to human health: death; life threatening diseases (e.g. cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions. Other health effects may be considered by the local authority to constitute significant harm. For example, a wide range of conditions may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. In deciding whether or not a particular form of harm is significant harm, the local authority should consider the seriousness of the harm in question: including the impact on the health, and quality of life, of any person suffering the harm; and the scale of the harm. The authority should only conclude that harm is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 of the Contaminated Land Statutory Guidance.	The risk posed by one or more relevant contaminant linkage(s) relating to the land comprises: (a) The estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question. (b) The estimated impact if the significant harm did occur – i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it. In estimating the likelihood that a specific form of significant harm might occur the local authority should, among other things, consider: (a) The estimated probability that the significant harm might occur: (i) if the land continues to be used as it is currently being used; and (ii) where relevant, if the land were to be used in a different way (or ways) in the future having regard to the guidance on "current use" in Section 3 of the Contaminated Land Statutory Guidance. (b) The strength of evidence underlying the risk estimate. It should also consider the key assumptions on which the estimate of likelihood is based, and the level of uncertainty underlying the estimate.
Any ecological system, or living organism forming part of such a system, within a location which is: • a site of special scientific interest (under section 28 of the Wildlife and Countryside Act (WCA) 1981 (as amended) and Part 4 of the Natural Environment and Rural Communities Act 2006 (as amended)); • a national nature reserve (under Section 35 of the WCA 1981 (as amended));	The following types of harm should be considered to be significant harm: • harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or • harm which significantly affects any species of special interest within that location and which endangers the long-term	Conditions would exist for considering that a significant possibility of significant harm exists to a relevant ecological receptor where the local authority considers that: • significant harm of that description is more likely than not to result from the contaminant linkage in question; or • there is a reasonable possibility of significant harm of that description being

Relevant types of receptor	Significant harm	Significant possibility of significant harm
• a marine nature reserve (under Section 36 of the WCA 1981 (as amended)); • an area of special protection for birds (under Section 3 of the WCA 1981 (as amended)); • a "European site" within the meaning of regulation 8 of the Conservation of Habitats and Species Regulations 2010 (as amended); • any habitat or site afforded policy protection under Section 11 of The National Planning Policy Framework (NPPF) on conserving and enhancing the natural environment (i.e. possible Special Areas of Conservation, potential Special Protection Areas and listed or proposed Ramsar sites); or • any nature reserve established under Section 21 of the National Parks and Access to the Countryside Act 1949.	maintenance of the population of that species at that location. In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010 (as amended).	caused, and if that harm were to occur, it would result in such a degree of damage to features of special interest at the location in question that they would be beyond any practicable possibility of restoration. Any assessment made for these purposes should take into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.
Property in the form of: • crops, including timber • produce grown domestically, or on allotments, for consumption • livestock • other owned or domesticated animals • wild animals which are the subject of shooting or fishing rights.	For crops, a substantial diminution in yield or other substantial loss in their value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage. The local authority should regard a substantial loss in value as occurring only when a substantial proportion of the animals or crops are dead or otherwise no longer fit for their intended purpose. Food should be regarded as being no longer fit for purpose when it fails to comply with the provisions of the Food Safety Act 1990. Where a diminution in yield or loss in value is caused by a contaminant linkage, a 20% diminution or loss should be regarded as a benchmark for what constitutes a substantial diminution or loss. In the Guidance states that this description of significant harm is referred to as an "animal or crop effect".	Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question, taking into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.
Property in the form of buildings. For this purpose, 'building' means any structure or erection and any part of a building, including any part below ground level, but does not include plant or machinery comprised in a	Structural failure, substantial damage or substantial interference with any right of occupation. The local authority should regard substantial damage or substantial interference as occurring when any part of the building ceases to	Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is

Relevant types of receptor	Significant harm	Significant possibility of significant harm
building, or buried services such as sewers, water pipes or electricity cables.	be capable of being used for the purpose for which it is or was intended. In the case of a scheduled Ancient Monument, substantial damage should be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled. The Guidance states that this description of significant harm is referred to as a 'building effect'.	more likely than not to result from the contaminant linkage in question during the expected economic life of the building (or in the case of a scheduled Ancient Monument the foreseeable future), taking into account relevant information for that type of contaminant linkage.

