Pell Frischmann

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Cambridge North Fringe East

Civils and Infrastructure Strategy
HIF Bid Document

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CAMBRIDGE NORTH FRINGE EAST – CIVILS STRATEGY

1. INTRODUCTION

1.1 OVERVIEW

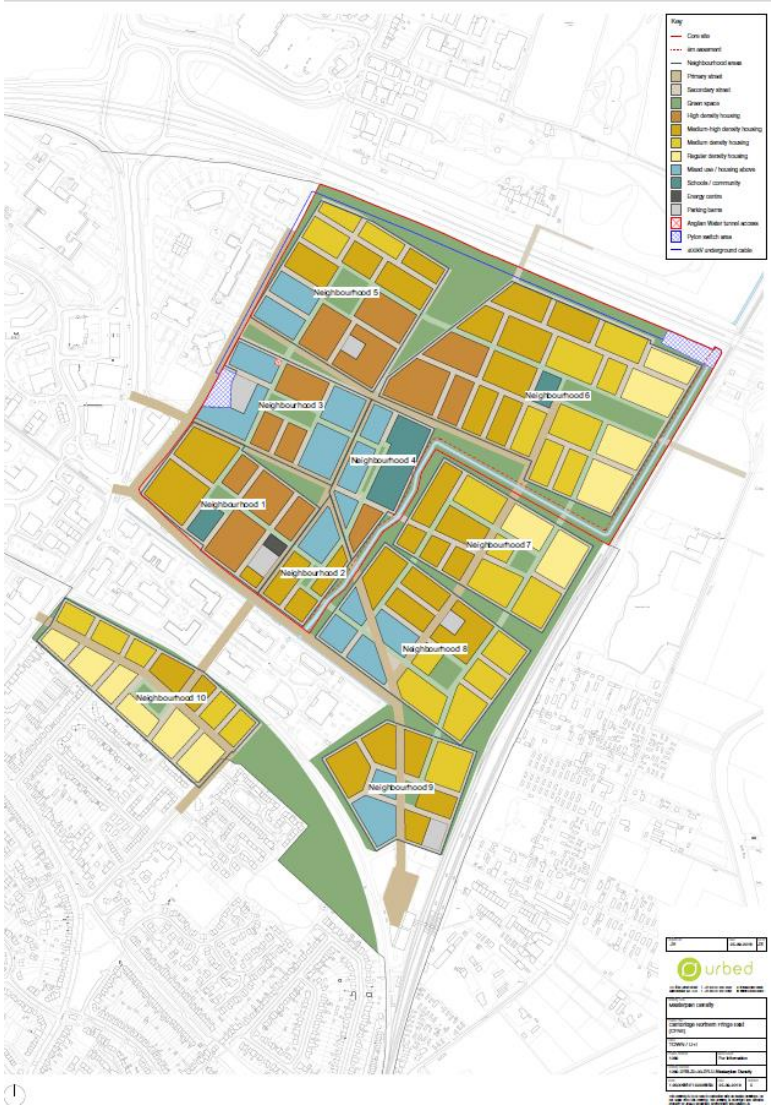
1.1.1 This 'live' document provides a statement on the ongoing strategy in delivering the Cambridge North Fringe East development.

1.1.2 In particular the Civils scope focuses on the following elements;
- Existing Utilities. Together with [redacted] formalising the proposed services strategy.
- Geotechnical Site Appraisal and planned approach
- Drainage and Flood Risk Assessment and Strategy
- Highways Strategy

1.1.3 This document and the proposed masterplan is based upon URBED drawing 1082-URB-Z0-00-DR-U-Masterplan Density issued 25.09.18

1.1.4 The **CORE SITE** is sites 1A and 1B – divided into 6 neighbourhoods. The masterplan also indicates sites 2A, 2B and 2C. The core site is an area of approximately 46.7ha.

The proposed masterplan is identified below.



1.1.4 Approximately two thirds of the CNFE site is the current Anglian Water (AW) sewage treatment plant with the remainder primarliy taken by a driving range area owned by Cambridge City Council

1.1.5 The existing site has a number of constraints including pylons, telephone masts and an existing water course which are all identified in Pell Frischmann drawing 101999_SK007. The detail of the constraints is explained further below.

1.1.6 Pell Frischmann have also highlighted the potential contraints to the proposed masterplan on drawing 101999_SK008

2. UTILITIES

2.1 EXISTING STATUTORY UNDERTAKERS PLANT AROUND AND SERVING THE SITE

2.1.1 For the site constraints of the existing site Pell Frischmann are looking at what existing infrastructure is to be removed post relocation of Anglian Water

2.1.2 We have received and assimilating all the C2 statutory undertaker's information surrounding and serving the site.

2.1.3 An initial review has concluded the following. All of which will be presented on a utilities constraints plan to be issued in due course:

Openreach – The only services indicated on site are connections to buildings from Cowley Road serving the STW, Orwell House and the driving range.

Vodafone – In Cowley Road, No services on site

Sky – Services on site to buildings from Cowley Road, possible connection to mast

City Fibre – In Cowley Road.

Mobile Phone Mast– Mast to west side of site appears to be 3 and O2 shared (Note mast info not updated since 2012). Others may now be using it too. Local substation as below.

