



Wroughton Closed Landfill Remediation Strategy

The Hills Group Ltd.

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1. INTRODUCTION

1.1 Terms of reference

Hydrock has been commissioned by The Hills Group Ltd. (the Client) to prepare a Remediation Strategy to support the proposed development of the Wroughton Closed Landfill (the 'site'). The site is located in the large village of Wroughton, near Swindon and comprises:

- a closed landfill in the north (hereafter referred to as the 'Former Landfill Area'); and
- two undeveloped fields in the south (hereafter referred to as the 'Greenfield Area').

A Site Location Plan (Ref: 11229-G016 [Rev C], dated 5 May 2022) is presented in Appendix A.

The proposed development is presented on the Proposed Site Layout Plan (Ref: 50467 P1-01 [Rev L], dated 4 February 2022) in Appendix A and comprises residential housing, public open space (POS), including a cricket pitch and a pavilion, supporting infrastructure, and a new access road off the A4361 Swindon Road to the east. It is proposed to remediate the Former Landfill Area to an appropriate condition for the proposed development to occur upon its footprint.

A Conceptual Site Model (CSM) (Ref: 02753-HYD-XX-XX-DR-G-1004, dated 16 September 2019), which illustrates the residual Source-Pathway-Receptor (S-P-R) contaminant linkages for the proposed development that require mitigation, is also presented in Appendix A.

The site benefits from existing Outline Planning (Swindon Borough Council [SBC] Ref: S/OUT/20/0556/TB), which includes a pre-commencement condition with respect to contaminated land (Condition 11). An earlier version of this Remediation Strategy (Rev: P01, dated 19 August 2021) was issued in support of the planning permission in August 2021 and was reviewed by the SBC Contaminated Land Officer. Comments were received via email (dated 25 October 2021). In addition, a meeting was held on site on 7 June 2022, which included the SBC Contaminated Land Officer and SBC Senior Landscape Architect. This Remediation Strategy has since been updated (Rev: P02) to reflect SBC's comments that were made both via email and during the on site meeting.

The works to update the Remediation Strategy have been undertaken in accordance with Hydrock's emailed fee proposal (dated 11 July 2022) and the Client's instructions to proceed (dated 12 July 2022).

1.2 Objectives

An extensive enabling works phase comprising significant earthworks will be required to create the development platform for the proposed development, and will involve the excavation, processing and reuse of site-won materials, including both landfill wastes and naturally occurring materials. This document details the proposed remediation concept with respect to the approach, targets and verification of the remedial works required in order to mitigate future risks to human health, plant life and Controlled Waters in relation to the proposed redevelopment.

The objective of this document is to:

- set out the primary objectives of the remediation;
- allow regulatory scrutiny and agreement of the remediation concept;
- support eventual discharge of pre-commencement Condition 11 of the Outline Planning (SBC Ref: S/OUT/20/0556/TB); and
- provide the design for specialist Remediation Contractors tendering for the remediation.

This document ultimately seeks to agree the remediation concept for the proposed development with the relevant regulatory authorities, namely SBC. It is anticipated that regulatory agreement of this document will have been gained in advance of tendering the remediation contract, therefore, allowing tender returns for the remedial works to be prepared with a greater level of confidence. Significant departures and/or variations to this strategy will require approval from SBC.

Following the comments from SBC in October 2021, it is recognised that the appointed Remediation Contractor will subsequently be required to prepare a Detailed Remediation Method Statement (DRMS) that provides an additional level of detail on how the works will be physically undertaken to ultimately allow discharge of the pre-commencement Condition 11.

It will then be the responsibility of the appointed Remediation Contractor to undertake and validate the remediation as detailed within this Remediation Strategy and their subsequent DRMS.

This document sets out the primary objectives of the remediation works, with sufficient detail to permit regulatory scrutiny/agreement and to permit commercial tenders for the works to be received. This document therefore details;

- the minimum requirements of the design;
- the end performance criteria for the remediated landform; and
- a framework for regulatory approval for the proposed remediation.

Both civil and structural designers shall be made aware of both this and subsequent documents pertaining to remediation of the site. This is to ensure their respective designs give due consideration to the abnormal conditions which will persist within the remediated landform.

1.3 Sources of information

Several phases of ground investigations have been undertaken by Hydrock from 2008 to 2022 to characterise the ground conditions across the Former Landfill Area, and more recently the Greenfield Area. The findings are detailed in the following documents:

- Hydrock. Ground Surface Investigation and Risk Assessment at Wroughton Closed Landfill Site, Wiltshire. Ref: R/08180/001, dated July 2008.
- Hydrock. Gas Risk Assessment at Wroughton Closed Landfill Site, Wiltshire. Ref: R/08180/002 Issue 2, dated October 2009.
- Hydrock. Surface Water Monitoring at Wroughton Closed Landfill Site, Wiltshire. Ref: R/08180/003, dated October 2009.
- Hydrock. Geo-constraints Study at Wroughton Closed Landfill. Ref: R/11229/001, dated September 2011.
- Hydrock. Wroughton Closed Landfill – Revised ground gas assessment. Ref: C11229/Note 01, dated August 2012.
- Hydrock. Trial Pit Investigation of the Eastern Portion of the Site. Land off Woodland View Wroughton, Near Swindon. Ref: R/11229/002, dated August 2015.
- Hydrock. Wroughton Closed Landfill – Report on Trial Trenching. Ref: C11229/Note 02 ver2, dated November 2015.
- Hydrock. Land off Woodland View, Wroughton, Near Swindon – Update on Geo-constraints to Development. Ref: C11229/Note 03, dated September 2015.
- Hydrock. Wroughton - Gas and Groundwater Assessment. Ref: C11229/G1002, dated 30 May 2018.

- Hydrock. Wroughton Closed Landfill Geotechnical Option Appraisal Report. Ref: 02753-HYD-XX-XX-RP-GE-1001, dated 28 June 2019.
- Hydrock. Ground Conditions. Land off Woodland View Wroughton, Near Swindon. Ref: R/11229/003/Issue 03, dated 27 April 2020.
- Hydrock. Supplementary Ground Investigation (technical note). Ref: 02753-HYD-XX-XX-TN-GE-1001 (P02), dated 11 August 2022.
- Hydrock. Summary Controlled Waters Risk Assessment (technical note). Ref: 12248-HYD-XX-XX-TN-GE-1001, dated 11 August 2022.

The above April 2020 report (hereafter referred to as the 'updated 2020 GIR') compiled all data available at the time of preparation, including a 2019 supplementary ground investigation that targeted the proposed infrastructure alignments on the Former Landfill Area and also undertook investigation across the Greenfield Area, which had not been investigated previously.

During the on site meeting with SBC on 7 June 2022, the requirement for additional ground investigation works across the perimeter slopes of the Former Landfill Area was raised to strengthen the Ground Model and understanding of shallow ground conditions across these areas of the site. The ground investigation was undertaken in June-July 2022 and the findings are detailed in the August 2022 technical note listed above (hereafter referred to as the '2022 perimeter GI note').

In addition, all of the available information and data with respect to Controlled Waters has been collated into the Summary Controlled Waters Risk Assessment technical note listed above (hereafter referred to as the '2022 Controlled Waters note'). This includes recent surface water monitoring data provided by the Client.

It is assumed that the reader is familiar with the above listed documents, which should be read in conjunction with this report.

The Exploratory Hole Location Plan (Ref: 02753-HYD-XX-XX-DR-G-1003 [P02], dated 19 July 2022) is presented in Appendix A and shows all the intrusive investigation locations undertaken to date (e.g., boreholes, trial pits, etc.)

1.4 Limitations

The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

Information provided by third parties has been used in good faith and is taken at face value. However, Hydrock cannot guarantee the accuracy or completeness of any information provided by others.

The report has been prepared for the exclusive benefit of the Client and those parties designated by them for the purpose of providing information on the remediation and validation works to be undertaken during the enabling works and construction phases of the development. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Hydrock has used reasonable skill, care and diligence in the design of the remediation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the 'Land Contamination: Risk Management' (LCRM, 2021), BS5930:2015 and BS10175: 2011+A2:2017.

2. GROUND MODEL

This section presents a high-level summary of the factual Ground Model pertaining to the site, which has been developed from all of the ground investigation works undertaken to date. It is assumed that the reader is familiar with the findings of the reports that are detailed in Section 1.3, notably the updated 2020 GIR, as well as the more recent 2022 perimeter GI note and 2022 Controlled Waters note.

The associated risks assessments with respect to the different aspects of the Ground Model described below are then summarised in Section 3.

2.1 Site description

The site is accessed via a track off Swindon Road to the east. The site is closed off by fencing and a locked gate but it is believed the site is used by the local residents as an informal recreation area for dog walking.

The Former Landfill Area has been built up by the process of landfilling, evident by its raised topography and sloping nature of its northern, western and southern flanks. The centre of the site lies at approximately 112.6 m above Ordnance Datum (AOD), with the base of the northern and western slopes approximately 104 m AOD.

The Greenfield Area comprises two open fields sloping from 109 m AOD in the east to 104 m AOD in the west.

2.2 Site history

The Former Landfill Area was historically used for the excavation of clay from pits excavated into the underlying natural geology of the Kimmeridge Clay Formation ('Kimmeridge Clay'). This was followed by the landfilling of wastes that were deposited into the unlined former clay pits.

Historical documents and records reviewed as part of the historical ground investigations refer to the landfilling of the following types of waste streams within the Former Landfill Area.

- The 'deep pit' in the south eastern corner as filled by 1955-56 with 'clay, rubble, etc.'.
- A central spine filled with 'hardcore' as a haul road.
- To the north of the haul road a 1971 memo records that the then local authority deposited domestic and household refuse on old clay workings and marshland to a thickness of 2.5-2.7m.
- An area south of the haul road and immediately to the west of the deep pit is reported to have been used from 1966 for landfilling of 'excavated muck, general waste, rubble and container waste'.
- Post-1972 landfilling shall be 'of inert materials only and no domestic refuse, industrial waste or toxic materials shall be deposited on the site' and that 'upon completion of tipping operations the whole area shall be covered with a minimum of 0.3 m of topsoil sufficient to sustain plant growth'.
- A waste disposal licence (dated 1977) lists the waste types as (a) 'waste produced in the course of constructing, improving, repairing or demolishing any building or structure provided it does not contain any hazardous quantity or concentration of poisonous, noxious or polluting substance' and (b) 'excavated material in its natural state'. Asbestos was allowed provided it was immediately covered.
- Wiltshire Council archive records indicates that the waste disposal licence was surrendered on 24 February 1993 and 2,000 m³ of topsoil was required to complete the reprofiling works.

- The GroundSure database report lists a licence (dated 1977) for inert, industrial, household and liquid sludge wastes. The report also records that surrender was actually on 24 February 1994.

The extents and associated dates of the landfilling that has historically been undertaken at the site are summarised on the Extent of Fill (from Aerial Photos) drawing (Ref: 11229-G021, dated 15 December 2014) in Appendix A.

The Greenfield Area has been undeveloped open fields since the earliest mapping to the present day.

2.3 Ground conditions

The published Solid Geology of the site is the Kimmeridge Clay, which comprises a predominantly mudstone/claystone sequence that weathers to clay. The natural clay was extracted whilst the site was used as a brickworks between pre-1900 and the 1940s. There are no records of significant Superficial Deposits on site or the surrounding area.

Landfilling within the Former Landfill Area was recorded to have occurred at the site from the 1950s through to the late 1980s. Both domestic and commercial waste streams were historically landfilled but the exact nature is likely to be variable in composition and depth with the deepest fill known to be in the former brick pits.

The landfilled waste was then covered with a final cohesive 'Capping Layer', which comprises mostly clay with rare to occasional concrete and brick fragments. Followed by 0.3 m of topsoil to complete the profiling works. Although the Capping Layer does not constitute a formally designed landfill cap, it is a distinctly separate layer to the underlying waste.

2.3.1 As proven during ground investigation

The Ground Models for the Former Landfill Area and Greenfield Area are presented in Table 2.1.

Table 2.1 Summary of ground conditions

Stratum		Depth to top (m bgl) (range)	Depth to base (m bgl) (range)	Thickness (m) (range)	Thickness (m) (average)
Former Landfill Area					
Topsoil		0.0	0.05 - 0.4	0.05 - 0.4	0.2
Capping Layer		0.05 - 0.4	0.3 - 2.4	0.2 - 2.3	0.8
Recent Construction Waste		0.05 - 1.5	0.45 - 6.8	0.8 - 5.6	2.8
Pits	Landfill Waste	0.15 - 5.5	1.45 - 10	0.55 - 8	3.7
Backfill	Reworked Site-Won Material	2.2 - 6.2	3.5 - 7.1	0.6 - 1.5	1.0
Kimmeridge Clay Formation		0.8 - 10.0	3.0 - 13.0	Not proven	Not proven
Greenfield Area					
Topsoil		0.0	0.3	0.3	0.3
Kimmeridge Clay Formation		0.3	3.0 - 3.1	Not proven	Not proven

The interpreted ground conditions encountered across the Former Landfill Area to date are summarised below (from shallowest to deepest).

As part of the supplementary ground investigation in June 2019, a waste characterisation and quantification exercise of the different waste strata was also undertaken. This is detailed in Section 5 of the updated 2020 GIR and should be read in conjunction with the below.

- **Topsoil:** comprising brown sandy clay encountered to a maximum proven depth of 0.4 m below ground level (bgl).

- **Capping Layer:** a cohesive landfill cap predominantly comprising brown silty clay with occasional brick and concrete encountered to a maximum depth of 2.4 m bgl.
- The more recent waste stream deposited between 1974 and license surrender in the early-1990s.
 - **Recent Construction Waste:** comprising a variable material of brown to grey sandy gravelly clay or clayey gravelly sand, typically with fragments of brick and concrete, occasional metal, plastic and wood, and rare asbestos. Encountered to a maximum proven depth of 6.8 m bgl.
- The oldest waste streams collectively referred to as 'Pits Backfill' (deposited prior to 1974), which can be subdivided.
 - **Landfill Waste:** comprising a variable material of grey-black sandy gravelly clay or clayey gravelly sand, including significant anthropogenics (e.g., brick, concrete, ash, metal, plastic, wood, textiles, glass, ceramic and asbestos). Encountered to a maximum proven depth of 10.0 m bgl.
 - **Reworked Site-Won Material:** comprising blue-grey (almost black) silty clay, with occasional gravel of brick and concrete, and pockets of peat. Encountered to a maximum proven depth of 7.1 m bgl.
- **Kimmeridge Clay:** comprising stiff brown grey and yellow silty clay. Encountered to a maximum proven depth of 13.0 m bgl.

The ground conditions across the Greenfield Area are summarised below (from shallowest to deepest).

- **Topsoil:** comprising brown sandy clay encountered to a maximum proven depth of 0.3 m bgl.
- **Kimmeridge Clay:** comprising firm to stiff yellowish-brown mottled orange silty clay (moderately weathered) to maximum proven depth of 2.2 m bgl, overlying stiff brown grey and yellow silty clay (slightly weathered / unweathered) to maximum proven depth of 3.1 m bgl.

2.3.2 Site Zonation

The distribution of the different deposits identified across the Former Landfill Area is very heterogeneous at the small scale (i.e., of the order of metres) but appears to be similar at the larger scale (i.e., distinct areas of the site). The site has been characterised into three separate zones explaining the spatial distribution and sequence of the ground conditions present on site. These are presented on the Zonation Plan drawing (Ref: 11229-G018 [Rev E], dated 10 October 2019) in Appendix A. Three distinct areas have been classified, as summarised below.

- **Area A:** Greenfield Area, comprising natural topsoil and subsoil only.
- **Area B:** Recent Construction Waste deposits, comprising:
 - Topsoil, Capping Layer, Recent Construction Waste, and Kimmeridge Clay.
- **Area C:** Landfill Waste, comprising:
 - Topsoil, Capping Layer, Recent Construction Waste, Landfill Waste, Reworked Site-Won Materials, and Kimmeridge Clay.

The distinct Capping Layer has been encountered across the footprint of the Former Landfill Area and is interpreted as being the final cohesive cap. The material is largely free of the significant anthropogenic waste materials (i.e., ash, metal, textiles, glass, asbestos, etc.) that are encountered in the underlying waste deposits. Detailed assessment of the Capping Layer is provided in the 2022 perimeter GI note.

2.4 Hydrogeology and hydrology

The Kimmeridge Clay is dominated by low permeability clay and the Environment Agency designate the formation as 'unproductive' (i.e., there is no classified groundwater body beneath the site). The

Kimmeridge Clay has a very low hydraulic conductivity and for all practical purposes is considered impermeable. The site is not within 500 m of a Source Protection Zone.