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Appendix G Generic Assessment Criteria

Human Health Generic Assessment Criteria

Background

In order to be able to make inference on whether the results obtained during the site investigation (e.g. chemical concentrations in soils, waters and gas) point to the presence of a potential hazard to human health, it is necessary to distinguish between the results, reflecting background and/or insignificantly elevated levels of contamination (i.e. with negligible potential to cause harm or pollution) and the results with significantly elevated concentrations (i.e. with significant potential to cause harm or pollution).

The approach to risk assessment with respect to risks to human health from contaminated land in the UK is set out in the publication Model Procedures for the Management of Land Contamination (CLR11) Environment Agency (2004).

This sets out a tiered approach:

- Preliminary Risk Assessment (e.g. establishing potential contaminant linkages);
- Generic Quantitative Risk Assessment (GQRA) (e.g. comparison of site contaminant concentrations against generic standards and compliance criteria e.g. Soil Guideline Values (SGV) or other Generic Assessment Criteria including an assessment of risk using the source pathway target model); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

Preliminary Risk Assessment

This typically encompasses a desk based generation of a conceptual model to establish the potential contaminant linkages associated with the site and any proposed development. Works would typically involve:

- Evaluation of the potential sources of contamination on the site and in the locality and from both a current and historical perspective
- Statutory Consultation;
- Evaluation of a site's geology, hydrology and hydrogeology;
- Site inspection;
- Additional pertinent information as necessary on a site by site basis.

Where works indicate the presence of a potential contaminant linkage further evaluation and potentially site investigation works are necessary to determine the significance of the linkage.

Generic Quantitative Risk Assessment (GQRA)

In August 2008 the Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) announced the withdrawal of the Contaminated Land Reports CLR7 – 10, CLEA UK (beta) and existing SGV reports as they no-longer fully reflected the revised approach to human health risk assessment.

New partial guidance (in particular Science Reports SR2, SR3 and SR7) and new risk assessment tools (CLEA model version v1.04, v1.05 and currently v1.06) were published in 2009 and these allow environmental practitioners to derive generic and site specific Soil Assessment Criteria (GAC and SAC).

Soil Guideline Values (SGVs)

The EA and DEFRA updated the TOX reports and Soil Guideline Values (SGVs) to reflect the guidance documents published in 2009. SGVs for arsenic, cadmium, nickel, mercury, selenium, BTEX compounds (benzene, toluene, ethylbenzene and xylenes), dioxins, furans and dioxin like PCBs and phenol have been made available.

Since publishing the revised SGVs the CLEA model was updated to version v1.06. The Environment Agency has however confirmed that v1.05 has only a "minor effect on assessment criteria calculated using the CLEA software 1.04" and consequently the GACs derived are considered to remain valid. Environment

Agency SGVs generated using v1.04 have also not been updated. Software version v1.06 is identical to v1.05 with some password protection enhancements that in no way affect the GAC values generated.

Owing to the scientific advances since 2009 and in particular toxicological research outputs, less significance is now placed on the SGVs in the hierarchy outlined below.

Category 4 Screening Levels (C4SLs)

Category 4 Screening Levels were generated by Contaminated Land: Applications in Real Environments (CL:AIRE) on behalf of DEFRA and made available to the public in April 2014. Category 4 Screening Levels were derived in response to policy changes outlined in the recently revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A). Part 2A was originally introduced to ensure that the risks from land contamination to human health, property and the environment are managed appropriately, with the revised SG being designed to address concerns regarding its real-world application. The revised SG presents a new four category system for classifying land under Part 2A, ranging from Category 4, where the level of risk posed is acceptably low, to Category 1, where the level of risk is clearly unacceptable.

The document SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (March 2014) states that:

The Impact Assessment that accompanied the revised Part 2A Statutory Guidance identified a potential role for new 'Category 4 Screening Levels' in providing a simple test for deciding when land is suitable for use and definitely not contaminated land. It was envisaged that these new screening levels would allow 'low-risk' land to be dismissed from the need for further risk assessment more quickly and easily and allow regulators to focus efforts on the highest-risk land. The C4SLs were proposed to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels. It is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs.