Virgin Media – Connections to STW site buildings from Cowley Road, possibly to the mast

Anglian Water – Live Drainage indicated includes rising mains from southeast and from west to intake chamber (to be clarified if to remain), plus tunnel to intake chamber. There is also a pumping station indicated within the west part of the site adjacent to Cowley Road which discharges to the inlet chamber. Also, Final Effluent and combined sewer outfalls to east – presumed to be redundant with STW demolition. (Note the current outfall from the 'D' works is not indicated).
Depths are not indicated but it is assumed that these services are not deep (apart from the tunnel), in particular the rising mains, and may need diversion if they are left active by AWG.

Cadent Gas – MP and LP mains in Cowley Road. Connections to site buildings from Cowley Road west side only.

Cambridge Water – 7" and 6" mains in Cowley Road west. No services indicated crossing site, there will be service connections to buildings but these are not shown on water plans. (Note that new services on site may need to be installed in barrier pipe due to ground contamination).

UKPN – There are 132kV overhead power lines on pylons passing diagonally across the site. These feed to a railway substation to the east of the site (east side of the railway line) and then continue on pylons. There are 3 No pylons on the site.
HV services enter from Cowley Road to the west to connect to a substation (Cowley Road Mast) adjacent to the mobile phone mast.

Just to the north of this HV services enter the site to connect to 2 No substations adjacent to the intake chamber (Riverside Pumping Station & Milton Pumping Station). Further north HV services enter and run north to a substation (Sewage Pumping Station). These substations do not appear to serve any properties off site. Various connections, assumed to be LV, also from Cowley Road, connect to the buildings along the west side of the site.

To the south side of the site there are connections to Orwell House and the Driving Range.

Much of the onsite distribution appears to be private emanating from the Generator House. However, there is an HV cable from this which feeds (or is incoming from) offsite to the east side, crossing under the railway. This may feed to an industrial building on Fen Road which is off the UKPN record.

There are a number of redundant/abandoned incoming connections to the STW and across the site.

An allowance should be made in the cost plan for disconnection of all services currently serving the site.

2.1.4 Major diversions/relocation:

Initial UKPN discussions have confirmed the pylons are 132kV (6 or 7 core) supplies. 3 options for the rerouting of the 132kV main have been considered based upon burying the cables. We have commenced discussions with UKPN on the basis of the below diversion options:

- Option 1 rerouting of the cables on the western and northern edges of the site. It is anticipated this will require a [redacted] buffer zone. **It is anticipated that the cost or re-routing these cables is in the order of £[redacted]**
- Option 2 rerouting of the cables on the western side of the site and northern side of theA14 (within another Anglian Water Parcel of Land). **It is anticipated that the cost or re-routing these cables is in the order of £[redacted]**
- Option 3 rerouting of cables through the site (minimum width [redacted] zone). This is likely to be considered the least favourable by UKPN as they will be concerned will all the other statutory undertakers plan planned and future potential contact.

There is a requirement to relocate the mobile phone mast and local substation below. As indicated above we are investigating the full use of the mast together with outline costs for relocation. An allowance of £[redacted] should be assumed for relocation of the Mast, associated substation and potential land purchase.

3. GEOTECHNICAL

3.1 OVERVIEW

3.1.1 Information This report highlights the current situation in terms of geotechnical and, more pertinently, geo-environmental risks associated with the CNFE site, as well as possible next steps to achieve a clean and useable site, in the eventuality that the site is required to be decommissioned and de-contaminated from its current state.

3.1.2 In accordance with the discussions with the client team the geotechnical approach for the site is to assume Anglian Water depart the water treatment site and the Client team demolish, decontaminate the site in preparation for the residential development.

3.2 CURRENT SITUATION AND ASSUMPTIONS

3.2.1 A geo-environmental preliminary risk assessment was carried out by Mott McDonald in August 2018 (ref: 38808 - EA01 Revision A, 16 August 2018). This included a contaminated land qualitative risk assessment and information regarding previous site investigation works carried out at the Anglican Water site. The desk study was completed for site 1 only, including part A: The Cambridge Water Recycling Centre and part B: The Cambridge Golf Driving Range, Orwell House and the Cowley Road Park and Ride. These areas are also named Zone 1 – 6 on the most recent Masterplan.

3.2.2 A previous ground investigation was undertaken at the WRC site by A F Howland Associates during April and May 2005. The exploratory hole location plan is appended to this note. This comprised four boreholes at depths of 9-10m below ground level (bgl), 24 window sample holes between 2.5 and 5.0m bgl and 11 trial pits to 3m bgl. A general summary of the geology from the boreholes, window samples and trial pits is shown in the table below.

3.2.3 Groundwater was struck during drilling between 1.5 and 2.5m bgl, although these may not be a reliable measurement due to the age of the site investigation.

Strata	Depth to base (m bgl)	Thickness of strata (m)	Water depth (m bgl)
Topsoil	0.00 to 0.55	0.00 to 0.55	1.50 to 2.70 (strikes)
Made ground	0.40 to 2.50	0.40 to 2.50	
Sand (RTD)	0.40 to 4.80	0.90 to 3.50	
Clay (GLT)	Proven to 5m in window samples	0.20 to 7.70	

Proven to bottom of BH's only

3.2.4 According to the Environment Agency for groundwater resources, the superficial deposits at the site (River Terrace Deposits) are designated as a Secondary A aquifer.

