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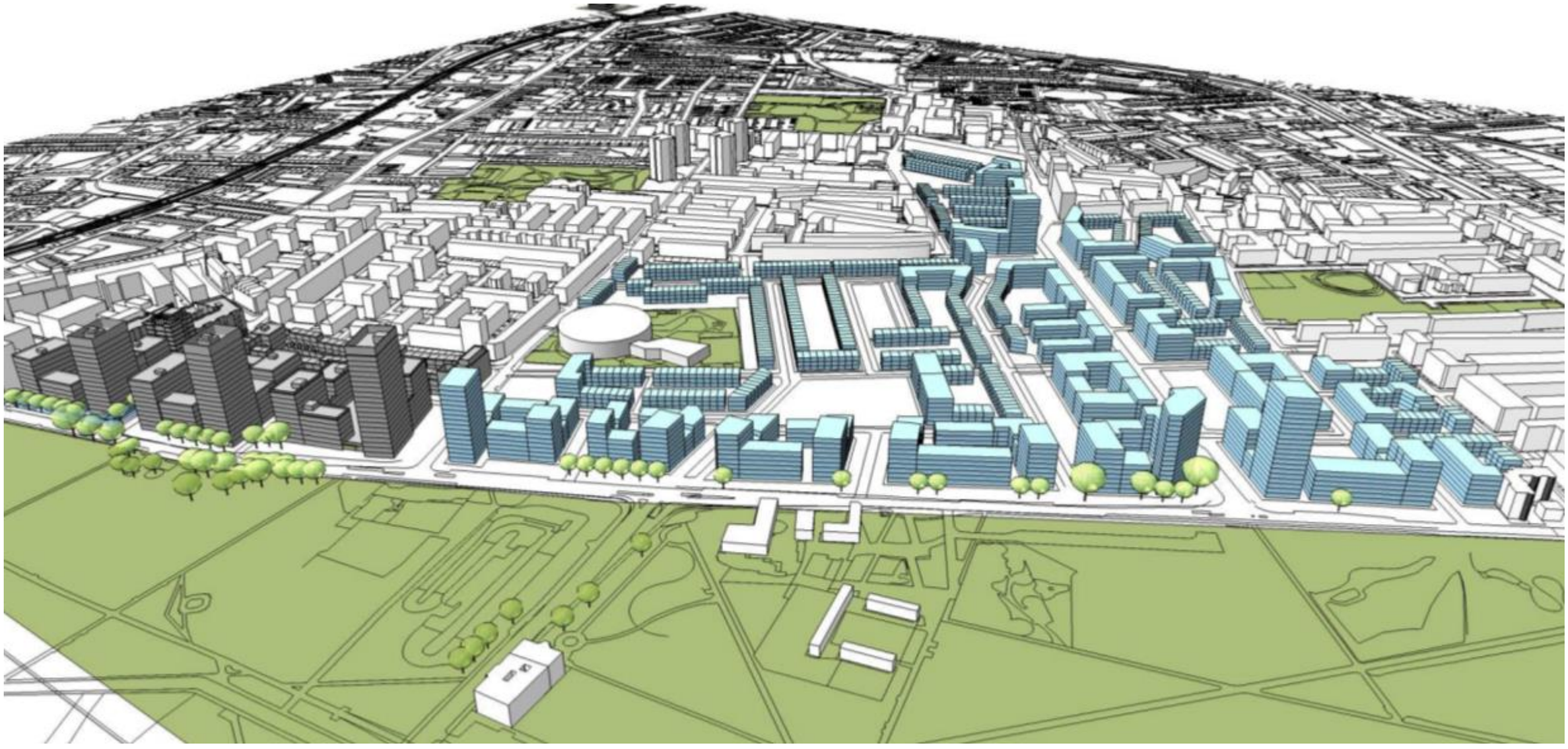

Energy Assessment and District Heating Study – Version 2

Notting Hill Housing

February 2015

Quality Management

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Prepared by	Justin Kilduff	Justin Kilduff	Justin Kilduff
Signature			
Checked by	Barny Evans	Barny Evans	Barny Evans
Signature			
Authorised by	Simon Clouston	Simon Clouston	Simon Clouston
Signature			
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AYLESBURY DEVELOPMENT