Suitable For Use Screening Levels (S4USLs)

In January 2015, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have published updated screening criteria that were derived in line with UK guidance on risk assessment (SR2 and SR3). The resultant screening criteria reflect the industries greater knowledge of the relevant toxicology and further consideration of exposure scenarios as set out in SP1010.

Waterman's Generic Assessment Criteria (GACs)

Waterman have used the following hierarchy for the generic assessment of soils to evaluate Human Health.

- Published Category 4 Screening Values (C4SLs) derived by CL:AIRE on behalf of DEFRA; or in their absence;
- Suitable 4 Use Screening Levels (S4USLs) derived by LQM/CIEH; or in their absence;
- Published Soil Guideline Values (SGVs);
- GAC prepared in accordance with the CLEA v1.04 / v1.06 model by authoritative bodies (e.g. Contaminated Land Applications in Real Environments (CL:AIRE) 2009; and
- Waterman in-house GAC prepared in accordance with the CLEA V1.06 model and associated documents.

Tabulated values of the GACs used are presented overleaf. The references of the sources quoted in the table are:-

- Environment Agency, 2009. CLEA Software, version 1.06;
- DEFRA, Environment Agency, 2004. Model Procedures for the Management of Land Contamination, Contaminated Land Report 11;
- DEFRA, 2014, SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document and appendices;
- LQM / CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment;

- Environment Agency, 2009. Human health toxicological assessment of contaminants in soil. Report SC050021/SR2;
- Environment Agency, 2009. Updated technical background to the CLEA model. Report SC050021/SR3;
- Environment Agency, 2008. Compilation of chemical data for priority organic pollutants for derivation of Soil Guideline Values. Report SC050021/SR7; and
- EIC / CL:AIRE, 2010. Soil generic assessment criteria for human health risk assessment.

Detailed Quantitative Risk Assessment (DQRA)

Detailed Quantitative Risk Assessments are undertaken on a site specific basis and full details of the alterations to the CLEA model and generic land use scenarios will be described within the specific reports.

Benzo(a)pyrene Surrogate Marker (SM) Approach

The DEFRA Category 4 Screening Level for B(a)P is based on the surrogate marker approach. In order to utilise the GAC or others based on this approach, the sample assessed must exhibit certain properties that comply with underlying assumptions.

SP1010, Appendix E states:

"The SM approach estimates the toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known. Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. In most cases, BaP is chosen as the SM due to its ubiquitous nature and the vast amount of data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food (EFSA 2008). However, RIVM considered that 'it would not be suitable to use BaP as a SM for carcinogenic risk assessment of PAH mixtures in soil due to the wide variety in composition of PAH mixtures in Dutch land contamination sites', although little data was provided in the report to support this statement (RIVM 2001). Similarly, the Canadian Council of Ministers of the Environment (CCME) also stated that contaminated soil is likely to contain a diverse range of carcinogenic and non-carcinogenic PAH of varying potency (CCME, 2008).

The SM approach relies on a number of assumptions (HPA 2010).

- *The SM (BaP) must be present in all soil samples.*
- *The profile of the different PAH relative to BaP should be similar in all samples.*
- *The PAH profile in the soil samples should be similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study.*

[sic] To assess the PAH profile in the test soil sample [complies with the assumptions above], the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated to ensure it is similar to the test material used in the Culp study (HPA 2010). To be considered sufficiently similar, the ratio relative to BaP should fit within the upper and lower limits (representing an order of magnitude above and below the mean ratio to BaP of test material used in the Culp study). In such cases BaP is considered an adequate SM and the LLTC for BaP may be used in the risk assessment.

If the site falls outside the order of magnitude limits, it may be appropriate to considering a LLTC for groups of surrogate markers, such as groups of 2, 4 or 8 PAHs, as used by EFSA for the evaluation of PAHs in food (EFSA 2008). Expert judgement should be sought in such situations where there is uncertainty as to whether BaP is sufficiently representative (HPA 2010)."

The ratios of the seven genotoxic PAHs relative to B(a)P can be calculated 'by hand' or using LQM's PAH profiling tool.

Generic Quantitative Risk Assessment Criteria

Commercial, Public Open Space end-uses.