3.2.5 Previous ground investigations, from 2005 (A F Howland Associates) and 2012 (Endeavour Drilling), encountered several contaminants in soil that exceeded current guideline criteria for residential land use without homegrown produce; the most representative of future development plans. The exceedances included: cadmium, chromium, lead, cyanide, and several Polycyclic Aromatic Hydrocarbons (PAH).

3.2.6 Groundwater and soil leachate samples from historical ground investigations were compared to Environmental Quality Standards (EQS) and Drinking Water Standards (DWS). The River Terrace Deposits are classified as a Secondary A aquifer and there are drains adjacent to the site boundary. Leachate tests show exceedances of: cadmium, copper, nickel and total PAH.

Groundwater samples included exceedances of: lead, nickel, ammonia, nitrate, individual PAHs, total PAH and Total Petroleum Hydrocarbons (TPH).

3.2.7 The locations of soil and leachate exceedances are shown below on the Figure 1a, and the exceedances for groundwater is also shown in Figure 1b. It can be seen that for the soil and leachate, contamination is confined to only a small proportion of the site, with the groundwater spread slightly further.

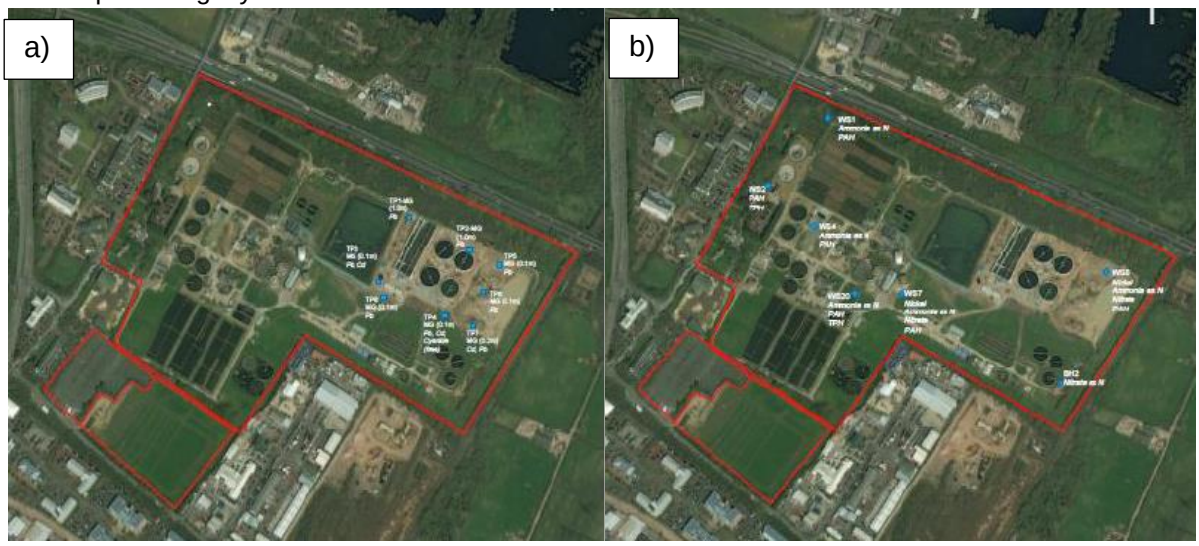


Figure 1a) Exceedances in soil and leachate contamination and b) groundwater contamination.

3.2.8 The results of the investigations indicate that hotspots of contamination are, or have the potential to be present, throughout the site. It should be noted that further contamination may be released during demolition, and testing should be included to assess this within the demolition plan.

3.2.9 The risks identified within the desk study were mostly assessed as low, however, there are potential moderate risks to human health (future site users), as a result of the presence of contaminated Made Ground and potential ground gases on site. There are moderate risks to groundwater in the River Terrace Deposits and nearby surface water. This is due to the presence of contaminants in Made Ground and existing exceedances in groundwater on site.

3.3 POTENTIAL REMEDIATION OPTIONS

3.3.1 Ground investigations will inform the scale of remediation works required at the site. Based on current available information it is considered that the remediation works are likely to comprise treatment of contaminant hotspots only, not pervasive contamination. It should also be noted that additional hotspots may be encountered following removal of existing tanks, structures and buildings. The likely remediation and mitigation works will include, but is not limited to:

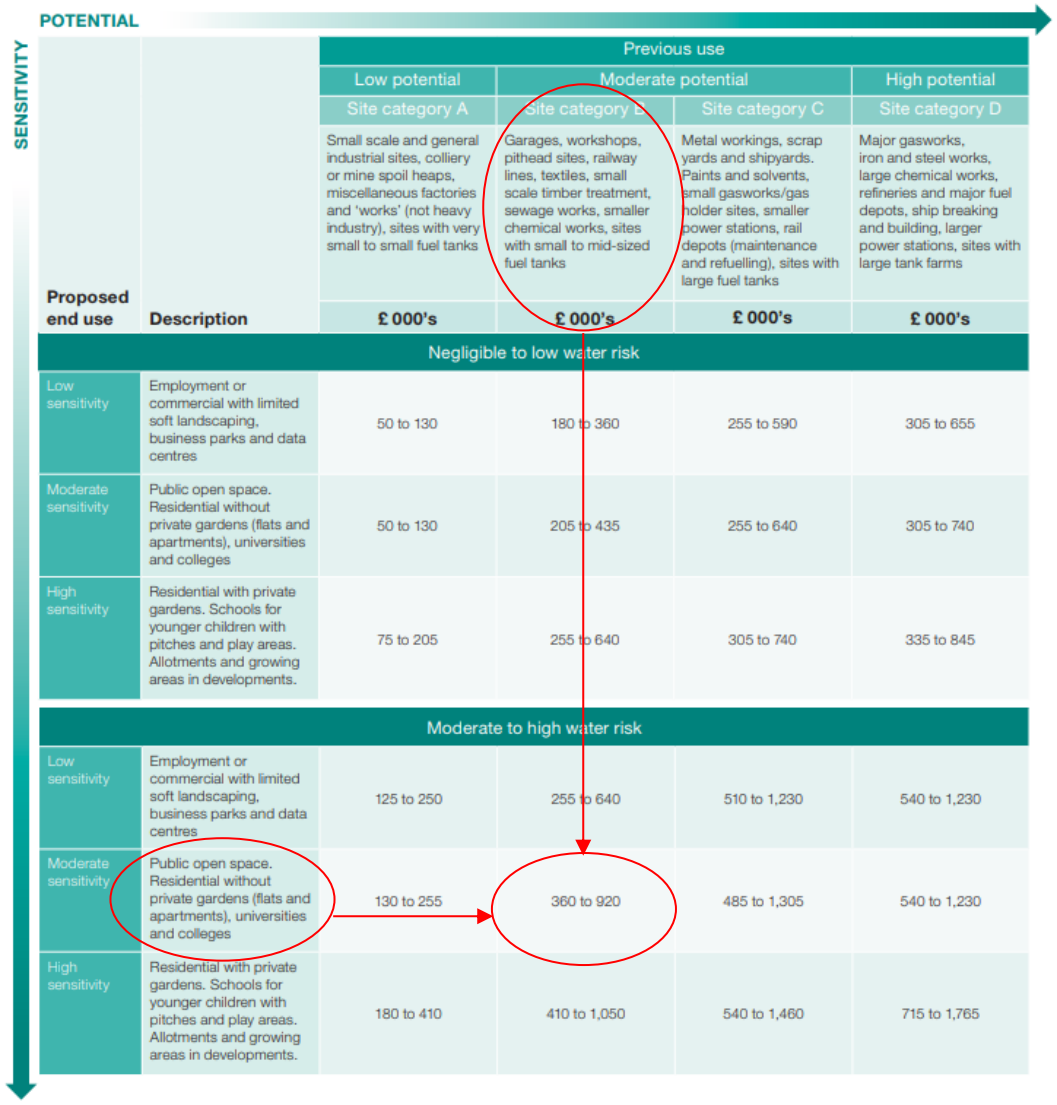
- Removal or treatment of hotspots encountered in the made ground/ underling natural strata. If the majority of the hotspots relate to organic contamination (as would be expected at the WRC) it is possible that on-site biodegradation may be a potential treatment option;
- Design of appropriate gas protection measures for the proposed buildings;
- Design of a ‘clean’ cover system in areas of soft landscaping (likely to be minimal), for planting areas the minimum cover thickness will be 600mm.

- If material is to be removed from site, this should be discussed with a waste carrier and Waste Acceptance Criteria testing would be required. A waste classification assessment can be carried out as part of any interpretation of the new site investigation.

- Any material that is to be reused on site should only be done following the completion of a risk assessment and production of a materials management plan (MMP).

3.3.2 The requirement for groundwater remediation will be confirmed following the additional ground investigation.

3.3.3 Remediation cost estimations have been based on guidance provided by Homes and Communities Agency (2015) and included in Figure 2. Cost is based on a category B site (moderate contamination potential due to presence of sewage works), with moderate to high water risk (due to presence of secondary aquifer) and moderate end use sensitivity (residential development without private gardens).



POTENTIAL

SENSITIVITY

Proposed end use	Description	Previous use – Low potential – Site category A	Previous use – Moderate potential – Site category B	Previous use – Moderate potential – Site category C	Previous use – High potential – Site category D
		Small scale and general industrial sites, colliery or mine spoil heaps, miscellaneous factories and 'works' (not heavy industry), sites with very small to small fuel tanks	Garages, workshops, pithead sites, railway lines, textiles, small scale timber treatment, sewage works, smaller chemical works, sites with small to mid-sized fuel tanks	Metal workings, scrap yards and shipyards. Paints and solvents, small gasworks/gas holder sites, smaller power stations, rail depots (maintenance and refuelling), sites with large fuel tanks	Major gasworks, iron and steel works, large chemical works, refineries and major fuel depots, ship breaking and building, larger power stations, sites with large tank farms
		£ 000's	£ 000's	£ 000's	£ 000's
Negligible to low water risk					
Low sensitivity	Employment or commercial with limited soft landscaping, business parks and data centres	50 to 130	180 to 360	255 to 590	305 to 655
Moderate sensitivity	Public open space. Residential without private gardens (flats and apartments), universities and colleges	50 to 130	205 to 435	255 to 640	305 to 740
High sensitivity	Residential with private gardens. Schools for younger children with pitches and play areas. Allotments and growing areas in developments.	75 to 205	255 to 640	305 to 740	335 to 845
Moderate to high water risk					
Low sensitivity	Employment or commercial with limited soft landscaping, business parks and data centres	125 to 250	255 to 640	510 to 1,230	540 to 1,230
Moderate sensitivity	Public open space. Residential without private gardens (flats and apartments), universities and colleges	130 to 255	360 to 920	485 to 1,305	540 to 1,230
High sensitivity	Residential with private gardens. Schools for younger children with pitches and play areas. Allotments and growing areas in developments.	180 to 410	410 to 1,050	540 to 1,460	715 to 1,765