ENERGY Assessment

February 2015

CLIENT

Notting Hill Housing

CONSULTANT

Barny Evans
WSP Group Ltd
WSP House
70 Chancery Lane
London
WC2A 1AF

Tel: +44 (0)20 7406 7188
Fax: +44 20 7314 5111

www.wspgroup.co.uk

REGISTERED ADDRESS

WSP
01383511
WSP House, 70 Chancery Lane, London, WC2A 1AF

WSP CONTACTS

Barny Evans

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Site Wide Energy Strategy

This document has been prepared in such a way as to detail the approach of the proposed Aylesbury Estate to adhere to relevant policy targets for both the FDS and Masterplan planning application however both are considered as one combined development site over an extended phasing programme within this report.

The figure shows the extended phasing of the development with the FDS being completed in October 2023, through until final phase of Outline in January 2034.

Given the scale of the development we have recommended the inclusion of a site wide district heating network in line with London Plan Policy 5.6. Due to the extended phasing programme we recommend including two energy centres at the site, the first serving the FDS and a second to be included in Phase 2 of the Masterplan to be completed in 2023. This approach is recommended in order to avoid requiring too large a space allocation in FDS to serve the entire site. Best practice also recommends that CHP is activated once 60% of planned dwellings or demand is present in order to avoid low efficiency from running CHP at part load.

Should the Energy Centre in FDS be sized to serve the entire site the plant wouldn't be activated until after 2025 representing the point at which 60% of planned dwellings will be completed.

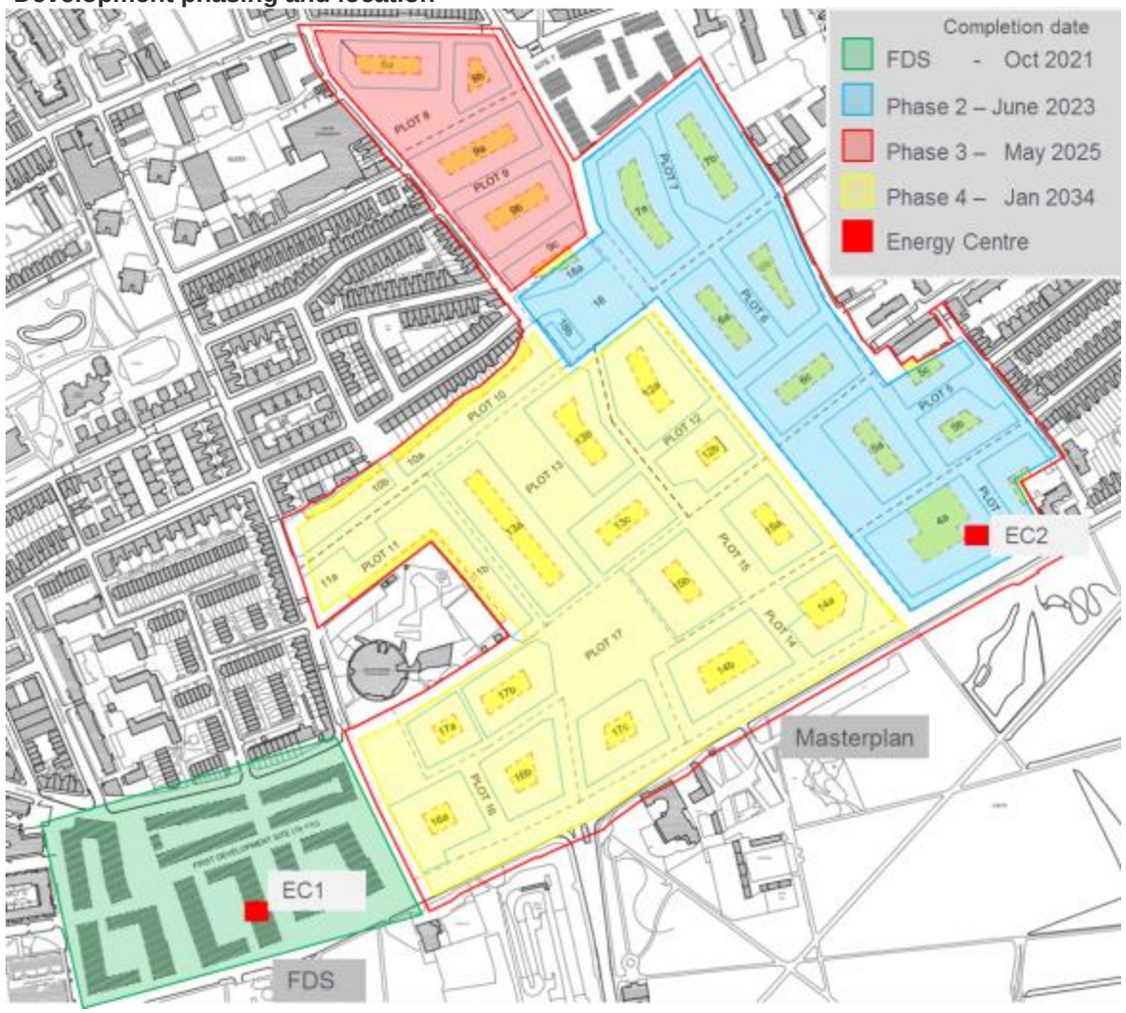
The energy centre (EC1) for the FDS is shown in picture to right and is assumed to be rated at 500kWe. It is recommended for the FDS DHN to be made connection ready to allow for connection to later phases of development.