Proposed End Use	units	Commercial			POS(resi)			POS (park)			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Arsenic	mg/kg	640	640	640	79	79	79	170	170	170	DEFRA C4SLs
Antimony	mg/kg	7500	7500	7500							CL:AIRE 2009
Barium	mg/kg	22000	22000	22000							CL:AIRE 2009
Beryllium	mg/kg	12	12	12	2.2	2.2	2.2	63	63	63	LQM S4ULs 2015
Boron (Water Soluble)	mg/kg	240000	240000	240000	21000	21000	21000	46000	46000	46000	LQM S4ULs 2015
Cadmium	mg/kg	410	410	410	220	220	220	880	880	880	DEFRA C4SLs
Chromium (Total)	mg/kg	8600	8600	8600	1500	1500	1500	33000	33000	33000	LQM S4ULs 2015
Chromium (VI)	mg/kg	49	49	49	21	21	21	250	250	250	DEFRA C4SLs
Copper	mg/kg	68000	68000	68000	12000	12000	12000	44000	44000	44000	LQM S4ULs 2015
Lead	mg/kg	2330	2330	2330	630	630	630	1300	1300	1300	DEFRA C4SLs
Mercury	mg/kg	58	58	58	16	16	16	30	30	30	LQM S4ULs 2015
Molybdenum	mg/kg	17000	17000	17000							CL:AIRE 2009
Nickel	mg/kg	980	980	980	230	230	230	800	800	800	LQM S4ULs 2015
Selenium	mg/kg	12000	12000	12000	1100	1100	1100	1800	1800	1800	LQM S4ULs 2015
Vanadium*	mg/kg	9000	9000	9000	2000	2000	2000	5000	5000	5000	LQM S4ULs 2015
Zinc	mg/kg	730000	730000	730000	81000	81000	81000	170000	170000	170000	LQM S4ULs 2015
Cyanide (Free)	mg/kg	16000	16000	16000							Waterman GAC - CLEA v1.06
Complex Cyanide	mg/kg	430000	430000	430000							Waterman GAC - CLEA v1.06

Proposed End Use	units	Commercial			POS(resi)			POS (park)			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Thiocyanate	mg/kg	22000	22000	22000							Waterman GAC - CLEA v1.06
Aliphatic EC5 - EC6	mg/kg	3200	5900	12000	570000	59000	30000	95000	130000	180000	LQM S4ULs 2015
Aliphatic EC6 - EC8	mg/kg	7800	17000	40000	600000	610000	620000	150000	220000	32000	LQM S4ULs 2015
Aliphatic EC8-EC10	mg/kg	2000	4800	11000	13000	13000	13000	14000	18000	21000	LQM S4ULs 2015
Aliphatic EC10-EC12	mg/kg	9700	23000	47000	13000	13000	13000	21000	23000	24000	LQM S4ULs 2015
Aliphatic EC12-EC16	mg/kg	59000	8200	90000	13000	13000	13000	25000	25000	26000	LQM S4ULs 2015
Aliphatic EC16-EC35	mg/kg	1000000	1000000	1000000	250000	250000	250000	450000	480000	490000	LQM S4ULs 2015
Aliphatic EC35-EC44	mg/kg	1000000	1000000	1000000	250000	270000	250000	450000	480000	490000	LQM S4ULs 2015
Aromatic C5-C7	mg/kg	26000	46000	86000	56000	56000	56000	76000	84000	92000	LQM S4ULs 2015
Aromatic C7-C8	mg/kg	56000	110000	180000	56000	56000	56000	87000	95000	100000	LQM S4ULs 2015
Aromatic C8-C10	mg/kg	3500	8100	17000	5000	5000	5000	7200	8500	9300	LQM S4ULs 2015
Aromatic C10-C12	mg/kg	16000	28000	34000	5000	5000	5000	9200	9700	10000	LQM S4ULs 2015
Aromatic C12-C16	mg/kg	36000	37000	38000	5100	5100	5000	10000	10000	10000	LQM S4ULs 2015
Aromatic C16-C21	mg/kg	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM S4ULs 2015
Aromatic C21-C35	mg/kg	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM S4ULs 2015
Aromatic C35-C44	mg/kg	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM S4ULs 2015
Benzene	mg/kg	27	47	90	72	72	73	90	100	110	LQM S4ULs 2015
Toluene	mg/kg	56000	110000	180000	56000	56000	56000	87000	95000	100000	LQM S4ULs 2015
Ethyl Benzene	mg/kg	5700	13000	27000	24000	24000	25000	17000	22000	27000	LQM S4ULs 2015
Xylene - m	mg/kg	6200	14000	31000	41000	42000	43000	17000	24000	32000	LQM S4ULs 2015