Figure 2 Remediation Cost Matrix from Highways and Communities Agency 2015.

3.3.4 Guidance suggests a cost of £[redacted] to £[redacted] per hectare (Homes and Communities Agency, 2015) for remediation of the site. This does not include a capping layer and should be applied to the gross area of the site and are not related to actual areas of contamination. The

range of costs exist to cover the wide possibilities of contamination and remediation requirements. The range of costs per hectare provided in Figure 2 can be narrowed by using Figure 3 and determining the associated risk for different criteria.

Range determining factors	Low	Mid	High
Size	If greater than 5ha	If circa 5ha site	If less than 5ha. If less than 1ha range may not apply
Site context	No history of contamination in surrounding area	Some history of contaminated sites in surrounding area	Significant history of contaminated sites in surrounding area. However if there is a regional contamination issue this might reduce the amount of remediation by an individual site.
Number of previous uses and duration	Single use site (unless that use was high potential and over a long time)	Primarily single use	Mixed uses
Geology	Non permeable barrier close to surface or at depth but protecting a sensitive aquifer	Variable or thin layers	Permeable geology in sensitive areas
Depth	Shallow or surface	Top metre or so	Deep and thick layers of contamination requiring excavation or treatment
Spread of concentration	Isolated hot spots	Large areas but not complete site cover	Majority of site covered
Site location	Easy access, rural location	Outer city areas	Inner city areas, restricted access
Market conditions	Not active, stagnant recession like economy	Stable	Active market, buoyant economy for several years
Procurement strategy	High client risk profile	Proportionate and appropriate ownership of risk	Low client risk profile

Figure 3 Remediation Cost Range Indicator Matrix from Highways and Communities Agency 2015.

3.3.5 Considering the cost range indicators, the cost estimate is thought to be near the lower estimate of £[redacted] per hectare and suggest an allowance of £[redacted] per hectare be use without additional site investigation. The WRC is approximately 40ha, therefore a total cost of £[redacted] can be estimated.

3.3.6 It is unlikely that the entire site will need to be remediated. From the previous site investigations, it is assumed that [redacted]% of the site will require remediation due to the presence of the contamination hotspots, however it has been conservatively suggested that remediation requirements of up to [redacted]% of the total site should be considered. The remediation extent will be confirmed following the site investigation works and subsequent assessments.

3.3.7 It is anticipated that low amounts of waste removal given the results of the previous SI and the only areas of known contamination being small and in hotspots. It should be assumed WAC classifications of “hazardous” waste not suitable for re-use to be conservatively [redacted]% of the site.

3.3.8 For the existing golf driving range site it has been assumed contamination (due to its previous use being a green field site) is extremely limited. As such we have suggested an allowance of £[redacted] per hectare be considered. The golf driving range is approximately 6.65ha, therefore a total cost of £[redacted] can be estimated.

3.3.9 The site will also require a capping layer for the entire site given the nature of hotspots and the previous use of the site. For the purposes of this assessment we should consider a capping layer a minimum of 600mm thick and covering the 40ha area is to be installed.

Ground Gases

3.3.10 Presence of ground gas at the WRC site was assessed by @one Alliance (2014). The report did not state which strata the boreholes were measuring gas in and no borehole logs from this report are available.

3.3.11 This assessment resulted in a gas characteristic situation of CS2 based on CIRIA guidance (CIRIA C665, 2007). A CS2 was identified due to presence of elevated concentrations of carbon dioxide ([redacted]%) and high gas flow rates (maximum of 6.1l/hr). A CS2 represents a low risk but does require gas protection measures to be incorporated into new dwellings. The gas monitoring undertaken was completed in atmospheric pressure conditions greater than 1000mBar and therefore the results may not represent worst case or low and falling atmospheric conditions. The monitoring period was also not long enough to inform the risk for a residential. As such, the results may not be representative and additional monitoring from dedicated wells should be undertaken to confirm the gas situation. Ground gases may therefore present a risk to residents in new dwellings if gas protection is not incorporated into designs. Further monitoring should be undertaken to inform this.

3.3.12 Typical scope of gas protective measures as defined in CIRIA C665 are to use either reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g Damp proof membrane (DPM) and underfloor venting, or beam and block or pre-cast concrete with a 2000g DPM/reinforced gas membrane and underfloor venting. All joints and penetrations are to be sealed for both options. It is suggested that suspended slabs are used for costing as worst case.