There is no engineered containment of the landfilled materials, nor does the former landfill contain any engineered drainage layer, therefore, a proportion of the rain will infiltrate the cover and become leachate upon contact with the waste materials. This is not technically considered 'groundwater' body but instead can be considered as 'perched water' confined within the former clay pits.

The site is bordered to the north and west by drainage ditches, with the ditch along the western boundary known as the Wroughton Ditch. This flows northwards to its confluence with the Wroughton Brook approximately 1,300 m downstream and eventually the River Ray.

2.4.1 *Perched water flow*

Perched water will accumulate within the waste deposits in the former clay pits, mainly from infiltration of rainwater, plus a very small proportion from biodegradation of the relatively low percentage of putrescible material. Significantly, water will not enter the Kimmeridge Clay, but will gradually fill the pore spaces within the waste materials until the water level reaches the lowest lip of the former clay pits from where it will flow out into the surrounding surface water system. This is evidenced by ochreous leachate outbreaks within the drainage ditches that flank the Former Landfill Area.

The recorded perched water levels within the waste deposits indicate a general flow direction towards the northwest where the water seeps out into the adjacent drainage ditches, notably along the northern and western perimeters.

2.4.2 *Engineered reed bed*

The surface water within the perimeter drainage ditches flows towards the northwest corner where it is now treated by passing through an engineered reed bed facility prior to flowing off site. The reed bed is operated and maintained in accordance with an environmental permit (Ref: EPR/JP3120XW, determined 25 November 2011). The construction of the reed bed is detailed on the Brunel Surveys Reed Bed Construction Details drawing (Ref: WR/RB/007A, dated 19 March 2017) in Appendix A.

2.5 Ground gases

An extensive ground gas monitoring programme has been undertaken across the site, notably as detailed within the Gas and Groundwater Assessment letter (Ref: C11229/G1002, dated 30 May 2018). Gas concentrations of up to 18.4% methane and 16.8% carbon dioxide have been recorded by volume, however, the highest recorded ground gas concentrations are in the west of the site and outside of the proposed residential footprint in the east (see previously referenced Site Zonation drawing in Appendix A). Gas flow rates from the monitoring wells have always been minimal, usually being below the limit of detection of the instrument (i.e., <0.3 l/hr).

2.6 Unexploded ordnance (UXO)

The Zetica online UXO map indicates the site to be in an area where the UXO risk is low.

2.7 Radon

The site is not in a Radon Affected Area and no radon protection measures are required.

3. RISK ASSESSMENT REVIEW

This section summarises the risk assessments and findings pertinent to the Remediation Strategy.

3.1 Human health (soil)

The Contaminants of Potential Concern (COPC) recorded within soils were compared against Hydrock's Generic Assessment Criteria (GAC) for a 'Residential with Plant Uptake' and/or 'POS (park)' CLEA land use scenario. The detailed findings are presented in the updated 2020 GIR and the more recent 2022 perimeter GI note. The pertinent findings are summarised below.

Former Landfill Area

- No GAC exceedances are recorded within the surface topsoil material indicting suitability for use.
- A marginal GAC exceedance of the US₉₅ for benzo[a]pyrene was recorded within the Capping Layer based on a Residential with Plant Uptake scenario (1.7 mg/kg against a GAC of 1.5 mg/kg). The marginal exceedance is based on three individual exceedances (out a possible 25 samples) and the concentration is also below the C4SL for benzo(a)pyrene (5 mg/kg). In addition, the US₉₅ also does not exceed the GAC for the POS (park) scenario (4.5 mg/kg), which is also applicable for the large POS area in the west. Hydrock consider that the Capping Layer is chemically suitable for use.
- The individual waste materials of the former landfill, including both the Recent Construction Waste and the Landfill Waste, are a pervasive source of heavy metals and polycyclic aromatic hydrocarbons (PAH), and also contain asbestos (both visible ACM and fibres).

With respect to the residential area in the east of the Former Landfill Area, the underlying waste materials of the former landfill are considered a risk to human health due to pervasive heavy metals, PAH and asbestos, therefore, mitigation measures are required (see Section 4.3).

When all available data for the top 1.3 m of the existing ground conditions across the Former Landfill Area are assessed, comprising the Capping Layer and the shallow Recent Construction Waste (split from the wider dataset), and excluding the topsoil, the US₉₅ for benzo[a]pyrene is significantly below the GAC for the POS (park) scenario. This indicates that the proposed POS area in west already has a sufficient thickness of cover, including around the perimeter of the Former Landfill Area (where there is potential for a decreased average Capping Layer thickness). A minimum thickness of cover should be maintained for the POS area consistent with the historical required thickness (i.e., 300 mm) (see Section 4.3).

The shallow soils in the vicinity of exploratory location TP319 contain significant deleterious materials, notably broken glass. In addition, the topsoil and Capping Layer have recorded individual exceedances of the GAC for benzo(a)pyrene and dibenz(a,h)anthracene at this location. It is considered likely that the underlying shallow Recent Construction Waste has historically mixed with the overlying materials at this location. The deleterious materials (and GAC exceedances) represent an unacceptable level of risk for the proposed development and require mitigation (see Section 4.3).

Greenfield Area

- No GAC exceedances were identified within either the topsoil or Kimmeridge Clay across the Greenfield Area.

3.2 Plant life

No GAC exceedances are recorded within the surface topsoil material or the underlying Capping Layer across the footprint of the Former Landfill Area.

The Recent Construction Waste recorded a marginal US₉₅ exceedance of the GAC for boron at a concentration of 4.0 against a GAC of 3 mg/kg. This is considered to be a marginal exceedance that is caused by four individual exceedances that raise the US₉₅ above the GAC. Significantly, the exceedances are from considerable depths (i.e., >2.0 m bgl).

The average thicknesses of overlying topsoil and Capping Layer across the Former Landfill Area are 0.2 m and 0.8 m, respectively. When all available data for the top 1.3 m of the existing ground conditions across the Former Landfill Area are assessed, including the shallow Recent Construction Waste, no exceedances with respect to plant life were recorded. Therefore, a significant thickness of suitable cover is currently in place. In addition, the vegetation coverage around the perimeter of the Former Landfill Area (where there is potential for a decreased average Capping Layer thickness) did not appear to show any signs of physical distress. A minimum thickness of cover should be maintained for the POS area as part of the mitigation measures for human health, which will also serve to protect plant life (see Section 4.3).

3.3 Controlled Waters

The 2022 Controlled Waters note provides a summary risk assessment of all available data with respect to Controlled Waters. The conclusions of the risk assessment are summarised below.

- Perched water beneath the Former Landfill Area sits within the hollow left by the historical excavation of clay. The flow direction is towards the northwest and outbreaks into the perimeter drainage ditches.
- The Controlled Waters receptor is the Wroughton Ditch along the western boundary of the site and flows through an engineered reed bed prior to discharge into the wider surface water network.
- The surface water monitoring data from the past 5 years (2017 to 2022) indicate that the containment afforded by the Kimmeridge Clay followed by the polishing through the engineered reed bed is providing a good level of protection to the Controlled Waters receptor.
- Provided the engineered reed bed is continually operated in accordance with the environmental permit, the risk to Controlled Waters is considered to remain low.

The 2022 Controlled Waters note also considered the impact of the proposed development on the surface water regime. The findings are summarised below.

- The proposed earthworks to create the development platform require the raising of ground levels in the Greenfield Area. The risk of leachate to the Controlled Waters receptor from the proposed placement of Capping Layer soils on the Greenfield Area to facilitate ground level raise is considered to be low, namely:
 - the exceedances of lead and iron (dissolved) in two of six leachate samples are marginal; and
 - all determinands in the leachate are below the discharge limits set in the environmental permit.
- The proposed development in the east of the Former Landfill Area may result in a slight reduction in infiltration and betterment of the leachate quality in this area of the site, namely due the construction of houses, pavement/road construction and other hard surfaced infrastructure (typically, 40% will feed into the storm network and not infiltrate to ground).
- The construction of cut-off drains along the southern, western and northern perimeters of the Former Landfill Area, will prevent breakouts from occurring at surface by intercepting and channelling the flow to the existing engineered reed bed facility.
- Therefore, the future risk of direct contact of site users with the ochreous leachate outbreaks is considered to be low.

The proposed mitigation measures for the protection of future site users from direct contact with the leachate outbreaks are discussed further in Section 4.4.

3.4 Ground gas

The site was previously characterised as Amber 1 (using the NHBC methodology) in terms of ground gassing risk and the requirement for ground gas protection measures was concluded (see the previously referenced Hydrock Gas and Groundwater Assessment letter from 2018). Furthermore, in written correspondence and in subsequent telephone conversations, SBC noted their agreement with Hydrock's findings and recommendations and, therefore, no further ground gas monitoring was required.

Although a classification of Amber 1 had previously been agreed with the SBC, the ground gas risk assessment was repeated to ensure the risks associated ground gases were assessed correctly in accordance with BS8485:2015, which cites the guidelines published by CIRIA (Wilson et al 2007). All available ground gas monitoring data for the site was therefore compiled and reassessed within the updated 2020 GIR using the guidelines published by CIRIA. The updated ground gas risk assessment also considered the impact of the proposed development on the ground gas regime.

The updated ground gas risk assessment confirmed the findings of the previous assessments that ground gas protection measures are required across the Former Landfill Area commensurate with Characteristic Situation (CS) 2. This was based on consistent elevated concentrations for carbon dioxide and methane, albeit with negligible/very low flow rates.

The ground gas mitigation measures for the Former Landfill Area are discussed further in Section 4.5.

The CS classification for the adjacent Greenfield Area was inferred from the ground gas monitoring results of the wells on the perimeter of the adjacent Former Landfill Area. Methane concentrations in these wells were either below, or marginally above, the detection limit and are considered to be of no significant risk to the proposed development on the Greenfield Area.

Carbon dioxide concentrations are also within the normal limits for soils and therefore indicate CS-1 from the calculated GSV. However, the maximum concentrations were above 5, which may indicate CS-2. The classification of CS-1 is however considered appropriate for the Greenfield Area, based on:

- The typical carbon dioxide concentration for these monitoring wells is below 5% (i.e., concentrations are not consistently above 5% and when the exceedances do occur, they are relatively marginal);
- The complete lack of ground gas flow (the limit of detection of the unit has been used as a conservative approach); and
- The good level of understanding of the CSM based on multiple phases of ground investigation, monitoring and assessment.

No ground gas protection measures are, therefore, required for the residential development on the Greenfield Area.

3.5 Water supply pipes

The northern part of the site is brownfield and a former landfill. Based upon the former site usage and the results of the chemical analyses undertaken to date, it is considered likely that barrier pipe will be required where water supply pipes are in contact with the former landfill waste materials (see Section 4.6). Confirmation should be sought with the relevant water authority as soon as possible.

3.6 Conceptual Site Model

Based on the findings of the investigation works and the risk assessments summarised above, the final CSM (Ref: 02753-HYD-XX-XX-DR-G-1004, dated 16 September 2019), illustrating the S-P-R contaminant linkages for which the risks are unacceptable and require mitigation, is presented in Appendix A. The CSM is also summarised in Table 3.1 below.

The proposed mitigation measures are discussed in detail in the following sections of this strategy document.

Table 3.1: Final conceptual model and residual risks following risk evaluation.

Contaminant Linkage				Comments	
Sources		Pathways	Receptors	General	Mitigation
1.	Pervasive arsenic, lead and benzo(a)pyrene in the waste materials of the Former Landfill Area.	Ingestion, inhalation or direct contact.	Human health.	Significant exceedance of the GACs.	Mitigation required in the form of a clean cover system.
2.	Visible ACM and asbestos fibres in the waste materials of the Former Landfill Area.	Inhalation.	Human health.	Presence of visible ACM and asbestos fibres in soil.	Mitigation required in the form of a clean cover system. In addition, any visible ACM encountered during earthworks will need to be handpicked and removed from site.
3.	Pervasive metals in the deeper waste materials of the Former Landfill Area.	Root uptake	Plant life	Significant exceedance of the GAC in deeper waste materials (i.e., >1.3 m bgl).	Deeper waste materials cannot be used as a growing medium in the proposed development. Data for upper 1.3 m bgl (all subsoil), suggests a significant thickness of cover already exists above. The installation / reinstatement of minimum thickness of cover for human health will ensure continuation of the protection for plant life.
4.	Elevated polycyclic aromatic hydrocarbons (PAH) in the waste materials of the Former Landfill Area.	Direct contact.	Water supply pipes.	Significant exceedance of the GACs.	Installation of barrier pipework will likely be required where water supply pipes are in contact with the waste materials.
5.	Elevated metals and anions in surface water within drainage ditches (due to perched water breakout)	Ingestion or direct contact.	Human health	Significant exceedances of DWS in surface water within drainage ditches.	Installation of improved drainage works across the POS area to capture perched water breakout at surface and direct to existing reed bed facility (previously agreed with SBC as part of Outline Planning).
6.	Elevated concentrations of ground gases (methane and carbon dioxide) in Former Landfill Area	Migration, build up, inhalation/asphyxiation, and explosion.	End users of new buildings on site by asphyxiation.	Former Landfill Area: CS-2. Greenfield Area: CS-1. As previously agreed with SBC.	Mitigation required in Former Landfill Area by the installation of appropriate gas protection measures (commensurate with CS-2 conditions). To be installed by trained installer. To be validated and verified. No mitigation measures are required in the Greenfield Area.

4. REMEDIATION STRATEGY

4.1 Introduction

For the site to be considered adequately remediated and thus suitable for residential development, the geo-environmental constraints summarised in Section 3 need to be addressed. In addition, the earthworks proposals need to address the potential geotechnical constraints.

The key constraints to the proposed development can be grouped as follows:

- Human health (soil);
- Human health (direct contact with perched water outbreaks);
- Ground gas; and
- Ground settlement.

Remedial works that address all of these potential development constraints will be required to render the site suitable for development. It is proposed that this will be achieved via a combination of: excavation, processing and engineering of the arisings; the provision of hardstanding capping or clean cover within soft landscaping; the installation of cut off drains and service corridor dams; and the installation of ground gas protection measures.

4.2 Remedial concept

Various options to render the site suitable for the proposed development have been considered during the investigations and assessment completed to date. It is recognised that while a variety of technical approaches may be adopted, the costs associated with some options are significant. The development of the site must be economically viable.

Based upon the findings and conclusions of the investigations detailed above, as well as subsequent detailed geotechnical design, it is considered that partial excavation and engineering of the highways and deep service corridors (i.e., storm and foul) across the residential footprint on the Former Landfill Area is technically feasible and also the preferred approach. The approach is discussed in more detail in Section 4.2.1.

Due to the proposed mitigation measures of a clean cover system across soft landscaping areas, excavation into the former landfill will also be required across the remainder of the residential footprint of the Former Landfill Area (i.e., outside of the highways and deep service corridors) to allow for the future installation of the clean cover system. This is envisaged to involve the careful stripping and segregation of the topsoil and Capping Layer for reuse.

4.2.1 *Partial excavation and engineering of highways and deep service corridors*

It is envisaged that the highways and deep service corridors of the proposed development on the Former Landfill Area will be partially and systematically excavated, with the arisings screened and sorted into the various constituents using a ‘*treatment train*’ approach. Broadly, the material would be sorted into:

- recyclables (i.e., wood/metal etc.);
- unacceptable, miscellaneous or hazardous material (i.e., handpicking of ACM) for off-site disposal; and
- recoverable soil materials suitable for engineering.

The soil arisings suitable for engineering would be screened, separated, graded, and potentially shredded, blended and conditioned/stabilised or bailed as appropriate to render them suitable to be engineered as a blended or layered fill. The engineered fill would be used in the reinstatement of the partial excavations for the improvement of the highways and services corridors across the residential footprint of the Former Landfill Area.

Should it prove impractical to fully dewater the excavations in the Former Landfill Area, a self-compacting fill may be used below the dewatering level.

This concept is illustrated on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) presented in Appendix A, which uses a cross section that is typical of the Former Landfill Area.

In addition, the earthworks proposals include the placement of Capping Layer soils excavated from the Former Landfill Area on the Greenfield Area for the ground level raise. The Capping Layer soils have been extensively tested (both soils and leachate) and demonstrated as chemically suitable for this use, without posing significant risk to human health, plant life or Controlled Waters.

The approach is primarily based on the excavation, processing and reuse of site-won arisings. However, the reinstatement could potentially also be undertaken using clean imported material. The site-won arisings would, therefore, be disposed of off site, which may also involve some screening/hand picking to support waste categorisation and disposal processes. The reuse of suitable site-won arisings is a preferable approach since replacement materials would require import to site to reinstate the significant excavations and also as part of the ground level raising. This would significantly increase the carbon footprint, and decrease the sustainability, of any development of the site.