Proposed End Use	units	Commercial			POS(resi)			POS (park)			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Xylene - o	mg/kg	3600	15000	33000	41000	42000	43000	17000	24000	33000	LQM S4ULs 2015
Xylene - p	mg/kg	5900	14000	30000	41000	42000	43000	17000	23000	31000	LQM S4ULs 2015
MTBE (Methyl tert-butyl ether)	mg/kg	7900	13000	24000							CL:AIRE 2009
Naphthalene	mg/kg	190	460	1100	4900	4900	4900	1200	1900	3000	LQM S4ULs 2015
Acenaphthylene	mg/kg	83000	97000	100000	15000	15000	15000	29000	30000	30000	LQM S4ULs 2015
Acenaphthene	mg/kg	84000	97000	100000	15000	15000	15000	29000	30000	30000	LQM S4ULs 2015
Fluorene	mg/kg	63000	68000	71000	9900	9900	9900	20000	20000	20000	LQM S4ULs 2015
Phenanthrene	mg/kg	22000	22000	23000	3100	3100	3100	6200	6200	6300	LQM S4ULs 2015
Anthracene	mg/kg	520000	540000	540000	74000	74000	74000	150000	150000	150000	LQM S4ULs 2015
Fluoranthene	mg/kg	23000	23000	23000	3100	3100	3100	6300	6300	6400	LQM S4ULs 2015
Pyrene	mg/kg	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM S4ULs 2015
Benzo(a)anthracene	mg/kg	170	170	180	29	29	29	49	56	62	LQM S4ULs 2015
Chrysene	mg/kg	350	350	350	57	57	57	93	110	120	LQM S4ULs 2015
Benzo(b)fluoranthene	mg/kg	44	44	45	7.1	7.2	7.2	13	15	16	LQM S4ULs 2015
Benzo(k)fluoranthene	mg/kg	1200	1200	1200	190	190	190	370	410	440	LQM S4ULs 2015
Benzo(a)pyrene	mg/kg	35	35	36	5.7	5.7	5.7	11	12	13	LQM S4ULs 2015
Indeno(1,2,3-cd)pyrene	mg/kg	500	510	510	82	82	82	150	170	180	LQM S4ULs 2015
Di-benzo(a.h.)anthracene	mg/kg	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM S4ULs 2015
Benzo(g.h.i.) Perylene	mg/kg	3900	4000	4000	640	640	640	1400	1500	1600	LQM S4ULs 2015
Phenol	mg/kg	760	1500	3200	760	1500	3200	760	1500	3200	LQM S4ULs 2015

Proposed End Use	units	Commercial			POS(resi)			POS (park)			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Pentachlorophenol (PCP)	mg/kg	400	400	400	60	60	60	110	120	120	LQM S4ULs 2015
1,1,2,2 Tetrachloroethane	mg/kg	270	550	1100	1400	1400	1400	1800	2100	2300	LQM S4ULs 2015
1,1,1,2 Tetrachloroethane	mg/kg	110	250	560	1400	1400	1400	1500	1800	2100	LQM S4ULs 2015
1,1,1 Trichloroethane	mg/kg	660	1300	3000	140000	140000	140000	57000	76000	100000	LQM S4ULs 2015
Trichloroethene	mg/kg	1.2	2.6	5.7	120	120	120	70	91	120	LQM S4ULs 2015
Tetrachloromethane (Carbon Tetrachloride)	mg/kg	2.9	6.3	14	890	920	950	190	270	400	LQM S4ULs 2015
1,2- Dichloroethane	mg/kg	0.67	0.97	1.7	29	29	29	21	24	28	LQM S4ULs 2015
Chloroethene (Vinyl chloride)	mg/kg	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM S4ULs 2015
Trichloroethene	mg/kg	1.2	2.6	5.7	120	120	120	70	91	120	LQM S4ULs 2015
Tetrachloroethene	mg/kg	19	42	95	1400	1400	1400	810	1100	1500	LQM S4ULs 2015
Trichloromethane (Chloroform)	mg/kg	99	170	350	2500	2500	2500	2600	2800	3100	LQM S4ULs 2015
Sum of PCDDs, PCDFs and dioxins like PCBs	ug/kg			240							CLEA SGVs 2009
Isopropylbenzene	mg/kg	1400	3300	7700							CL:AIRE 2009
Propylbenzene	mg/kg	4100	9700	21000							CL:AIRE 2009
Styrene	mg/kg	3300	6500	11000							CL:AIRE 2009
Bromobenzene	mg/kg	97	220	520							CL:AIRE 2009
1,1,2 Trichloroethane	mg/kg	94	190	400							CL:AIRE 2009
1,1-Dichloroethane	mg/kg	280	450	350							CL:AIRE 2009
1,1-Dichloroethene	mg/kg	26	46	92							CL:AIRE 2009