Re-use of Demolition Material

3.3.13 It has been proposed that demolition rubble can be used as fill material for the underground areas currently present at the AW treatment works. This consists of the sorting, stockpiling, testing and installation of rubble material from the demolition works as general recycled material. The recycled material may be also be used as subgrade material for the future temporary or permanent works for the proposed development.

3.3.14 The use of recycled materials will be subject to the agreement and approval of the client. It would be necessary to ensure that where such material was used, either by themselves or in combination with other materials or ground water, that they would not present a health hazard or result in damage to structures (for example high sulphate content could cause an adverse reaction in contact with concrete). Clearly recycled material containing potentially contaminating and hazardous substances, such as asbestos, could be detrimental to the health and safety of the workforce.

3.3.15 The recycled materials shall thus be free of:

- organic materials and general mixed waste;

- peat or alluvium or material containing organic matter such as topsoil;
- logs or stumps;
- materials susceptible to spontaneous combustion;
- materials with a high sulphate content;
- material containing potential contaminants and hazardous substances as defined in the Hazardous Waste (England and Wales) Regulations 2005, such as asbestos; and,
- material containing reinforcing rods, steel and cast iron.

3.3.16 The use of recycled demolition materials is considered a sustainable approach to construction and will be utilised as far as is practically possible.

3.3.17 We would assume almost all of the demolition material is able to be re-used as fill given the current information about the site and usual demolition practices. To be conservative we would recommend it is best to assume [redacted]% of material can be re-used, to allow for small asbestos/contamination findings and the removal of steel reinforcement.

3.4 RECOMMENDED SITE INVESTIGATION WORKS

3.4.1 The following recommendations are made to assess the current conditions prior to any demolition of the current site:

- Ground investigations are necessary to determine the extent of contamination on site in the Made Ground and River Terrace Deposits.
- Ground investigations should extend to the golf driving range and old Park and Ride areas since there is currently no known ground investigations for these areas of the site.
- Groundwater monitoring and analysis is needed to determine the extent of groundwater contamination and determine the groundwater levels. In particular, the historical TPH hotspots identified on the WRC site may indicate a potential for free phase contamination.
- Further ground gas monitoring should be undertaken, potentially using dedicated wells, to assess the risks to proposed developments, including new dwellings, since historical monitoring has identified elevated CO2 concentrations and gas flow rates.

3.4.2 The ground investigation works are likely to involve some targeted exploratory holes around historical contaminant hotspots and known sources, together with a larger number of windowless samples to identify any additional hotspots.

3.4.3 The proposed site investigation for the whole of site 1, including the Park and Ride and the driving range, can be extended to investigate the contamination levels at site 2.

3.4.4 A range of boreholes around the site will be required, these will include the installation of groundwater monitoring standpipes in the RTD to delineate hotspots and determine groundwater levels and flow directions. Also, soil sampling through the depth of the Made Ground and underlying strata will be undertaken in the boreholes.

3.4.5 Window samples will also be required. These will be to install ground gas monitoring standpipes in areas of future residential buildings to inform ground gas protection requirements and undertaken further soil sampling of the Made Ground and underlying natural ground in areas of hotspots and on a non-targeted grid. The sampling locations will be dependent on the presence of existing structures. Further testing may be required following demolition of the existing structures.

3.4.6 The following table shows the anticipated number of boreholes and window samples. These are an upper estimate based on the previous site investigations, site requirements and available space:

Exploratory hole type	Number Required for Site 1	Number Required for Site 2
Boreholes	[redacted]	[redacted]
Window Samples	[redacted]	[redacted]

4. DRAINAGE

4.1 FLOOD RISK

4.1.1 Flood Risk - Fluvial

The site is situated within Flood Zone 1, having a low risk (<0.1% probability) of flooding in any given year. Mixed use developments are suitable within Flood Zone 1 in accordance with the NPPF. Flood Zone 2 of the River Cam is shown to be located to the east of the site.

4.1.2 Flood Risk – surface water

The majority of the site is having a very low risk of surface water flooding. Isolated areas are affected by high, medium and low risk of surface water flooding, dictated by the current topography of the site. The existing ditches along the sites eastern boundary convey surface water through the site and outfall to the River Cam downstream.

4.1.3 Flood Risk - groundwater

The site is underlain by superficial deposits consisting of sand and gravel. The British Geological Survey (BGS) SuDS map shows the site has the potential of high groundwater.

The use of soakaways as a means of disposing of surface water has been discounted due to the presence of the high groundwater and the existing contamination present on the site.

4.2 SURFACE WATER MANAGEMENT

4.2.1 The use of sustainable drainage needs to be at the forefront of the development masterplan. The philosophy of the surface water drainage strategy is to maximise water re-use and source control surface water management techniques to provide a robust and sustainable drainage scheme.The overall SuDS strategy will be fully integrated into the proposed scheme, will promote water reuse as well as limiting peak runoff flows to that of a greenfield site. The SuDS scheme will improve the water quality and provide amenity within the urban landscape as part of the management of the surface water.