4.2.2 Concept summary

The engineering approach for the highways and deep service corridors is summarised in Table 4.1.

Table 4.1. Summary of remedial concept

Former Landfill Area			
Approach	Topsoil and Capping Layer	Highways & Deep Service Corridors	Installation of Clean Cover System
Partial excavation and engineering of highways and deep service corridors.	Carefully stripped, segregated and characterised for reuse. Depth of reduced level dig sufficient to allow the installation of clean cover system in residential footprint.	Partial excavation and engineering of the void for improvement of the highways and services corridors. Reinstatement with: • Site-won arisings screened, separated and treated to render them suitable for reuse as an engineered fill; or • Imported material.	Installed across the soft landscaping areas of the residential footprint and reinstatement of the historical minimum thickness across the POS.
Greenfield Area			
Approach	Topsoil	Ground Level Raise	
As above.	Carefully stripped, segregated and characterised for reuse.	To be undertaken using either: • Capping Layer (from Former Landfill Area); or • Imported material. No mitigation measures are required.	

4.3 Protection of human health (soil)

4.3.1 Former Landfill Area residential footprint

The engineering approach involves excavation into the waste materials of the Former Landfill Area and the processing/recovery and re-deposition of the arisings as engineered fill. While it is anticipated that the remedial works (i.e., screening, separating etc.) will remove much of the biodegradable material from the excavated areas, the residual material may not be suitable for use at the surface. This will be due either to its physical nature, or due to the presence of COPC. Accordingly, it is proposed to install a clean cover system above the underlying waste materials across the Former Landfill Area.

A clean cover system is designed to provide the complete separation of the receptor from the hazard (i.e., to break the applicable S-P-R linkages discussed in Section 3.6). The thicknesses of the clean cover system for the different residential areas are detailed below. Detailed guidance on this type of cover system is also given in CIRIA Special Publications 105, 106 and 124.

For clarity, the Capping Layer soils have been extensively tested and deemed suitable for use as part of the ground level raise in the Greenfield Area. Therefore, no mitigation measures are proposed on the Greenfield Area.

Following the excavation works and subsequent placement of engineered fill, there is a desire to avoid further excavation into the underlying waste materials during future construction activities. Accordingly, a precautionary approach is to be implemented and a minimum clean cover thickness of 1,000 mm shall be adopted across the residential footprint of the proposed development on the Former Landfill Area (combined thickness of topsoil and subsoil). Essentially, the formation level across the residential footprint following the cut/fill earthworks will provide a minimum thickness of 1,000 mm between the top of the waste materials (both engineered fill or untreated) and the proposed finished development level to allow for the installation of the clean cover system.

The extent of the residential footprint of the Former Landfill Area requiring a clean cover system, as well as the proposed clean cover system design, is illustrated on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) in Appendix A. The clean cover system in the residential footprint shall also comprise a suitable basal geo-fabric separation layer above all underlying waste materials (both engineered or untreated).

Clean cover specification

The minimum specification of the clean cover across the residential footprint is summarised below.

- Be placed in all soft landscaping areas across the residential footprint of the proposed development on the Former Landfill Area as shown on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) in Appendix A, and will comprise a minimum thickness of 1,000 mm.
- Comprise a suitable basal geo-fabric separation layer.
- Comprise soils approved as suitable for use by an appropriately qualified Geo-environmental Engineer i.e., comprise soils which are both physically* and chemically suitable with concentrations of COPC below those set out within the Soil Quality Criteria in Appendix B.
- Comprise a proposed thickness of 300 mm topsoil to provide a suitable growing medium.

*i.e., free from anthropogenic materials, oversize material (>50 mm) and anything which could be reasonably deemed to be of potential harm.

The remediation contract will likely be let to provide a finished remediation level within the clean cover system, which is proposed to be set at the basal geo-fabric separation layer plus 100 mm of overlying clean material to allow for later placement of the clean cover – see indicative green line on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) in Appendix A. This will be confirmed within the appointed Remediation Contractor's DRMS.

The clean cover system shall also give consideration to the permeability and the consequential impact upon both the surface runoff and ground gas regimes. This principally relates to their composition (granular, cohesive or composite). The Hydrock Geotechnical Design Report and Earthworks Specification should be consulted for more detail, which will be issued under a separate cover. The capping material will also need to satisfy the requirements of NHBC Standards Chapter 4.1 and 10.2.

4.3.2 *Former Landfill Area public open space, excluding cricket pitch*

The extensive ground investigations undertaken demonstrate that an average thicknesses of topsoil and Capping Layer across the Former Landfill Area are 0.2 m and 0.8 m, respectively. There is potential variability of the Capping Layer between the top and the base of the slopes around the perimeter, with an average thickness 0.65 m at the top and decreasing to 0.45 m at the base. However, when combined with the overlying topsoil this is still significant thickness for POS (typically in excess of 0.5 m).

It is likely that as part of the earthworks for the proposed development, the topsoil will be carefully stripped, segregated and stockpiled for future reuse. As this time, any oversize materials identified at the surface (i.e., the rare concrete and brick that has historically been identified) can be removed. The stripping across the site will likely be required to provide sufficient space for storage, processing and treatment during the enabling works phase. On completion on the development, it is proposed that the historical 300 mm thickness of topsoil is reinstated across the footprint of the POS area (outside of the cricket pitch). This is consistent with the thickness that was required to complete the historical profiling of the site. In combination with the underlying thickness of Capping Layer soils that are already present, it is considered that this will provide an appropriate thickness of cover for the POS area.

The extent of the reinstatement of the clean cover across the POS footprint is illustrated on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) in Appendix A.

Clean cover specification

The minimum specification of the reinstatement of the clean cover across the POS footprint (excluding the cricket pitch) is summarised below.

- Comprise a thickness of 300 mm (proposed all topsoil to provide a suitable growing medium).
- Comprise soils approved as suitable for use by an appropriately qualified Geo-environmental Engineer i.e., comprise soils which are both physically* and chemically suitable with concentrations of COPC below those set out within the Soil Quality Criteria in Appendix B.

*i.e., free from anthropogenic materials, oversize material (>50 mm) and anything which could be reasonably deemed to be of potential harm.

4.3.3 *Former Landfill Area cricket pitch*

To create a level development platform for the cricket pitch, it is envisaged that a cut and fill exercise will be required that will excavate 600 mm beneath the existing site level across the footprint of the pitch. A 600 mm thickness of suitable material is then proposed to be reinstated and is proposed to

comprise Capping Layer soils, imported granular material (to support the installation of the herringbone drainage beneath the pitch), and followed by topsoil. Again, a 300 mm thickness of topsoil is proposed.

The drainage and finished levels for the cricket pitch are presented on the Cole Easdon Consultants Detailed Drainage Strategy & Finished Levels drawing (Sheet 2 of 3) (Ref: 4175/507/02 [Rev A], dated 18 February 2022) in Appendix A.

A combined thickness of 600 mm reinstatement, plus the additional Capping Layer soils that are also likely to be present beneath, will provide a sufficient level of cover to allow for disturbance, weathering and erosion of the outfield of the cricket pitch.

It is assumed that the wicket area of the cricket pitch (understood to be approximately 33 m by 21 m according to the Cole Easdon Consultants Finished Levels drawing referenced above) will be designed by a specialist in accordance with an appropriate specification (such as Sports England). Therefore, additional requirements, over and above the proposed 600 mm across the cricket pitch may also be installed.

The extent of the clean cover across the cricket pitch is illustrated on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022) in Appendix A.

Clean cover specification

The minimum specification of the clean cover across the cricket pitch is summarised below.

- Comprise a thickness of 600 mm.
- Comprise a suitable geo-fabric separation layer (proposed as part of the drainage layer).
- Comprise soils approved as suitable for use by an appropriately qualified Geo-environmental Engineer i.e., comprise soils which are both physically* and chemically suitable with concentrations of COPC below those set out within the Soil Quality Criteria in Appendix B.

*i.e., free from anthropogenic materials, oversize material (>50 mm) and anything which could be reasonably deemed to be of potential harm.

Shallow soils in vicinity of exploratory location TP319

The soils in the vicinity of exploratory location TP319 contain significant deleterious materials, notably broken glass. In addition, the topsoil and Capping Layer have recorded individual exceedances of the GAC for PAHs. It is considered likely that the underlying shallow Recent Construction Waste has historically mixed with the overlying materials at this location.

The shallow materials impacted with significant deleterious materials and elevated concentrations of PAHs require delineation and removal, followed by reinstatement of the 300 mm historical clean cover.

4.4 Protection of human health (direct contact with perched water outbreaks)

The potential risk to future site users from the leachate outbreaks into the surrounding drainage ditches and also to the proposed storage basins (i.e., through direct contact) has been addressed by the proposed installation of cut-off drains along the southern, western and northern boundaries of the Former Landfill Area. These drains will feed into the existing engineered reed bed facility located in the north western corner.

The proposed cut-off drains are being designed to intercept and prevent the breakouts from occurring at the surface. This will sever the pathway between the surface water (i.e., the source) and future site users (i.e., the receptor).

The location and design of the proposed drains are presented on the Cole Easdon Consultants SuDS Maintenance Plan (Ref: 4175/SK503 [Rev C], dated 8 June 2020) in Appendix A, which is understood to have been submitted and agreed with SBC as part of Outline Planning. In addition, the drains are also shown on the Cole Easdon Consultants Detailed Drainage Strategy & Finished Levels drawings (Sheets 1 to 3) (Ref: 4175/507/02 [Rev A], dated 18 February 2022) in Appendix A, which are understood to have been submitted as part of Reserved Matters planning.

Depending on the depth of deep drainage (i.e., storm and foul), a potential preferential pathway may exist that allows the flow of perched water along the drainage corridors from the Former Landfill Area and into the Greenfield Area, which could then flow on towards the proposed storage basins in the west of the site. If deep drainage is constructed beneath the elevation of the perched water, measures such as dams will need to be installed within the deep service corridors to intercept and divert any perched flow before it enters the Greenfield Area.

4.5 Ground gas protection measures

4.5.1 Former Landfill Area

Mitigation of the risk from ground gases needs to be undertaken across the Former Landfill Area of the proposed development in accordance with BRE 414, CIRIA 665, BS 8485:2015 +A1:2019 and CIRIA C735. The design of gas protection measures needs to be undertaken in accordance with CS-2.

The final design of ground gas protection measures is to be specified by the designer (in accordance with CIRIA 665 and BS 8485:2015+A1:2019). The design of the scheme will be required to discharge pre-commencement Condition 11. The protection will need to be achieved by a combination of two or more of the following three types of protection measures:

- the structural barrier of the floor slab;
- ventilation measures; and
- gas resistant membrane.

Where design elements are required to meet certain standards to qualify for the number of protection points required (e.g., cast *in situ* monolithic reinforced floor slab), it is up to the designer to ensure the minimum requirements of the standards are met.

Where used, gas resistant membranes should be:

- sufficiently impervious to methane and carbon dioxide;
- capable, after installation, of providing a complete barrier to the entry of the relevant gas;
- sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- sufficiently strong to withstand in service stresses (e.g., due to ground settlement if placed below a floor slab);
- sufficiently strong to withstand the installation process and following construction activities until covered (e.g., penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools); and
- chemically resistant to degradation by other contaminants that might be present.

Where a gas resistant membrane is required as part of the design, all joints and penetrations are to be sealed and the installation is to be verified in accordance with CIRIA C735 (Mallet et al 2014) or it will score zero points and will not be deemed to afford any protection. This verification will involve

verification by the Contractor and independent verification on a selected number of plots by a qualified independent third party.

Whilst tape can be utilised to seal the seams Hydrock would recommend the membranes are sealed using welded seams and the use of specialist seals around penetrations (top hats etc.). The installer is to present an installation methodology and a QA/QC plan for installation to Hydrock for comment, with particular attention given to sealing the membrane.

In order to achieve the points specified for ventilation, the architect is to design passive ventilation to meet at least 'good performance', as detailed in Annex B of BS8485:2015+A1:2019.

4.5.2 Greenfield Area

No ground gas protection measures are required for the residential development on the Greenfield Area.

4.6 Water supply pipework

The waste materials of the Former Landfill Area contain organic contamination and it is considered that barrier pipe will be needed where water supply pipes are in contact with the former landfill waste materials, including where landfill arisings are engineered back into the development platform.

Ground investigation and assessment has indicated no plausible contaminant sources in the natural soils of Greenfield Area of the site, therefore, it is envisaged that standard pipework will be suitable here. However, Capping Layer soils are proposed to be placed on the Greenfield Area as an engineered fill material as part of the ground level raise, and the water authority may expect to see barrier pipe where water supply pipes are in contact with the engineered fill.

Subject to agreement with the Water Authority, it may be possible for the site to be classified as 'dual status', i.e. contaminated and non-contaminated, from the perspective of the water supply pipe requirements, with standard pipework for where it is in contact with clean material (i.e. the clean cover system to be installed in the upper 1,000 mm across the residential area of the Former Landfill Area, or the natural Kimmeridge Clay etc.) and barrier pipe for where it is in contact with waste materials. However, confirmation should be sought from the water supply company at the earliest opportunity.

4.7 Health & safety considerations

During the implementation of the remedial works, the Remediation Contractor should ensure that appropriate measures are in place to protect adjacent site users and local residents from nuisance. The Remediation Contractor shall implement measures that:

- protect the workforce from potential contaminants,
- control nuisance odours;
- control dust and fibres from being generated and released; and
- limit soil being tracked into, or dropped on to, public highways.

The proposed schemes to implement the above measures will be required as part of Remediation Contractor's DRMS, including details on appropriate environmental monitoring on the site boundary.

Whilst risks to construction workers are not discussed in detail, and this will be a requirement of future submissions such as the Remediation Contractor's DRMS, the following section discusses potential risks that should be considered. Information presented in this document is provided to assist in managing the risk associated with contamination in soil and groundwater at the site but is not definitive. The

Remediation Contractor is responsible for undertaking their own risk assessments and assessing what risks are present and what control measures are required.

4.7.1 Contamination risks to ground workers

As the site is a former landfill, significant thicknesses of Made Ground have been encountered, which have included visual ACM and asbestos fibres. Furthermore, ground gas monitoring has identified methane and carbon dioxide concentrations. Therefore, there is the potential that soils contain contaminants and site workers should be made aware of the possible presence and build-up of gases when working in trenches or confined spaces.

All site staff should also be made aware of the possibility to encounter asbestos within the Made Ground soils anywhere on the site at any stage of the development. It is advised that the Remediation Contractor should consider supplying suitable and sufficient 'Asbestos Awareness' training (specific to asbestos in soils) to all site staff who could foreseeably encounter asbestos containing materials during the course of their work.

It is the responsibility of the Remediation Contractor to ensure that mitigation measures are suitable and sufficient to prevent exposure to airborne asbestos so far as is reasonably practicable in accordance with Regulation 11 of CAR2012. However, the asbestos fibres detected at the site are at a very low concentration and within a soil matrix. As such, if the soils are kept damp and appropriate site hygiene measures are in place, this should assist in minimising the risk of the release of airborne fibres.

Task specific risk assessments and method statements should be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and, if required, RPE should be provided and utilised.

4.7.2 Control of dust emissions

To reduce the potential for the generation of dust, it is recommended that double handling of soils is kept to a minimum, wherever possible. However, it is recognised that the soil arisings suitable for engineering require screening, separating, grading, and potentially shredding and blending to render them suitable to be engineered. Therefore, stockpiling of materials is likely.

Appropriate risk assessment and mitigation measures should be in place throughout the development. As a minimum, this should include damping down of the site surface, excavations and stockpiles to prevent the generation of dust.

It is recommended that any soil export or import to site is undertaken utilising covered vehicles. Dust suppression systems shall be utilised as required, dependent upon site activities and conditions.

4.7.3 Vehicle movements

The works could create mud from vehicle movements and subsequent tracking off-site on vehicle tyres. This will be managed during the works to prevent off-site mud transfer. Measures to control these issues may include the provision of a wheel-wash facility and when necessary, a mechanical road sweeper to further ensure that the road is kept clean.

4.7.4 Protection of Controlled Waters

Measures to protect Controlled Waters (i.e., the Wroughton Ditch) should also be adopted to prevent surface run off from the different materials during the works (i.e., from stockpiles awaiting processing,

processed materials, waste, etc.). This should include mechanisms to allow for the collection of potentially contaminated water at the surface (i.e., drainage measures around any processing and/or stockpiling areas).

The Remediation Contractor will be required to detail the proposed schemes as part of their DRMS, including the layout and design of any stockpiling and processing areas required to facilitate the earthworks.