Proposed End Use	units	Commercial			POS(resi)			POS (park)			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
1,2,4-Trimethylbenzene	mg/kg	42	99	220							CL:AIRE 2009
1,2-Dichloropropane	mg/kg	3.3	5.9	12							CL:AIRE 2009
2-Chloronaphthalene	mg/kg	390	960	2200							CL:AIRE 2009
Bromodichloromethane	mg/kg	2.1	3.7	7.6							CL:AIRE 2009
Bromoform	mg/kg	760	1500	3100							CL:AIRE 2009
Chloroethane	mg/kg	960	1300	2100							CL:AIRE 2009
Chloromethane	mg/kg	1	1.2	1.6							CL:AIRE 2009
Cis 1,2 Dichloroethene	mg/kg	14	24	47							CL:AIRE 2009
Dichloromethane	mg/kg	270	360	560							CL:AIRE 2009
Hexachloroethane	mg/kg	22	53	120							CL:AIRE 2009
Trans 1,2 Dichloroethene	mg/kg	22	40	81							CL:AIRE 2009
Bis (2-ethylhexyl) phthalate	mg/kg	85000	86000	86000							CL:AIRE 2009
Butyl benzyl phthalate	mg/kg	940000	940000	950000							CL:AIRE 2009
Diethyl Phthalate	mg/kg	150000	220000	290000							CL:AIRE 2009
Di-n-butyl phthalate	mg/kg	15000	15000	15000							CL:AIRE 2009
Di-n-octyl phthalate	mg/kg	89000	89000	89000							CL:AIRE 2009
Biphenyl	mg/kg	18000	33000	48000							CL:AIRE 2009
2,4-Dinitrotoluene	mg/kg	3700	3700	3800							CL:AIRE 2009
2,6-Dinitrotoluene	mg/kg	1900	1900	1900							CL:AIRE 2009
Tributyl tin oxide	mg/kg	130	180	200							CL:AIRE 2009

Soil Contamination – Risk of Harm to Property

Structures and Underground Services

Buried Concrete

BRE Special Digest 1 (2005), 3rd Edition, entitled *Concrete in aggressive ground*, provides guidance on the specification for concrete for installation in natural ground and in brownfield locations. The procedures given for the ground assessment and concrete specification cover the fairly common occurrences of sulfates, sulfides and acids, and the more rarely occurring aggressive carbon dioxide found in some ground and surface waters, which affects concrete foundations and sub-structures. It gives procedures for specification of concrete and applies to both buildings and civil engineering construction.

Water Supply Pipes

Guidance is provided in the UK Water Industry Research (UKWIR) report entitled *"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites"* Report Ref. No. 10/WM/03/21, 2010.