4.2.2 SuDS general principals;

The general principal of the site wide SuDS scheme will be to;

- Mimic the greenfield runoff regime of the site and surface water runoff towards the River Cam.
- Surface water flows generally flow east and north east and will be intercepted by the existing drainage ditches on the site.
- The drainage ditches will be enhanced and used to provide a green corridor around the site. A buffer zone adjacent to the ditches of 8 m will be required as a minimum for maintenance purposes.
- Surface water reuse will be encouraged on the site at plot level.
- Source control measures such as green roofs and permeable paving will used to help manage the surface water as close to source as possible.
- Infiltration is deemed not to be a solution when dealing with surface water runoff from the site. This is due to the potential of high ground water and the risk of groundwater contamination.

- The use of swales and green streets will be incorporated into the masterplan to help improve the water quality, slow down surface water runoff, provide attenuation and provide an attractive and practical way to manage the surface water through the site.

- The use of above ground attenuation will be preferred to underground tanks.

- For every 1ha of impermeable area an attenuation volume of approximately 800 m³ will be required, without considering the effects of SuDS. Attenuation to be provided for the 100-year plus 40% design event.

- The masterplan and integration with SuDS techniques will be critical in providing a robust SuDS solution for this high-density site.

- The ownership and maintenance of the SuDS scheme will need to be determined and agreed, so that it can be demonstrated the SuDS scheme be suitable over the lifespan of the development.

- The SuDS scheme will need to take into account the phasing of the proposed development.

4.3 SURFACE WATER DRAINAGE STRATEGY

4.3.1 The primary constraints which affect the drainage strategy are high ground water levels and potential ground contaminates. Both these issues prevent infiltration being used as a method of disposing the surface water runoff generated by the site. All SuDS techniques will need to be fully lined to prevent infiltration of surface water into the ground water.

4.3.2 It is envisaged that blue / green roofs are considered across much of the roof area across the site. The greater proportion the greater benefit these systems will achieve. The blue roofs will provide the ability to store and treat water for grey water use within the buildings.

4.3.3 Where possible all surfaces on the site should be permeable or allow surface water into a permeable layer. Permeable paving with a porous sub-base will be used wherever practically possible throughout the site, such as within the courtyards and private streets, to enhance water quality, provide attenuation and conveyance throughout the site. Other SuDS measures such as swales and filter strips are envisaged to aid improving water quality from the surface water runoff. New trees will be introduced across the site to aid with amenity and ecology, which in places can be used to supplement the drainage scheme. Landscaped ponds, underlain by a permeable sub-base are proposed within areas of public open space. This will provide the additional attenuation requirements to limit the runoff from the proposed development to greenfield runoff QBAR rates.

4.3.4 The existing ditch along the boundary of the site, will be enhanced and incorporate a minimum 8 m buffer zone from the top of the bank. Areas alongside the ditch will be formed into a ‘green corridor’ which can be used to enhance ecology and amenity. It is proposed that the site’s surface water is discharged into this ditch at greenfield runoff rate.

4.3.5 The high density nature of the site and multiple SuDS solutions and control mechanisms will affect the surface water management strategy for the site. However the principal of attenuating and reusing water at source will help manage surface water and help reduce on surface attenuation requirements.

4.3.6 The proposed outline strategy has been undertaken on the basis that 800 m³ of attenuation will be required for every hectare of impermeable area on site, which is equivalent to limiting the surface water runoff to greenfield QBAR rates. In order to come up with the drainage strategy this volume has been split between the different attenuation features as shown by the table below and on the attached spreadsheet.

4.3.7 Below is an outline volume area calculation indicating the provision of various measures to formulate the surface water strategy

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Project/Calc No. 10199/SWDS01
Sheet No. 1 of 1
Date 05/11/2018
By SCS Chkd

CALCULATIONS | Project CNFE

Subject: Surface water attenuation - indicative strategy

Ref.

Output

Total site area (ha) [redacted]

Attenuation per hectare (m³) [to match Greenfield runoff rates]

Areas	% of site	Area (ha)	Indicative volumes (m³)
Blue roofs	15%	6.71	10067.10
Impermeable areas (roads / roofs et	44%	20.24	n/a
open space and excluded areas	15%	6.90	excluded from these calcs
courtyards & Green Streets	27%	12.31	11078.97
		Sum	[redacted]

Total attenuation required based upon developed surfaces (m³): [redacted]