5. MATERIALS MANAGEMENT

5.1 Deposit for recovery environmental permit

As the proposed remediation methodologies involve the excavation, processing and reuse of site-won arisings, including waste deposits of the former landfill, this will need to be done under a Deposit for Recover environmental permit. In this case, it will first be necessary to demonstrate that the proposed activity constitutes recovery through the submission of a Waste Recovery Plan to the Environment Agency.

Conversations to this end have begun with the Environment Agency and a pre-application meeting was held in February 2020, and further discussions were undertaken in June 2022. The next step is the preparation and submission of a Waste Recovery Plan and the required supporting evidence to the Environment Agency for review.

5.2 Materials Management Plan

The earthworks proposals also include the reuse of site-won and imported soils in line with a Materials Management Plan to be prepared in accordance with 'The Definition of Waste: Development Industry Code of Practice', Version 2 (CL:AIRE), known as the 'DoWCoP'. The Materials Management Plan will need to be signed off and Declared with CL:AIRE by a Qualified Person.

5.3 Characterisation of former landfill arisings

Additional characterisation of the different arisings from the Former Landfill Area will be undertaken during the works to determine that the concentrations of COPC are suitable for the proposed end use as part of the development, which could include:

- back into the excavation beneath the highway alignments as an engineered fill (Former Landfill Area);
- ground level raise to formation level on the Greenfield Area; and
- clean cover (residential or POS).

Each of the different arisings are to be segregated and stockpiled separately to minimise the risk of cross contamination.

A suitably qualified Geo-environmental Engineer will visit site to assess whether excavated material is both physically* and chemically suitable for reuse with concentrations of COPC below those set out within the Soil Quality Criteria presented in Appendix B.

*i.e., free from anthropogenic materials, oversize material (>50mm) and anything which could be reasonably deemed to be of potential harm.

As part of the characterisation, each stockpile is to be sampled on the following basis:

- 3 samples for the initial 250m³ of material, followed by 1 sample for each additional 250m³ (i.e., a 500m³ stockpile would require 4 samples, whereas a 1,000m³ stockpile would require 6 samples).

Once a stockpile has been sampled and is awaiting results, no further material is to be added to/removed from that stockpile, or is the stockpile to be moved to a new location. In the event of the stockpile being disturbed the chemical results will be invalid and new samples will be required.

The different arisings from the former landfill are discussed separately below as well as their suitability for potential reuse. The Soil Quality Criteria for the different end uses are presented in Appendix B and are also discussed in Section 5.8. Some criteria will be provided in a future revision of this document.

Topsoil

The topsoil material across the Former Landfill Area (typically the upper 0.2 m to 0.3 m) is suitable for reuse at surface. During stripping and stockpiling, any oversize materials identified at the surface (i.e., the rare concrete and brick that has historically been identified) can be removed.

Capping layer

As part of the additional ground investigation detailed in the recent 2022 perimeter GI note, extensive sampling and risk assessment was undertaken for the Capping Layer material. The works concluded that the Capping Layer soils are free of pervasive COPC and the leachate does not pose a significant risk to Controlled Water, therefore, the material is considered suitable for use.

It is envisaged that the Capping Layer is to be carefully stripped and segregated for future reuse within the proposed development platforms, which is proposed to include the ground level raise in the Greenfield Area. During stripping and stockpiling, any oversize materials identified at the surface (i.e., the rare concrete and brick that has historically been identified) can be removed.

The stripping should be undertaken under supervision of a suitably qualified Geo-environmental Engineer to ensure that only the Capping Layer is initially stripped and segregated so verification testing can be employed to further demonstrate that this layer is free of pervasive contamination prior to its final placement. The stripping is to be undertaken in zones to minimise the risk of a contaminated zone being identified and impacting the whole volume.

Waste materials (e.g., Recent Construction Waste and Landfill Waste)

Following the excavation, screening, separation and treatment of the waste arisings from the former landfill, and prior to reuse as an engineered fill, the treated material will also undergo verification testing to determine its reuse destination as part of the development. It is likely that the recovered materials rendered suitable for reuse as engineered fill will be reinstated within the Former Landfill Area (i.e., within the excavation beneath highways and deep service corridors).

Asbestos hotspot removal

Visible ACM was encountered within the waste materials (both the Recent Construction Waste and Landfill Waste) excavated from several trial pits during the supplementary ground investigation in 2019. The potential therefore exists for ACM to be encountered within these units across the Former Landfill Area. The full breakdown of where visible ACMs (and also laboratory detected fibres) were encountered is detailed within the updated 2020 GIR and presented on the Site Zonation Plan (Ref: 11229-G018 Rev E, dated 10 October 2019) presented in Appendix A.

Any hotspots should be segregated, handpicked and disposed of off site. In addition, any hotspots not previously identified and encountered during the investigation works to date should similarly be dealt with to minimise the risk of asbestos impacting large volumes of excavated material.

5.4 Reuse of materials from Greenfield Area

The natural materials from the Greenfield Area, comprising topsoil and clays of the Kimmeridge Clay, are suitable for use at surface as part of the proposed development .

5.5 Sourcing of imported materials

Any material to be imported and used at the site must comply with the following:

- Be accompanied with provenance to demonstrate that there is no potential for the soils to have been contaminated as a result of past land uses. This information should be obtained in advance of import and the required chemical testing (see below).
- Be accompanied with a plan of the source site, which provides accurate details of where the soil was actually stripped from and not just the where it has been stockpiled.
- Comprise soils approved as suitable for use by an appropriately qualified Geo-environmental Engineer i.e., comprise soils which are both physically* and chemically suitable with concentrations of COPC below those set out within Appendix B (Table B1 or B2).

*i.e., free from anthropogenic materials, oversize material (>50 mm) and anything which could be reasonably deemed to be of potential harm.

5.6 Stockpiling of materials

All materials shall be stockpiled separately by material type (i.e., untreated waste arisings, processed waste arisings, Capping Layer, natural material, topsoil etc.). Similarly, any materials being imported to site, for example for use in the clean cover system, or construction aggregates, shall likewise be stockpiled separately.

Stockpile locations will be clearly marked and documented on working drawings maintained in the site office.

The Contractor for each phase of works is to take appropriate mitigation measures and environmental precautions as considered necessary at storage locations. However, as a minimum, stockpiles should be mechanically sealed and compacted to prevent dust and they should be kept wet in periods of dry weather.

Stockpile management shall be undertaken in accordance with the following protocol:

- Separate stockpiles shall be created for each material type, whether site-won materials or imported materials and shall be appropriately labelled and clearly identifiable on site.
- Stockpiles shall not be cross contaminated, double handing should be avoided and stockpiles shall remain quarantined until ready for use.
- Topsoil shall not be placed during or after heavy or prolonged periods of rainfall.
- For imported materials, copies of the carrier's Consignment Notes shall be retained on site and made available for inspection by the Geo-Environmental Engineer and for inclusion within the Verification Report.
- A record of all imported materials (i.e., deliveries) shall be maintained by the Site Manager, recording details of material type, source of the imported material, and Consignment Note reference numbers. In addition, the Site Manager shall record the status of each stockpile, in terms of material type, source site, volume and intended use on site.

The appointed Remediation Contractor will be required to provide additional details on their proposed system of stockpiling (i.e., what stockpiles are envisaged throughout the works, where these will be located on site, how suspect materials will be quarantined and tested, etc.).

5.7 Materials tracking

The Remediation Contractor will be required to undertake detailed tracking of all material movements across the site to provide a permanent and auditable record of what has been placed where. This should include the tracking of volumes of the different materials, significantly detailing their source, description/characterisation, stockpiled location (if required), analytical testing, and final placement location. This information will be used as part of the verification works listed in Section 7.

The tracking should be regularly updated to provide an auditable trail of what materials have been excavated, stockpiled, reused on site, or disposed of off site. This register will be used at the handover between the different Contractor's undertaken the different phases of works (i.e., between enabling works, groundworks and construction works).

5.8 Soil Quality Criteria

Soil Quality Criteria for each of the proposed end uses is required, including:

- back into the excavation beneath the highway alignments as an engineered fill (Former Landfill Area);
- ground level raise to formation level on the Greenfield Area; and
- clean cover (residential or POS).

Highway alignments (Former Landfill Area)

Any criteria for placement of the engineered fill into the excavation beneath the Former Landfill Area will be provided within a future revision to this document.

Ground raise (to formation level) on Greenfield Area

The Capping Layer is currently proposed to be reused as part of the ground level raise required on the Greenfield Area. Extensive sampling and risk assessment has been undertaken for the Capping Layer material. The works concluded that the Capping Layer soils are free of pervasive COPC and the leachate does not pose a significant risk to Controlled Water, therefore, the material is considered suitable for use.

Any criteria and further testing to support the placement of the Capping Layer material on the Greenfield Area will be provided within a future revision to this document.

Clean cover (residential areas)

Materials proposed for use within the clean cover system (i.e., both topsoil and subsoil) across the residential footprint on the Former Landfill Area are to comply with the proposed Soil Quality Criteria listed in Table B1 presented in Appendix B.

Clean cover (POS)

Materials proposed for use within the clean cover system (i.e., both topsoil and subsoil) across the POS area are to comply with the proposed Soil Quality Criteria listed in Table B2 presented in Appendix B.

6. PROTOCOL IF UNEXPECTED CONTAMINATION ENCOUNTERED

As with any site, the potential exists for encountering materials that were not recorded during the original ground investigation works.

Should any previously unidentified material suspected of being contaminated (by visual or olfactory means) be encountered during the development of the site, then the following protocol should be implemented:

- Site activities in the immediate vicinity shall cease and an independent and suitably qualified Geo-environmental Engineer shall be contacted and provided with a summary of the observations made.
- The Geo-environmental Engineer shall attend site and undertake appropriate investigations to establish the extent of the materials in question. Depending upon the extent and volume of material present, the materials shall be removed and temporarily stockpiled (on heavy grade polythene sheeting) to enable construction activities to continue.
- The Geo-environmental Engineer shall identify an appropriate scope of chemical analysis and agree this with the relevant regulator(s) as necessary.
- The resultant chemical analyses shall be compared with the appropriate trigger concentrations for the land use in question. The findings and recommendations shall be discussed and agreed with the relevant regulator(s).
- This Remediation Strategy will be updated, if required. In the majority of cases, it would be proposed that unexpected contaminative issues are dealt with via independent correspondence, but on occasion it may be necessary to revisit and update the Remediation Strategy.
- If necessary, the SBC Contaminated Land team shall be contacted.
- Should there be a perceived risk to Controlled Waters, the Environment Agency shall be contacted.

Prior to implementing any amendments to the Remediation Strategy, SBC shall be consulted and the amendments agreed in writing.

7. VERIFICATION

7.1 Objectives

This Remediation Strategy has identified mitigation measures as being necessary at the site in order to provide a development that is fit for purpose/suitable for use.

These remedial requirements need verification such that the regulating bodies can be satisfied that the Remediation Strategy has been fully complied with, and ultimately such that any associated planning conditions relating to land quality can be discharged. The verification process is also required to provide a permanent record of the remedial works undertaken.

Verification visits shall be made by a suitably experienced and qualified independent Geo-environmental Engineer who shall undertake the necessary works outlined below.

7.2 Verification works

In summary, the verification works will comprise a site watching brief during periods of significant excavation and materials movement/management. The watching brief will comprise full-time or part-time oversight by a suitably qualified Geo-environmental Engineer, depending on the significance and frequency of the earthworks being undertaken at the time. It is envisaged that more oversight (likely full-time) would be required during key stages, such as excavation and segregation of the Capping Layer, excavation of the waste materials beneath the highways and deep service corridors, and subsequent placement back onto the development platform. Oversight would then reduce (likely part-time) during less significant periods. Attendance on site would be required suspect material/previously unidentified contamination is encountered.

Verification works during the enabling works will also include the review of any in situ testing and analytical data collected during the works (i.e., testing of materials prior to their final placement to provide an audit trail of materials).

During the construction phase, the quality and thickness of placed clean cover system in new soft landscaping areas will be required, as well as the independent verification of the ground gas protection measures that are installed (in accordance with CIRIA 735).

The verification should include photographic proof of activities undertaken, site inspection records, laboratory testing and ground gas protection measures specifications. A record of all material movements, imported material certifications and stockpile tracking and associated documentation shall be maintained by the Contractor for each phase of the works.

7.3 Verification reporting

7.3.1 Enabling works phase

The site watching briefs and verification visits shall be made by a suitably experienced and qualified independent Geo-environmental Engineer who shall undertake the necessary works outlined above. All site visits will be recorded in the form of a site inspection log for inclusion as part of a summary verification/feedback report on completion of the enabling works.

The Remediation Contractor is to provide their own Remediation Verification Report that should include an auditable trail for tracking of materials excavated, moved and placed across the site (i.e., source, stockpiling, processing, testing, and final placement, including volumes, etc.).

A summary verification/feedback report should then be prepared by a suitably qualified and independent Geo-environmental Engineer to demonstrate that the required mitigation measures have been undertaken. All reports should be issued to the local authority for approval.

The verification report(s) shall include the following as a minimum:

- The organisation and staff carrying out the verification;
- The remedial objectives that are being verified, including any numerical limits (such as minimum frequency of testing and chemical testing results);
- Relevant plans, sketches and photographs as documentary evidence;
- As built plans; and
- A written statement that the remediation has been undertaken in accordance with this Remediation Strategy and subsequent DRMS (to be prepared), and that the site is suitable for its intended use.

7.3.2 Construction phase

Verification of the cover systems across the residential and POS footprints shall comprise the following:

- A. the provision of an '*as built level survey*' recording the extent of buried former landfill materials (in both the residential footprints and POS) and the basal geo-fabric separation layer.
- B. physical and chemical verification of the required depth of clean cover upon achieving finished development levels (i.e., following placement of clean cover system). Verification to be undertaken as follows:
 - i. At a minimum rate of 1 verification trial pit for every 4 residential plots to verify the thickness of clean cover (with photographs) and collect samples of both subsoil and topsoil for chemical analysis (applicable to any plot into which the clean cover system extends).
 - ii. At a minimum rate of 1 verification trial pit for every 500 m² of reinstated clean cover across the POS footprint. Trial pits are to verify the thickness of clean cover (with photographs) and collect samples of both subsoil and topsoil for chemical analysis.

The ground gas protection measures shall be verified by an independent specialist (in accordance with CIRIA 735).

8. GEOTECHNICAL CONSIDERATIONS

All works to mitigate the geotechnical constraints of the proposed development will be detailed within the Geotechnical Design Report and Earthworks Specification that are to be issued by Hydrock under a separate cover. The high-level information below is provided to aid discussion in support of the remediation concept, and should be considered as preliminary and subject to final geotechnical design.

8.1 Design

The proposed remedial methodologies may involve utilising the suitable, separated, potentially shredded, blended or layered former landfill arisings (moisture conditioned/cement stabilized, where necessary) for the improvement of the highways and services corridors across the residential footprint of the Former Landfill Area. The foundation solution of the proposed buildings is out of the scope of this Strategy document and will be detailed within in the Hydrock Geotechnical Design Report and Earthworks Specification that are to be issued under a separate cover.

The resultant material from the excavation for the highways and/or deep service corridors will not conform to a standard fill class in accordance with SHW Series 600. A site-specific Earthworks Specification shall therefore be produced as part of the detailed design process. It will be necessary to achieve a certain ratio of landfill materials to soil in order to ensure that all suitable material can be incorporated into the available void space. This will be limited by the ratio above which effectiveness cannot be assured. It is anticipated that both a blending/layering and placement optimisation exercise will be required to establish how the material is best handled and placed, and to ensure effectiveness. The appropriate methods of testing shall, therefore, be established within the Earthworks Specification, which will form part of the Hydrock Geotechnical Design Report, which will be issued under a separate cover. The Geotechnical Design Report will characterise the geotechnical strength parameters of the different strata and also detail the required geotechnical specification for the temporary plant platforms and foundation solutions as well.

Notwithstanding the above, it is necessary for the remediated landform to support the proposed infrastructure for the design life of the proposed development.

Performance criteria which need to be set ahead of design, which will include the minimum permissible California Bearing Ratio (CBR) grade to be achieved below both adoptable and non-adoptable highways and the acceptable design life settlement limit. Below private driveways and shared parking areas it is considered that the maximum pavement construction thicknesses will be less than 1 m as detailed within NHBC Standards, Chapter 9.2, Appendix 9.2A, Table 2.

The design and subsequent remediation will provide a development platform suitable for Groundworks Contractors to complete the construction of all associated infrastructure and services, without the need to excavate further into the untreated waste materials. The preferred foundation solution for the proposed buildings across the Former Landfill Area will be detailed within the Hydrock Geotechnical Design Report, however, the preferred option is the use of driven piles, which will not generate a significant volume of arisings.