Guidance is provided in the November 2010 Q&A Update and the Questions and Answers Sheet dated 4 May 2011 included at the back of the UKWIR report. Item 3 has been reproduced here:

Item	Question	Answer
3	Following the flow chart in Figure 1.1, **would it be acceptable to not undertake a site investigation and specify the use of barrier pipes** (these seem to be suitable for all conditions)? Would it be acceptable to adopt the blanket approach of always using barrier pipes at Brownfield sites, negating the need for a desk study or intrusive investigation?	The UKWIR project steering group decided that barrier pipes would provide sufficient protection for the supply of drinking water in all Brownfield site conditions. It is therefore reasonable to expect that water companies will accept the use of barrier pipe in all situations as a blanket approach

Soil Contamination – Risk of Combustion

The combustibility of soils is a complex function of soil type, energy content, and availability of oxygen. The Building Research Establishment (BRE) has published guidance based on Calorific Value (i.e. energy content, alone), namely *IP 2/87, Fire and explosion hazards associated with the redevelopment of contaminated land*. This document provides a level below which combustibility is unlikely (2MJ/kg) and a level above which combustibility is likely (10MJ/kg). In the range between these two values combustibility is uncertain. Therefore, where the lower value is exceeded, the other key factors mentioned above need to be considered.

Soil Contamination – Risk of Harm to Vegetation

Where there is topsoil present on Site and it is being considered for reuse in landscaped areas then it needs to be assessed for its suitability for use by an appropriately qualified specialist. Topsoil can be both naturally occurring and manufactured. The requirements for topsoil that is to be reused on site are specified in BS3882:2007 and cover a range of properties including texture, organic matter content, grading, pH, nutrients and phytotoxic contaminants. The specification for phytotoxic contaminants is reproduced in the table below:

Phytotoxic Contaminants (by soil pH) for Topsoil

Contaminant*	pH		
	<6	6.0 to 7.0	>7
Zinc (Nitric acid extractable**)	<200mg/kg	<200mg/kg	<300mg/kg
Copper (Nitric acid extractable**)	<100mg/kg	<135mg/kg	<200mg/kg
Nickel (Nitric acid extractable**)	<60mg/kg	<75mg/kg	<110mg.kg

Footnotes: * The lower of the Generic Assessment Criteria for chemical contaminants (human health and the environment) and phytotoxicity shall be used for topsoil

** The method of testing is given in Annex D to BS3882:2007 Specification for topsoil and requirements for use.

The risk to human health and the environment needs to be considered as well as phytotoxicity and this will be carried out using the Generic Assessment Criteria selected for these risks as described elsewhere in this appendix and this report.

In order to assess the suitability of topsoil to be reused the full range of testing specified needs to be carried out and assessed by an appropriately qualified specialist.

Controlled Waters Generic Assessment Criteria

The Screening Values adopted by Waterman for ground and surface water quality have been selected on the basis of the water quality standards that apply at the controlled water receptor considered to be at potential risk of harm.

Surface Waters

The Water Framework Directive (WFD) (2000/60/EC) was originally introduced in 2000, however a raft of Daughter Directives have been brought in to address the objectives the WFD originally set out. Over time the WFD and its Daughter Directives have gradually replaced number of the existing Directives including the Dangerous Substances Directive (DSD) and Surface Water Directive (SWD).

The WFD identifies 'Priority' and 'Priority Hazardous Substances', to which Environmental Quality Standards (EQS) have been determined. The WFD EQS do not provide a full complement of applicable values to adopt. In the absence of an EQS, values under the replaced Surface Water Directive have been used as a guide.

Groundwater

The EU Drinking Water Directive (DWD) (98/83/EC) lays out the standards for drinking water EU wide. The UK have followed the EU regulations and translated the Directive into the Water Supply (Water Quality) Regulations England 2000. The UK Drinking Water Standards are the most relevant criteria to use for the assessment of risks to water destined for potable sources.

The WFD, to date, have not set threshold values for groundwater on a river basin basis.

TPH and PAHs

A suitable risk based assessment criteria for risks from TPH in both surface waters and groundwater are not available in the UK. The WHO have produced a health based risk assessment for drinking waters with regard to TPH “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123”.

The WHO Guideline values have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of TPH (70kg body weight and 2l of water consumed per day).

A complete list of assessment criteria for PAHs is absent from the UK (benzo(a)pyrene is available). However, the risk from PAHs should be considered. The theory presented in the WHO document “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123” has been applied to provide indicative screening values for PAHS with regard to drinking water. Published TDI and ID effects have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of PAHs (70kg body weight and 2l of water consumed per day).

The derived TPH and PAH screening values are used as an indication of the risks from TPH and PAHs to human health through drinking water only.

The standards for the substances tested for in this investigation are provided in Table D3 and D4 below.

UK and Ireland Office Locations