Attenuation assumptions

Blue roofs — Peak water depth **0.15** m

Porous sub-base — Depth **0.3** m and void porosity of **30%**

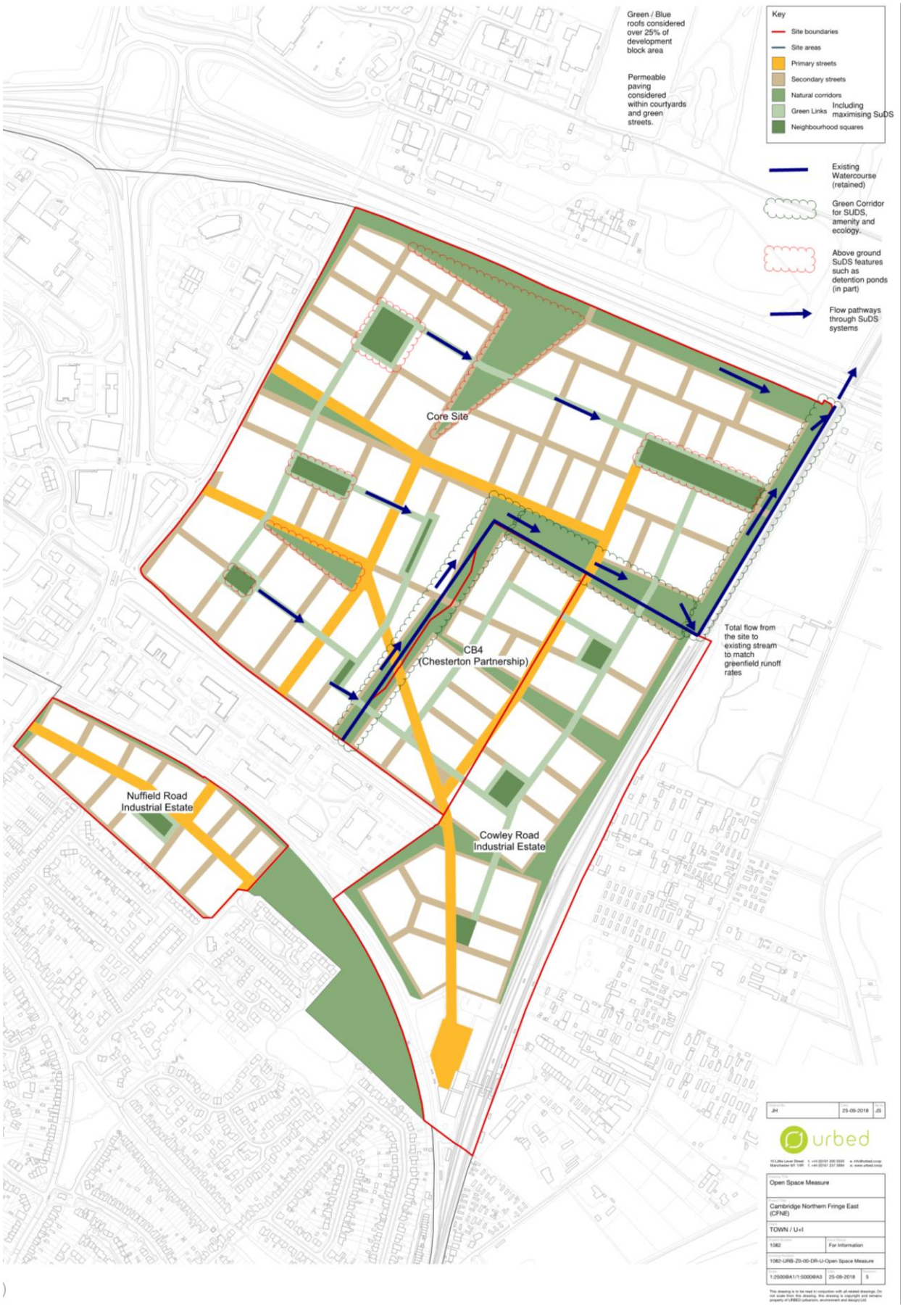
The area and volume indicated for the 'courtyards and green streets has been equally spit between 'courtyards', 'green streets', and 'other permeable surfaces'

Indicative attenuation volume summary

	Attenuation volume potential (m³)	Plan area (ha)	Plan area (m²)
Blue roofs	10067	6.71	67114
Courtyards	3693	4.103	41033
Green Streets	3693	4.103	41033
Other permeable roads	3693	4.103	41033
Ponds	10263		
Total	***31409***	*12.310*	*123100*

Note: Required attenuation volumes are based upon 'quick storage estimates' within MicroDrainage. Volumes are indicative and will vary depending on surfacing, SuDS components and how they are linked

4.3.8 Below is an outline strategy for SuDS introduction.



5. HIGHWAYS

5.1 SCOPE

5.1.1 Following issue of the frozen masterplan by URBED on 25.09.18 and the Client Team Meeting a Masterplan Road Hierarchy plan has been issued. This drawing shows the following approach to road strategy:

	Road Types	Width (m)	Comments	Drainage Strategy	Material Strategy
i	Primary Streets	16.5		Underground attenuation	Highest quality
ii	Secondary Streets	16.5		Underground attenuation	
iii	Tertiary Streets	11.0 5.5	Normal width Edge of neighbourhoods	Underground attenuation	
iv	Green (Street) Links	11.0 8	Normal width Around neighbourhood squares	Drainage Swales	

5.1.2 With regard to connections to the existing highway network it is understood the following is being considered:

- A Carriageway/footway/cycleway link between Cambridge North station to the site (running south east to north west is proposed)
- On the southern extent of the site a footway/cycleway link is proposed linking Cowley Park to the development
- 3 new main junctions serving the site (two along the western boundary and on along the southern boundary)
- Minor alterations are required to the junctions of Cowley Road and Milton Road
- Introduction of a potential underpass/ pedestrian bridge.
- On the northern extremity of the site a proposed footbridge is anticipated across the A14
- On the Eastern extremity a footway/cycleway link over the railway.

5.1.3 We have produced plans for consideration and focus as the masterplan develops these are;

- Drawing 101999_SK007 – Existing site layout/ Existing site information. The plan shows the existing site operation, site limits and existing constraints.
- Drawing 101999_SK008 – Proposed Masterplan Constraints Plan.