The remedial concept is illustrated on the Former Landfill Area: Remediation Conceptual Model (Ref: 02753-HYD-XX-XX-DR-G-1005 [P02], dated 11 August 2022).

8.2 Settlement (associated with highways and deep service corridors only)

The following sections introduce and discuss the geotechnical requirements of the highways and deep service corridor design, as well as the performance criteria where appropriate. However, the detailed geotechnical design will be provided in the Hydrock Geotechnical Design Report, which will be issued under a separate cover. Discussions are currently ongoing with SBC regard to the geotechnical design of the highway and deep service corridors.

8.2.1 Performance criteria

The design will limit post construction design life settlements to <50mm across the entirety of the remediated landform (i.e., the highways and deep service corridors of the proposed development). Furthermore, notwithstanding the juxtaposition with piled structures, the design shall limit differential settlement to no more 1:250. This is to ensure any post construction movements are within the tolerable limits of both pavements and buried infrastructure. These criteria have been set to ensure against abnormal maintenance requirements upon both surface and buried infrastructure.

All designers shall be made aware of these criteria and ensure they can be accommodated by their designs with particular attention given at the juxtaposition with piled structures where differential settlements of up to 50 mm may occur.

8.2.2 Verification

Surface settlement monitoring pins shall be constructed at positions agreed with SBC Highways Department at the earliest opportunity following placement of the remediated landform. Settlement monitoring will commence immediately upon installation of the pins and be undertaken at a frequency agreed with the above parties. Settlement readings shall be to within +/- 2mm and checked against at least 3 fixed base stations remote from the remediated landform. Base stations shall be designed/located as not to be prone to movement and agreed with SBC.

Settlement monitoring pins shall be placed such that they can be maintained and monitored whilst key infrastructure is constructed. Following highway construction, settlement monitoring pins may be moved and replaced with suitable pins set within the highway, subject to agreement with SBC. All monitoring positions shall be protected against accidental damage. There shall be sufficient redundancy in monitoring positions to ensure that continuity of monitoring can be maintained should accidental damage occur.

Settlement monitoring shall remain ongoing for the length of the highway maintenance period prior to adoption or as agreed with SBC.

8.3 Minimum CBR grade (associated with highways and deep service corridors only)

8.3.1 Performance criteria

To ensure that the proposed highways and associated infrastructure remain serviceable in the long term, and without excessive maintenance requirements, the design of the highways and deep service corridors shall ensure that a minimum equilibrium CBR of >3% is achieved below both non-adoptable and adoptable highways.

The minimum equilibrium CBR grade of >3% shall be achieved at formation level. This may be achieved through the use of geogrids, geotechnical mattresses or stabilisation. The aforementioned shall be set

at levels below all adoptable services / highway construction thicknesses and to a sufficient extent to protect the highway footpaths and verges.

Where measures such as those detailed above are required to provide a sub-grade of suitable stiffness below adoptable highway areas, any measures employed shall extend a distance beyond the kerb/edging at the back of the adoptable area which is commensurate with the depth to formation level for the highway (equivalent to an angle of 45°). This will inevitably extend below areas in private ownership as would be the case under normal circumstances.

8.3.2 Verification

Verification of the CBR grade shall be undertaken using plate load tests. Plate load tests shall be undertaken by an independent UKAS accredited company, using a 300mm diameter plate in accordance with DMRB IAN 73/00 Rev 1 & SWH Clause 642. Two load cycles shall be completed with CBR calculated from the second cycle. This is to ensure a repeatable result reflecting the true elastic modulus and to test under conditions which reflect the cyclic loading of a highway.

In addition, testing shall be meet SBC material testing requirements (as identified on their web site). All verification tests shall be provided to SBC prior to placement of further materials.

9. FRAMEWORK FOR REGULATOR APPROVAL

9.1 Introduction

To deliver the proposed development, regulatory approval of the methodologies, rationale and performance criteria outlined within this Remediation Strategy is required. This is to enable remediation of the site to progress upon an assured basis where clear criteria have been agreed upon which successful remediation may be demonstrated.

Agreement to the principles presented within this document are considered key to providing sufficient clarity to Remediation Contractors who will tender to undertake the remedial works in due course. It is recognised that the appointed Remediation Contractor will subsequently be required to prepare a Detailed Remediation Method Statement (DRMS) that provides an additional level of detail on how the works will be physically undertaken to ultimately allow discharge of the pre-commencement Condition 11 as part of the Outline Planning (SBC Ref: S/OUT/20/0556/TB).

The following regulatory approval stages are required for the proposed remediation:

- Approval of Remediation Strategy;
- Approval of detailed design ahead of tendering remediation contract;
- Approval of appointed Remediation Contractor's DRMS and
- Approval of verification report(s).

The below sections detail the proposed mechanism(s) for approval for these documents.

9.2 NHBC / Building Control

Each development parcel across the site to be conditioned such that the subsequent detailed design and verification reports conform to this Remediation Strategy.

Additional conditions are anticipated for approval of the detailed design and verification reports in accordance with this Remediation Strategy. A post remediation foundation zoning assessment will be required and it is anticipated that an NHBC Engineering Condition will be applied to this effect.

9.3 Swindon Borough Council

One of the objectives of this document is to receive SBC approval of the remediation concept detailed within, which will allow Remediation Contractors to tender the required remedial works. Following this the remediation works across the site shall not commence until:

- All necessary third-party consents have been obtained for the works and copies supplied to SBC.
- A DRMS has been prepared by the appointed Remediation Contractor and submitted to SBC for review and approval. This step will allow discharge of pre-commencement Condition 14.
- An Air Quality Management Plan for the control of odour and dust has been prepared for the remediation and submitted by the Remediation Contractor to SBC and approved by SBC.
- SBC have been notified by the Client of the intent to commence the physical remediation works on site, no less than 2 weeks ahead of the planned start date.

9.4 Environment Agency

As the proposed remediation methodologies involve the excavation, processing and reuse of site-won arisings, including waste deposits of the former landfill, this will need to be done under a Deposit for Recover environmental permit. In this case, it will first be necessary to demonstrate that the

proposed activity constitutes recovery through the submission of a Waste Recovery Plan to the Environment Agency.

Conversations to this end have begun with the Environment Agency and a pre-application meeting was held in February 2020, and further discussions were undertaken in June 2022. The next step is the preparation and submission of a Waste Recovery Plan and the required supporting evidence to the Environment Agency for review.

Appendix A

Drawings

OS NORTH



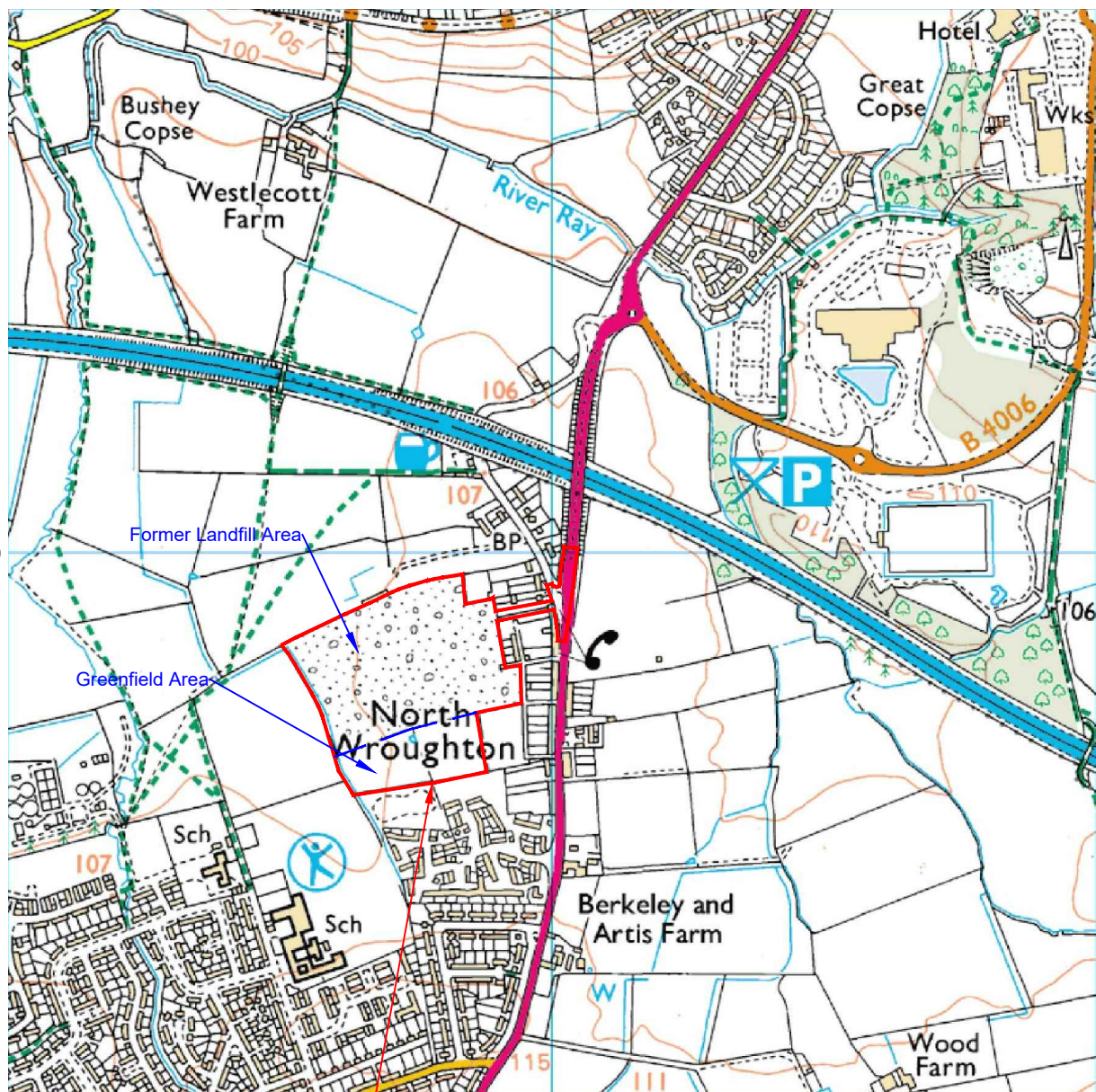
183000

182000

181000
414000

415000

416000



The Site

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Project

Land Off Woodland View, Wroughton

Client



Hydrock

Drawing Status

INFORMATION

Job No.

C11229

Over Court Barns, Over Lane, Almondsbury, Bristol, BS32 4DP.
TEL: 01454 619 533 FAX: 01454 614 125 or visit www.hydrock.com

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Drawn
KPChecked
KPScale at A4
1:12,500Date
23/06/11Issue Date
05/05/22

Drawing No.

11229-G016

Revision

C

Title

SITE LOCATION PLAN

C	05/05/22	Minor edits	MK	MK
B	18/08/15	Minor edits	KP	KP
A	23/06/11	Initial issue	KP	KP
Rev	Date	Description	By	Ckd



KEY	
	Proposed Strategic Landscape
	Retained habitat to support reptile mitigation
	Existing trees to be retained
	Existing trees to be removed
	Proposed trees
	Proposed footpath diversion
	Existing footpath (FP 78)
	Other footpath
	Primary (Spine) Road - Asphalt 6m + 2m footpath on both sides
	Secondary (Residential) Road - Asphalt 5m + 2m footpath
	Adoptable Shared Surface - Block Paving TBA Min 5m + no footpath
	Private Shared Surface - Block Paving TBA Min 4.5m + no footpath
	Affordable Unit
111.35	Finished Floor Level
122.51	Ridge Level
Site Area	= 11.6 Ha approx.
Development Area	= 5.2 Ha approx.
Houses	= 98
Apartments	= 6
TOTAL	= 104
Approx. 21 DPH	

LAND OFF WOODLAND VIEW, WROUGHTON

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REV	DATE	AMENDMENTS	DRAWN	CHECKED
1	2019.02.22	Amendments to apartment units 40-51	JP	
2	2019.02.22	General amendments	JP	

CLIENT:
Hills UK Ltd

PROJECT:
Land off Woodland View,
Wroughton

DRAWING:
Proposed Site Layout

DATE:
June 2019

SCALE: 1:1000

SIZE: A1

JOB NO: 50467

DWG NO: P1-01

REV: L

PRO VISION
PLANNING | ARCHITECTURE | URBAN DESIGN
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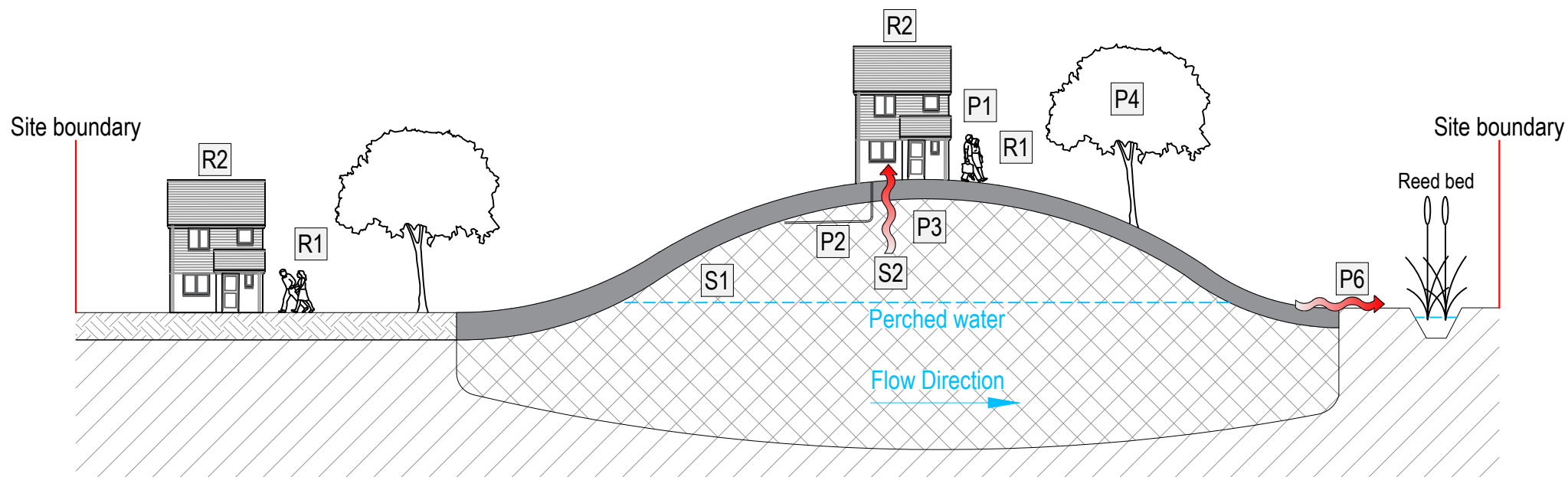
Southeast

Northwest

Greenfield Area (Area A)

Former Landfill Area (Areas B & C)

Drainage
ditches



On-site sources of contamination

- S1 - Made Ground associated with the former landfill
- S2 - Ground gases (CH_4 & CO_2) from potential organic materials present in Made Ground associated with former landfill

Pathways

- P1 - Humans: ingestion, skin contact, inhalation of dust and outdoor air
- P2 - Buildings: direct contact with substances deleterious to building materials (i.e. water supply pipes)
- P3 - Buildings: ground gases (CO_2 & CH_4) ingress via permeable soils and/or construction gaps
- P4 - Plant life: root uptake
- P6 - Surface water: leachate breakout

Receptors

- R1 - Humans (neighbours, site end users)
- R2 - Development end use (buildings, utilities and landscaping)

	Topsoil
	Capping Topsoil
	Kimmeridge Clay Formation (natural)
	Made Ground/Waste materials
	Water level

KEY

NOTES

1.

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CLIENT
THE HILLS GROUP

PROJECT
WROUGHTON CLOSED LANDFILL

TITLE
FINAL CONCEPTUAL
SITE MODEL

HYDROCK PROJECT NO.
C-02753-C

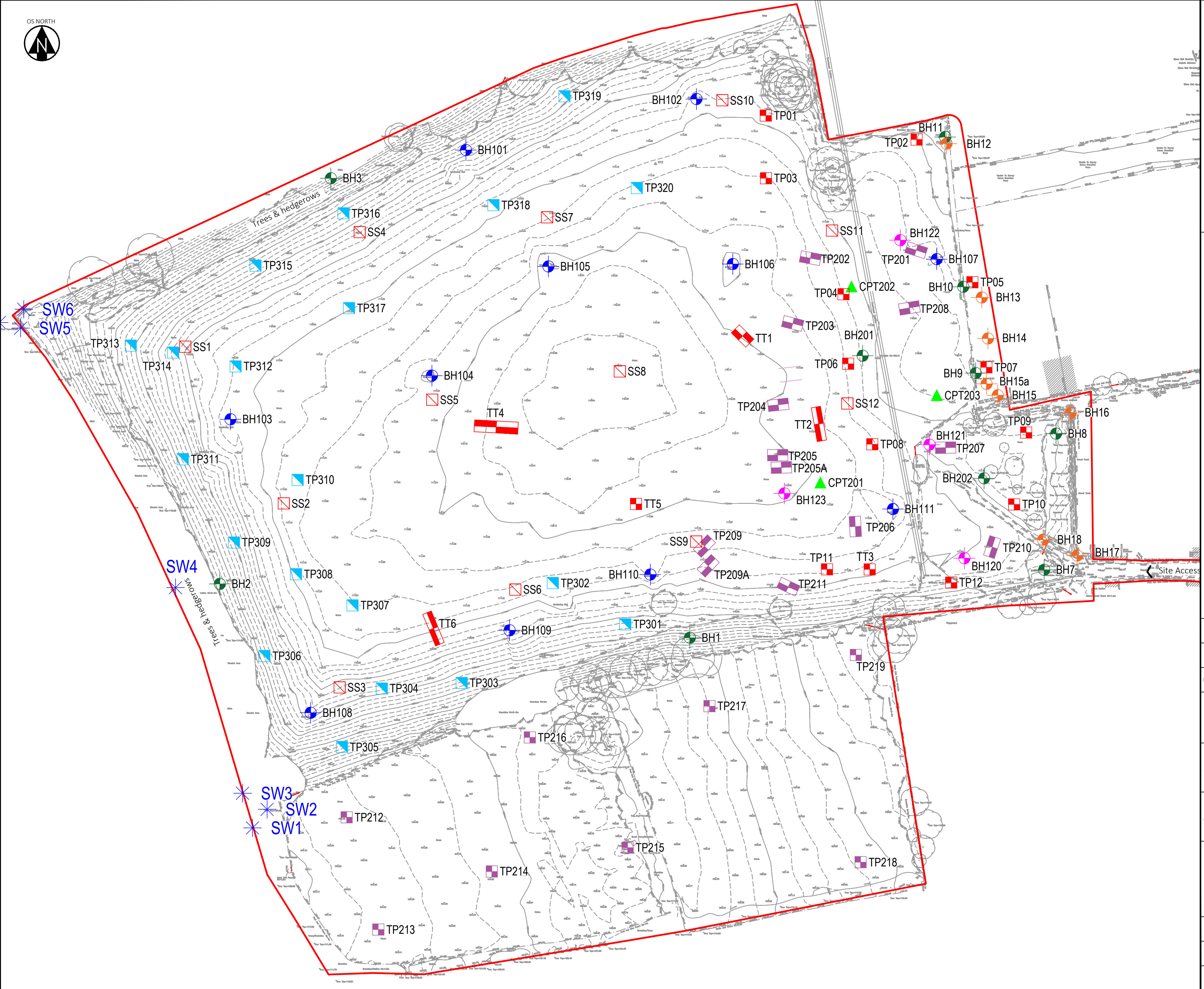
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PURPOSE OF ISSUE
SUITABLE FOR INFORMATION

DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)
02753-HYD-XX-XX-DR-G-1004

STATUS
S2
REVISION
P1

P1	FIRST ISSUE	AT	16/09/19	MK	16/09/19	MK	16/09/19
REV.	REVISION NOTES/COMMENTS	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE



KEY	
	Site boundary
	BH2 Pre-existing gas monitoring borehole
	BH13 Hydrock gas monitoring borehole (June 2008)
	SW4 Surface water monitoring point (June 2008)
	SS3 Surface soil sample location (June 2008)
	BH101 Supplementary Shell & Auger Borehole (July 2011)
	TP01 Trial pits (Aug 2015)
	TT1 Trial trenches (Jan 2015)
	BH120 Hydrock borehole (December 2017)
	BH13 Hydrock borehole (June 2019)
	TP210 Trial pit (June 2019)
	CPT203 Cone Penetration Test (June 2019)
	TP318 Trial Pit (June 2022)

NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.

2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

3. This drawing has been based on the following drawings and information:
Cole Easdon Consultants - Drawing No: 3429/300/01 May 2019

P2	SECOND ISSUE - INCLUDING JUNE 2022 LOCATIONS					
	EP	19/07/22	MH	19/07/22	MK	19/07/22
P1	FIRST ISSUE					
	AT	06/09/19	MK	06/09/19	RH	06/09/19
REV.	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT

THE HILLS GROUP

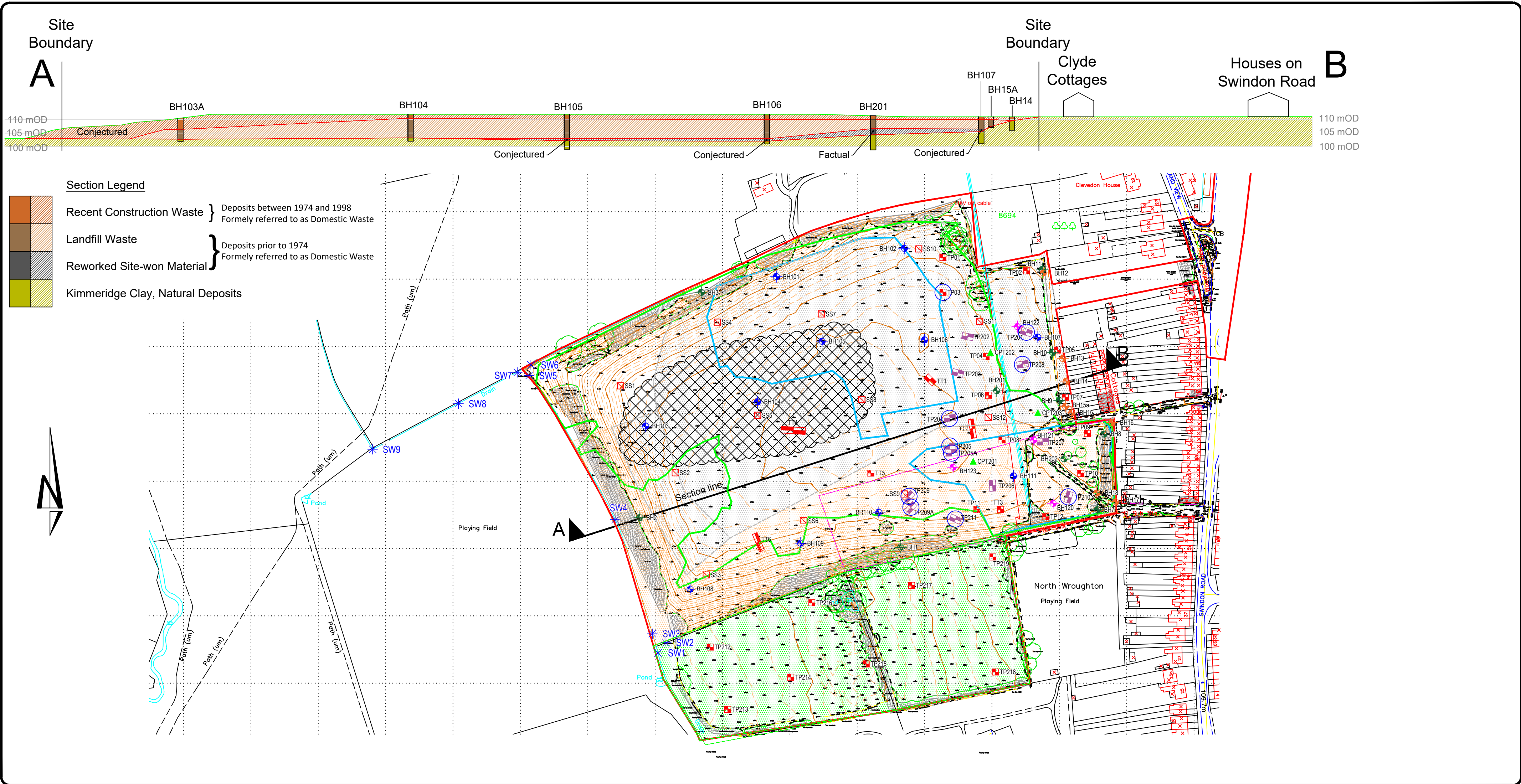
PROJECT

WROUGHTON CLOSED LANDFILL

TITLE

EXPLORATORY HOLE LOCTION PLAN

HYDROCK PROJECT NO. C-02753-C		SCALE @ A2 1:1000	
PURPOSE OF ISSUE SUITABLE FOR INFORMATION			STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 02753-HYD-XX-XX-DR-G-1003			REVISION P2



Legend

- Site boundary
- BH2 Pre-existing gas monitoring borehole
- BH13 Hydrock gas monitoring borehole (June 2008)
- SW4 Surface water monitoring point (June 2008)
- SS3 Surface soil sample location (June 2008)
- BH101 Supplementary Shell & Auger Borehole (July 2011)
- TP01 Trial pits (Aug 2015)
- TT1 Trial trenches (Jan 2015)
- BH120 Hydrock borehole (December 2017)
- BH13 Hydrock borehole (June 2019)
- TP210 Trial pit (June 2019)
- CPT203 Cone Penetration Test (June 2019)
- Maximum extent of clay pits (from historical OS maps & aerial photos)
- Maximum extent of fill (from historical OS maps & aerial photos)
- Site boundary
- Area A: Greenfield
- Area B: Recent Construction Waste
- Area C: Landfill Waste
- Asbestos (visible ACM or fibres) encountered within waste materials of former landfill
- Boreholes with significantly elevated gas readings (8/8/11 & 5/9/11)

BH No.	X	Y
101	414690.0	181902.0
102	414785.0	181923.0
103	414593.0	181791.0
104	414676.0	181809.0
105	414724.0	181854.0
106	414800.0	181855.0
107	414884.0	181857.0
108	414626.0	181670.0
109	414708.0	181704.0
110	414766.0	181727.0
111	414866.0	181754.0
201	414853.5	181817.2
202	414903.5	181766.7

Rev	Date	Description	By	Ckd
E	10/10/19	Supplementary GI added	EP	PLA
D	06/01/16	Trial pits added	KP	KP
C	15/01/15	Trial trenches added	KP	KP
B	15/12/14	Survey data added	KP	KP
A	14/09/11	Original issue	AJ	KP

Client

Hills

Project

WROUGHTON CLOSED LANDFILL

Title

Zonation Plan

Drawing Status

INFORMATION

Hydrock Consultants

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Job No.

C11229

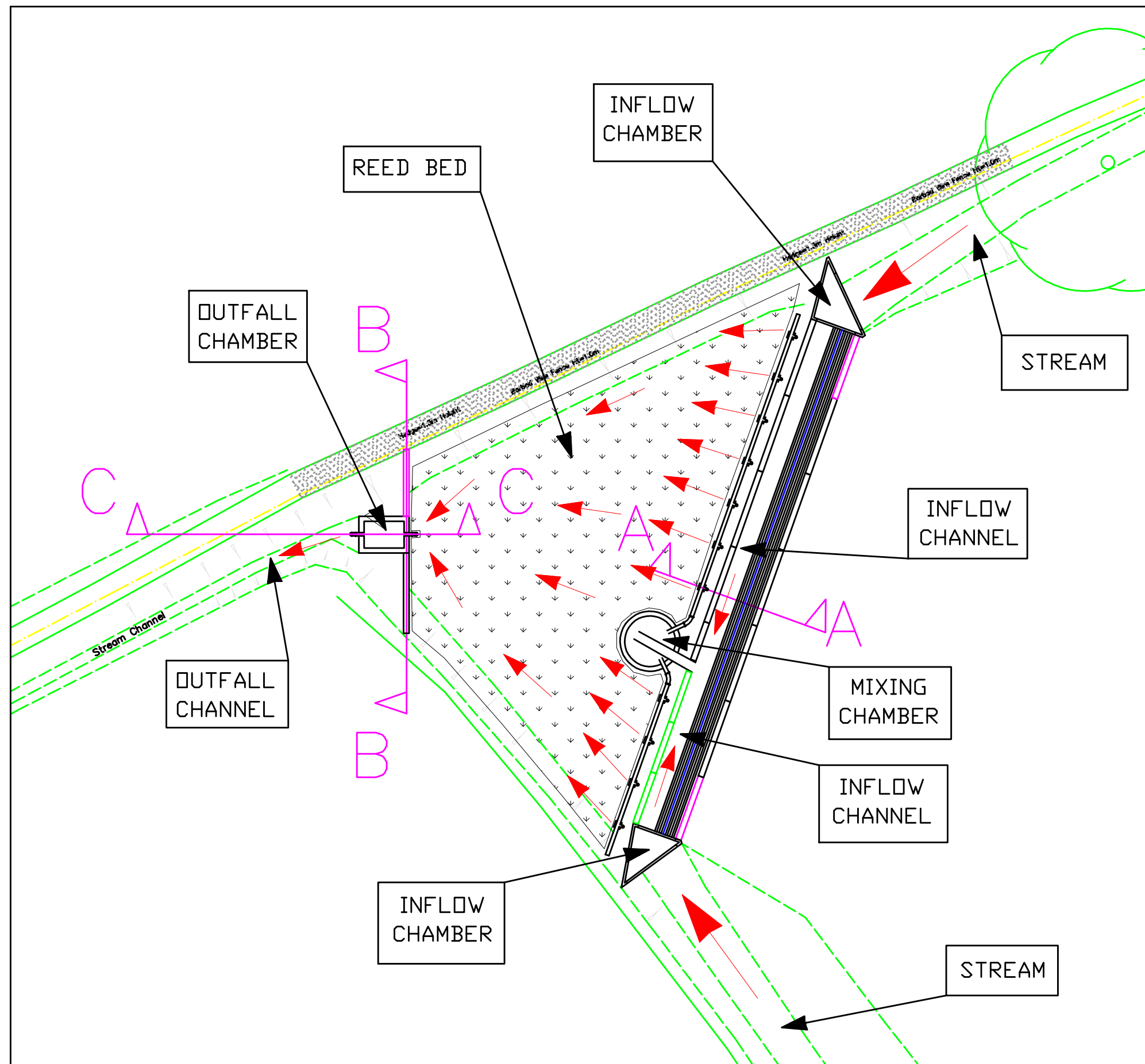
Drawn	Checked	Plan=1:2,000 Section = 1:1,000	Date	Issue Date
EP	PLA		14/09/11	10/10/19

Drawing No.

11229-G018

Revision

E



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 Web : www.brunelsurveys.com



Client



Minerals & Waste

Ailsbury Court, High Street,
 Marlborough, Wilts. SN8 1AA

Job Title

WROUGHTON
 LANDFILL SITE

REED BED/
 SETTLEMENT POND

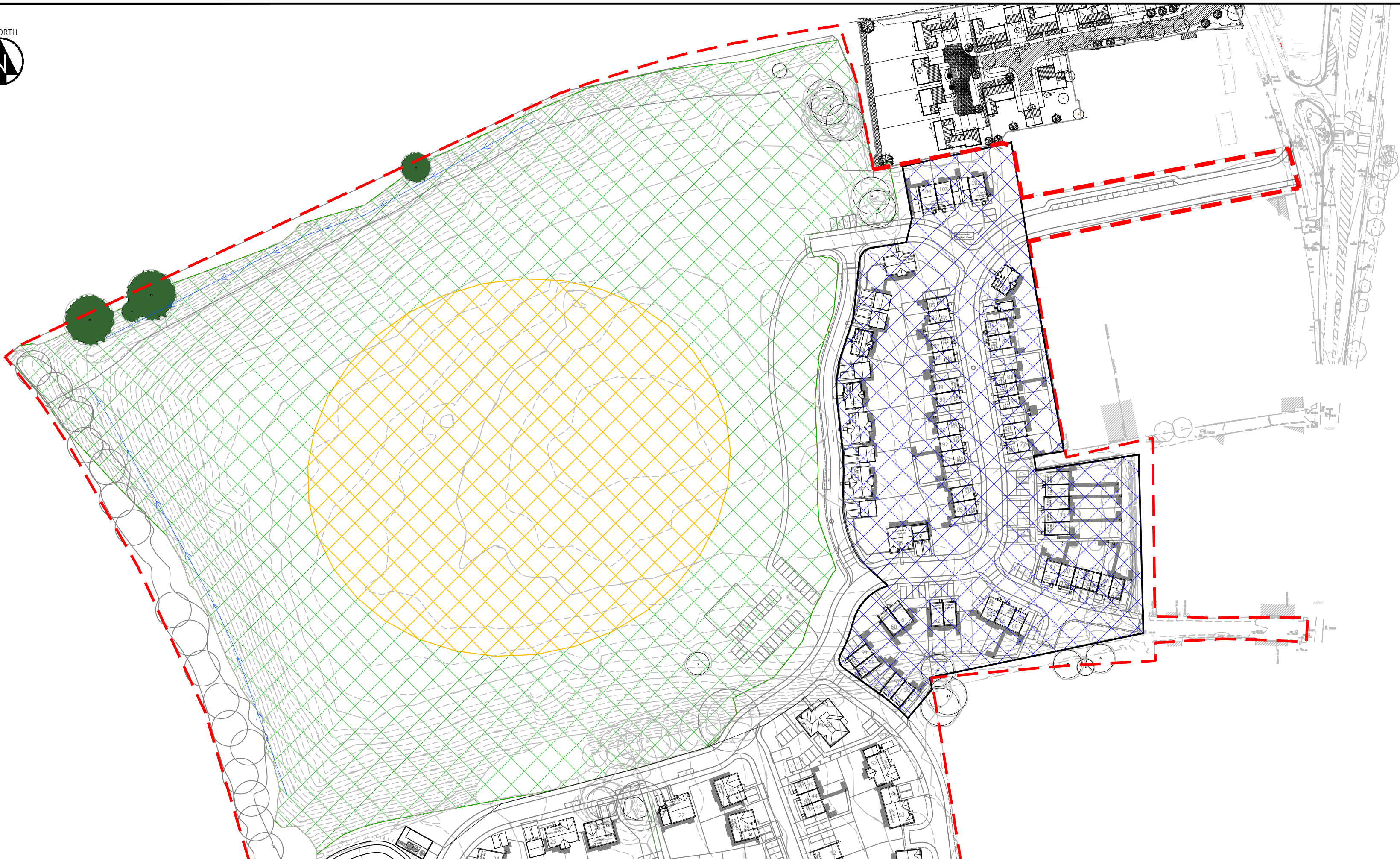
CONSTRUCTION DETAILS

Scale 1:200 (A3)

Date 19/03/17

Surveyed by SP/SMC

Drg. No. **WR/RB/007A**



NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.
3. This drawing has been based on the following drawings and information: CEC-4175/25

KEY

- Public Open Space footprint on Former Landfill Area reinstatement of 300mm historical thickness of topsoil cover
- Residential footprint on former landfill area requiring 1000mm clean cover in all soft landscaping areas with basal geo-fabric separation layer
- Construction of cricket pitch proposed to comprise total thickness of 600mm, including Capping Layer soils, imported granular material for drainage, and 300mm topsoil (wicket area to be designed by specialist in accordance with appropriate specification).
- Finished formation level for remediation works (Min CBR of 3.0% for highways and driveways) delineated with basal geo-fabric marker layer
- Clean Cover
- Existing Topsoil
- Treated Waste / Engineered Fill (or imported)
- Engineering Load Transfer Platform
- Untreated Waste
- Sub Base
- Natural Ground - Kimmeridge Clay Formation
- Gas and Vapors

P2	SECOND ISSUE					
	EP	11/08/22	MK	11/08/22	MK	11/08/22
P1	FIRST ISSUE					
	KB	31/10/19	MK	31/10/19	MK	01/04/20
REV.	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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E-Mail: bristol@hydrock.com
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CLIENT

THE HILLS GROUP

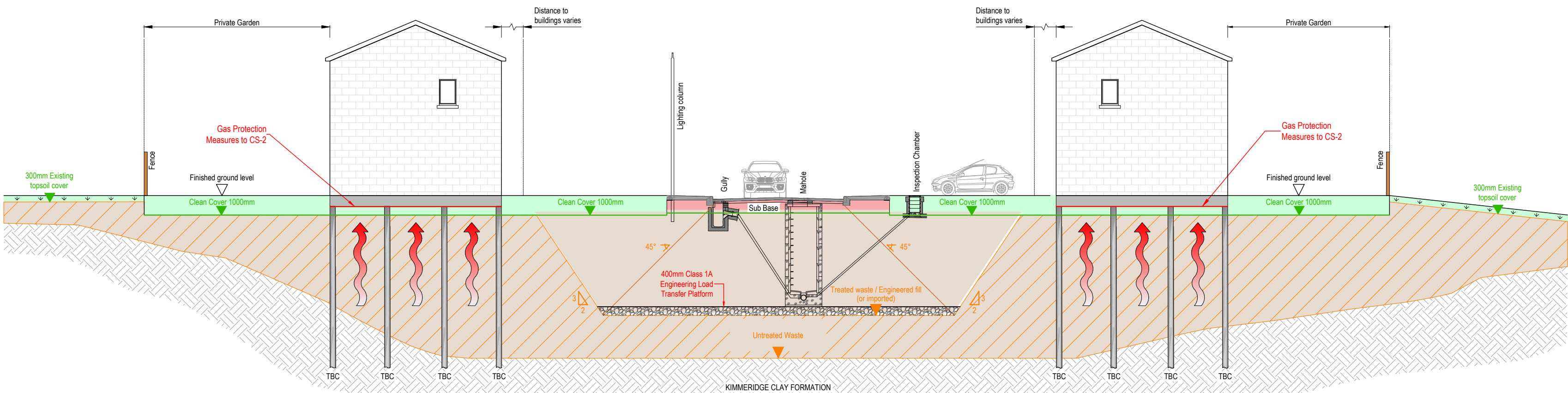
PROJECT

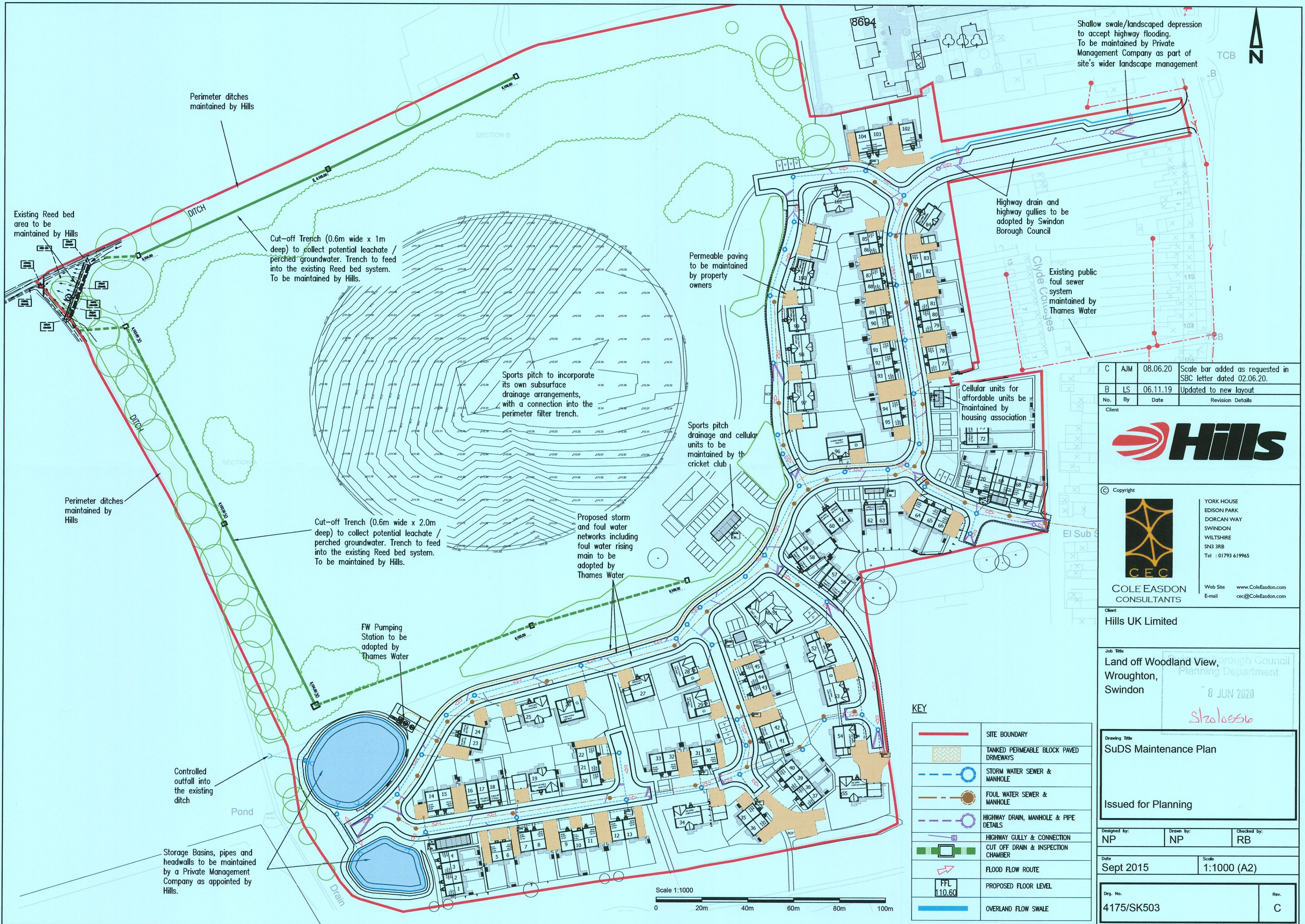
WROUGHTON CLOSED LANDFILL

TITLE

FORMER LANDFILL AREA:
REMEDATION CONCEPTUAL MODEL

HYDROCK PROJECT NO. C-02753-C		SCALE @ A2 1:1250	
PURPOSE OF ISSUE SUITABLE FOR INFORMATION			STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 02753-HYD-XX-XX-DR-G-1005			REVISION P2





C	AJM	08.06.20	Scale bar added as requested in SBC letter dated 02.06.20.
B	LS	06.11.19	Updated to new layout
No.	By	Date	Revision Details



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Hills UK Limited

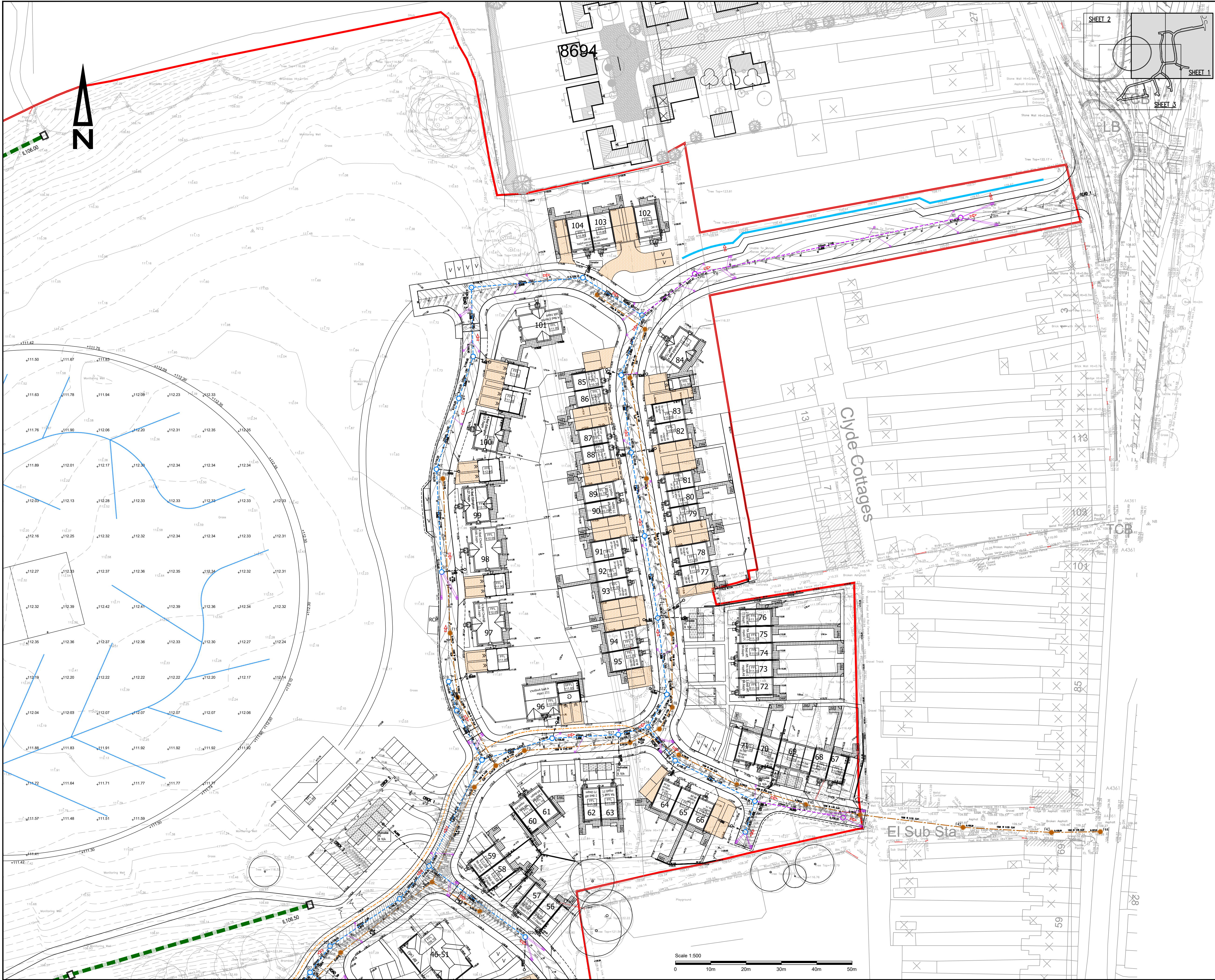
Job Title
Land off Woodland View, Wroughton, Swindon

Swindon Borough Council
Planning Department
8 JUN 2020
Slzaloessio

Drawing Title
SuDS Maintenance Plan

Issued for Planning

Designed by: NP	Drawn by: NP	Checked by: RB
Date Sept 2015	Scale 1:1000 (A2)	
Dr. No. 4175/SK503	Rev. C	



KEY:

---	ROAD CENTRE LINE
---	ROAD KERBS
---	FOOTWAY EDGING KERB
---	ROAD CHAINAGE
---	PROPOSED ROAD CONTOURS
FFL 110.60	FINISHED FLOOR LEVELS
+110.50	PROPOSED SPOT LEVELS
1/30	FALL ARROWS
---	PROPOSED GRADIENT INDICATOR
---	RETAINING WALL & MAXIMUM RETAINED HEIGHT
---	EXPOSED BRICKWORK
---	TANKING
---	TANKED PERMEABLE BLOCK PAVED DRIVEWAYS
---	STORM WATER SEWER, MANHOLE & PIPE DETAILS
---	FOUL WATER SEWER, MANHOLE & PIPE DETAILS
---	HIGHWAY DRAIN, MANHOLE & PIPE DETAILS
---	HIGHWAY GULLY & CONNECTION
---	FOUL WATER RISING MAIN & CHAINAGE
---	SITE BOUNDARY
---	FLOOD FLOW ROUTE
1.002	PIPE NUMBERS (ADOPTABLE SEWERS)
---	CUT OFF DRAIN & INSPECTION CHAMBER
---	OVERLAND FLOW SWALE
150mm PERF	150mm PERFORATED PIPE LAND DRAINAGE TO CRICKET PITCH

A	JRC	18/02/22	Cricket pitch land drainage shown. Shallow pond with permanent water & low flow channel added to ponds.
---	-----	----------	---

Client

No.	By	Date	Revision Details
1	CEC	18/02/22	YORK HOUSE EDISON PARK DORCAN WAY SWINDON WILTSHIRE SN3 3RB Tel : 01793 619965

COLE EASDON CONSULTANTS

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Client: Hills Homes Developments Ltd.

Job Title: Land at North Wroughton Swindon Wiltshire

FOR PLANNING

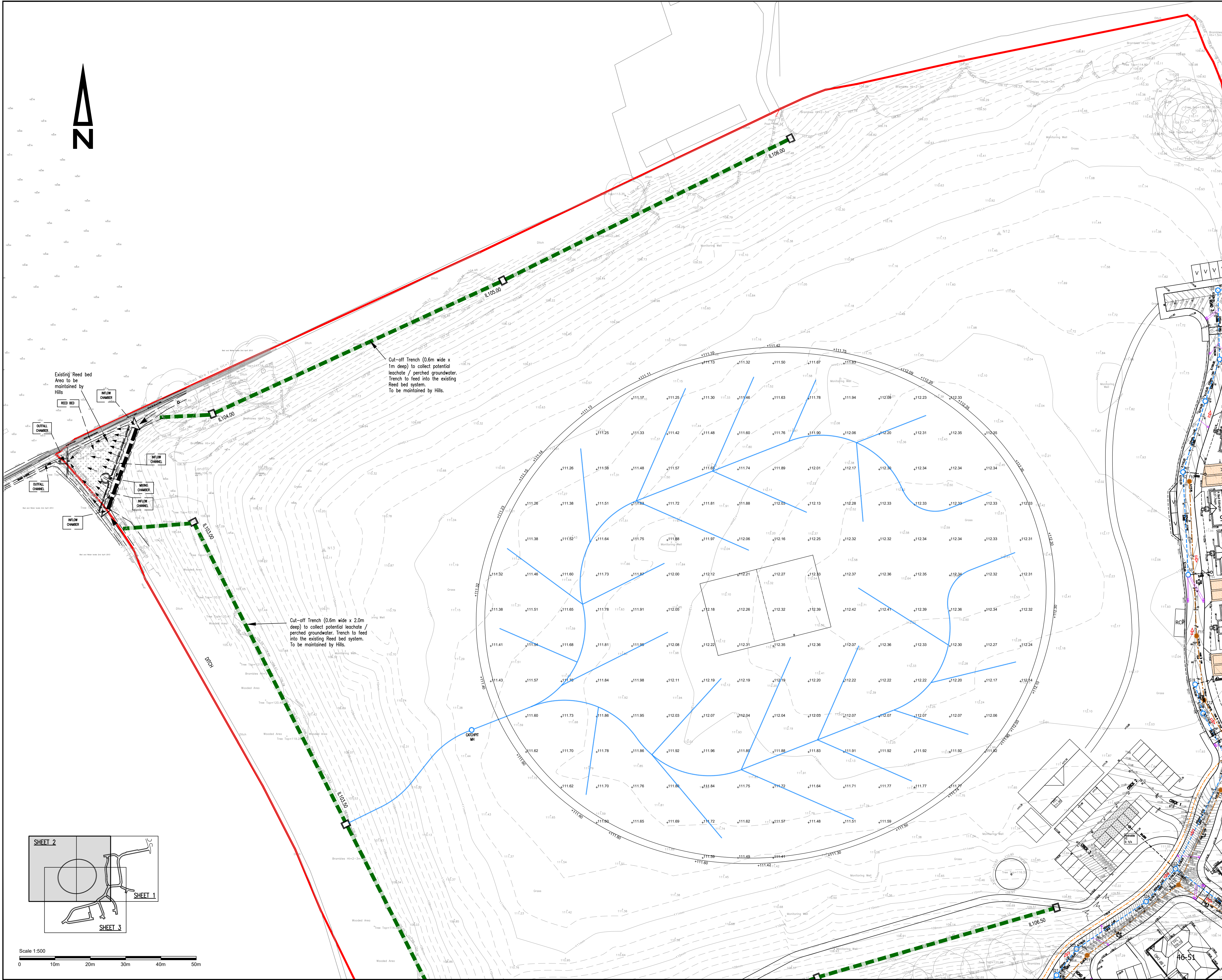
Drawing Title: Detailed Drainage Strategy & Finished Levels

Sheet 1 of 3

Drawing Status				
FOR COMMENT	FOR PLANNING	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION
CONSTRUCTION AT CLIENT / CONTRACTOR RISK				

Designed by: CEC	Drawn by: JRC	Checked by: PW
Date: October 2019	Scale: 1:500 @ A1	

Dwg. No.: 4175/507/01	Rev.: A
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KEY:	
	ROAD CENTRE LINE
	ROAD KERBS
	FOOTWAY EDGING KERB
	ROAD CHAINAGE
	PROPOSED ROAD CONTOURS
	FINISHED FLOOR LEVELS
	PROPOSED SPOT LEVELS
	FALL ARROWS
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	PIPE NUMBERS (ADOPTABLE SEWERS)
	CUT OFF DRAIN & INSPECTION CHAMBER
	OVERLAND FLOW SWALE
	150mm PERFORATED PIPE LAND DRAINAGE TO CRICKET PITCH

A JRC 18/02/22 Cricket pitch land drainage shown. Shallow pond with permanent water & low flow channel added to ponds.



No.	By	Date	Revision Details
1	CEC	18/02/22	Initial Issue
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YORK HOUSE EDISON PARK DORCAN WAY SWINDON WILTSHIRE SN3 3RB Tel : 01793 619965			
Cole Easdon Consultants			
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Hills Homes Developments Ltd.

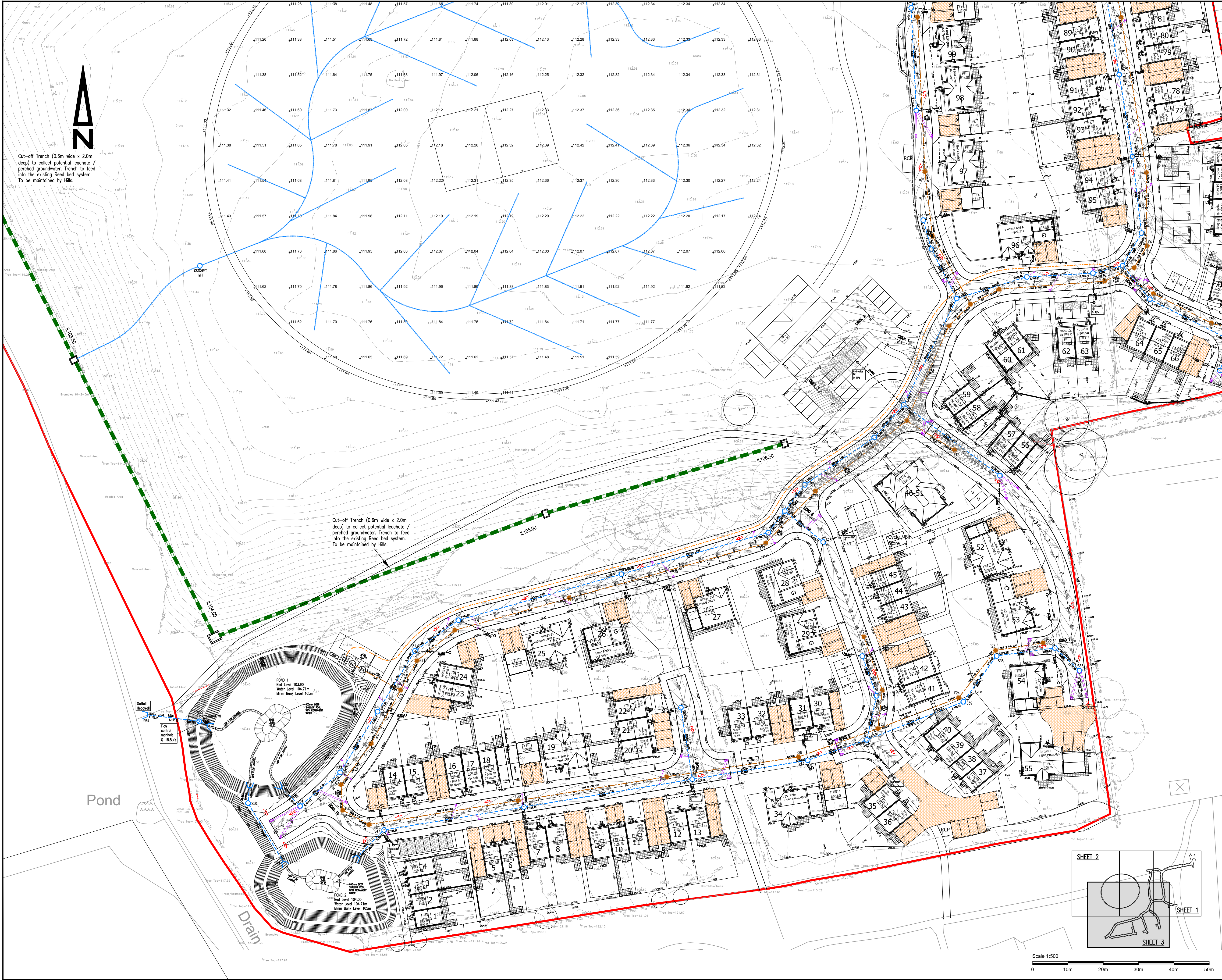
Land at North Wroughton
Swindon
Wiltshire

FOR PLANNING

Detailed Drainage Strategy &
Finished Levels

Sheet 2 of 3

Drawing Status:			
FOR COMMENT	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION
FOR COMMENT	FOR TENDER	FOR APPROVAL	FOR CONSTRUCTION
"CONSTRUCTION AT CLIENT / CONTRACTOR RISK"			
Prepared by CEC	Drawn by JRC	Checked by PW	
Date October 2019	Scale 1:500 @ A1		
Dwg. No. 4175/507/02	Rev. A		



KEY:	
	ROAD CENTRE LINE
	ROAD KERBS
	FOOTWAY EDGING KERB
	ROAD CHAINAGE
	PROPOSED ROAD CONTOURS
	FINISHED FLOOR LEVELS
	PROPOSED SPOT LEVELS
	FALL ARROWS
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	RETAINING WALL & MAXIMUM RETAINED HEIGHT
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	TANKING
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	STORM WATER SEWER, MANHOLE & PIPE DETAILS
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	HIGHWAY DRAIN, MANHOLE & PIPE DETAILS
	HIGHWAY GULLY & CONNECTION
	FOUL WATER RISING MAIN & CHAINAGE
	SITE BOUNDARY
	FLOOD FLOW ROUTE
	PIPE NUMBERS (ADOPTABLE SEWERS)
	CUT OFF DRAIN & INSPECTION CHAMBER
	OVERLAND FLOW SWALE
	150mm PERFORATED PIPE LAND DRAINAGE TO CRICKET PITCH

A JRC 18/02/22 Cricket pitch land drainage shown. Shallow pond with permanent water & low flow channel added to ponds.



No.	By	Date	Revision Details
1	CEC	18/02/22	YORK HOUSE EDISON PARK DORCAN WAY SWINDON WILTSHIRE SN3 3RB Tel : 01793 619965
Cole Easdon Consultants			Web Site www.ColeEasdon.com E-mail cec@ColeEasdon.com

Client
Hills Homes Developments Ltd.

Job Title
Land at North Wroughton
Swindon
Wiltshire

FOR PLANNING

Detailed Drainage Strategy &
Finished Levels

Sheet 3 of 3

Drawing Status			
FOR COMMENT	FOR PLANNING	FOR TENDER	FOR APPROVAL
FOR CONSTRUCTION	AS BUILT		
"CONSTRUCTION AT CLIENT / CONTRACTOR RISK"			
Designed by CEC	Drawn by JRC	Checked by PW	
Date October 2019	Scale 1:500 @ A1		
Drp No. 4175/507/03			Rev. A

Appendix B

Soil Quality Criteria (both reuse and import)

**Table B1. Wroughton Closed Landfill - Proposed Soil Quality Criteria for Clean Cover Soils
in Residential Footprint (i.e., top 1,000 mm)**

Contaminant	Generic Assessment Criteria (GAC)		Source	
	Human Health	Plant Life*	Human Health	Plant Life
Inorganics				
Arsenic	37	--	SGV report + CLEA 1.07	--
Beryllium	73	--	LQM/CIEH + CLEA 1.07	--
Boron	300	3	LQM/CIEH + CLEA 1.07	New Zealand timber 1997
Cadmium	14	--	SGV report + CLEA 1.07	--
Chromium (III)	890	400	LQM/CIEH + CLEA 1.07	MAFF 1998 (Cr(TI))
Chromium (VI)	6	--	LQM/CIEH + CLEA 1.07	--
Copper	2,500	110	LQM/CIEH + CLEA 1.07	BS 3882 2015
Lead	200	--	C4SL	--
Mercury, inorganic	170	--	SGV report + CLEA 1.07	--
Nickel	130	--	Hydrock + CLEA 1.07	--
Selenium	360	--	SGV report + CLEA 1.07	--
Vanadium	410	--	LQM/CIEH + CLEA 1.07	--
Zinc	1,000		Hydrock**	
Cyanide (free)	790	--	Hydrock + CLEA 1.07	--
Organics				
	Soil Organic Matter (SOM)			
	1%	2.5%	6%	
Benzene	0.099	0.2	0.42	NA
Toluene	100***	100***	100***	
Ethylbenzene	76	100***	100***	
Xylenes	100***	100***	100***	
Phenol (total)	100***	100***	100***	
Acenaphthene	100***	100***	100***	
Acenaphthylene	100***	100***	100***	
Anthracene	100***	100***	100***	
Benz(a)anthracene	4.2	6.7	8.6	
Benzo(a)pyrene	1.5	1.5	1.5	
Benzo(b)fluoranthene	7.6	9.4	10	
Benzo(ghi)perylene	64	69	71	
Benzo(k)fluoranthene	12	14	15	
Chrysene	7.7	11	13	
Dibenz(a,h)anthracene	1.1	1.3	1.4	
Fluoranthene	100***	100***	100***	
Fluorene	100***	100***	100***	
Indeno(1,2,3,cd)pyrene	4.3	5.5	6.2	
Naphthalene	2.2	5.2	12	
Phenanthrene	97	100***	100***	
Pyrene	100***	100***	100***	
Other				
pH	>5 - <9		NA	NA
Visual/olfactory evidence	Absent			
Asbestos (visual)	Free of visible asbestos containing materials (ACM) as far as reasonably practicable.			
Asbestos (fibres)	Absent			

Notes:

- Criteria suitable for residential with plant uptake land use. This list of contaminants is not exhaustive, should the source of the cover soils warrant it, additional determinant thresholds may need to be agreed with the LPA and/or NHBC.

* = Plant life GAC are also provided, where relevant. The lowest/most conservative GAC for each contaminant is required.

** = Proposed Hydrock value considered to provide protection of human health whilst also being considered suitably protective of plant life.

*** = Proposed GAC for hydrocarbons / PAHs are limited to 100 for amenity criteria (i.e., to be free of significant visual/olfactory evidence, free phase, etc.).

**Table B2. Wroughton Closed Landfill - Proposed Soil Quality Criteria for Clean Cover Soils
in Former Landfill Area Public Open Space (i.e., Cricket Pitch and Wider POS)**

Contaminant	Generic Assessment Criteria (GAC)		Source	
	Human Health	Plant Life*	Human Health	Plant Life
Inorganics				
Arsenic	170	--	SGV report + CLEA 1.07	--
Beryllium	670	--	LQM/CIEH + CLEA 1.07	--
Boron	46,000	3	LQM/CIEH + CLEA 1.07	New Zealand timber 1997
Cadmium	560	--	SGV report + CLEA 1.07	--
Chromium (III)	27,000	400	LQM/CIEH + CLEA 1.07	MAFF 1998 (Cr(TI))
Chromium (VI)	220	--	LQM/CIEH + CLEA 1.07	--
Copper	44,000	110	LQM/CIEH + CLEA 1.07	BS 3882 2015
Lead	1,300	--	C4SL	--
Mercury, inorganic	1,100	--	SGV report + CLEA 1.07	--
Nickel	800	--	Hydrock + CLEA 1.07	--
Selenium	2,600	--	SGV report + CLEA 1.07	--
Vanadium	5,000	--	LQM/CIEH + CLEA 1.07	--
Zinc	1,000		Hydrock*	
Cyanide (free)	3,400	--	Hydrock + CLEA 1.07	--
Organics				
	Soil Organic Matter (SOM)			
	1%	2.5%	6%	
Benzene	90	100	100***	NA
Toluene	100***	100***	100***	
Ethylbenzene	100***	100***	100***	
Xylenes	100***	100***	100***	
Phenol (total)	100***	100***	100***	
Acenaphthene	100***	100***	100***	
Acenaphthylene	100***	100***	100***	
Anthracene	100***	100***	100***	
Benz(a)anthracene	26	33	40	
Benzo(a)pyrene	4.5	5.6	6.5	
Benzo(b)fluoranthene	30	38	45	
Benzo(ghi)perylene	100***	100***	100***	
Benzo(k)fluoranthene	46	57	67	
Chrysene	34	45	55	
Dibenz(a,h)anthracene	4.5	5.5	6.3	
Fluoranthene	100***	100***	100***	
Fluorene	100***	100***	100***	
Indeno(1,2,3,cd)pyrene	17	22	26	
Naphthalene	100***	100***	100***	
Phenanthrene	100***	100***	100***	
Pyrene	100***	100***	100***	
Other				
pH	>5 - <9		NA	NA
Visual/olfactory evidence	Absent			
Asbestos (visual)	Free of visible asbestos containing materials (ACM) as far as reasonably practicable.			
Asbestos (fibres)	Absent			

Notes:

- Criteria suitable for public open space (park) land use. This list of contaminants is not exhaustive, should the source of the cover soils warrant it, additional determinant thresholds may need to be agreed with the LPA and/or NHBC.

* = Plant life GAC are also provided, where relevant. The lowest/most conservative GAC for each contaminant is required.

** = Proposed Hydrock value considered to provide protection of human health whilst also being considered suitably protective of plant life.

*** = Proposed GAC for hydrocarbons / PAHs are limited to 100 for amenity criteria (i.e., to be free of significant visual/olfactory evidence, free phase, etc.).