The second energy centre (EC2) will be rated at approximately 2.5MW and sized to meet 65% of remaining thermal load. This energy centre is expected to come online by 2030 following completion of Phase 4a, as up to 79% of dwellings will be developed. Temporary gas-fired boilers will be required to serve phases 2a, 2b and 3 until the second energy centre comes online. This district heating network will be extended into final phase of development to be completed in 2034. An indicative layout is shown in Appendix D.

Following the completion of the final phase the two district heating networks can be joined at some point along Portland street. This would result in a single site wide district heating network served by two energy centres. This is subject to relevant engineering and efficiency analysis likely present following completion of final phase in 2034.

The remaining level of emissions reduction required in order to adhere to the 35% London Plan target will be achieved by implementing photovoltaic panels on unshaded roofs within development. It is expected that the total level of photovoltaic panels deployable at the site is estimated at 2,840m^2.

Development phasing and location



Timescales and Quantum of Development

	2021	2023	2025	2028	2030	2034
	FDS	Phase 2a	Phase 2b	Phase 3	Phase 4a	Phase 4 b
	EC1	EC2				
Number of dwellings (indicative)	830	916	206	434	565	579
As a % of total	23%	49%	55%	68%	84%	100%
As a % of Outline		34%	42%	58%	79%	100%

EXECUTIVE SUMMARY

This report serves to support two applications for the redevelopment of the Aylesbury Estate, the Masterplan application (outline) and the First Development Site (FDS) application (detailed). The FDS application proposes 830 dwellings, (including some as part of an extra care facility), and a small community centre within the detailed application). The Masterplan application proposes up to 2,745 units in the later phase that is being submitted in outline. This site wide energy assessment therefore covers a total of over 3,575 dwellings including commercial uses and outlines the approach to providing heating and power efficiently whilst meeting policy objectives for both detailed and outline elements of Proposed Development. The strategy for both elements is expected to be similar.

FDS Application

Policy Target

The overriding target identified at the site is a 35% saving in emission against Part L of Building Regulations 2013 Target Emission Rate (TER) in line with the London Plan 2011.

The Energy Hierarchy

In line with the London Plan and GLA energy assessment guidance we have followed the Energy Hierarchy within this report.

'Be Lean'

Energy efficiency measures were first assessed to reduce energy demand. Efficiency measures that are expected to be included in design of dwellings to achieve a 3.4% saving in emissions beyond TER. Measures include;

- ❑ Low air permeability
- ❑ Efficient fabric

A complete list of measures can be found in 'Be Lean' section

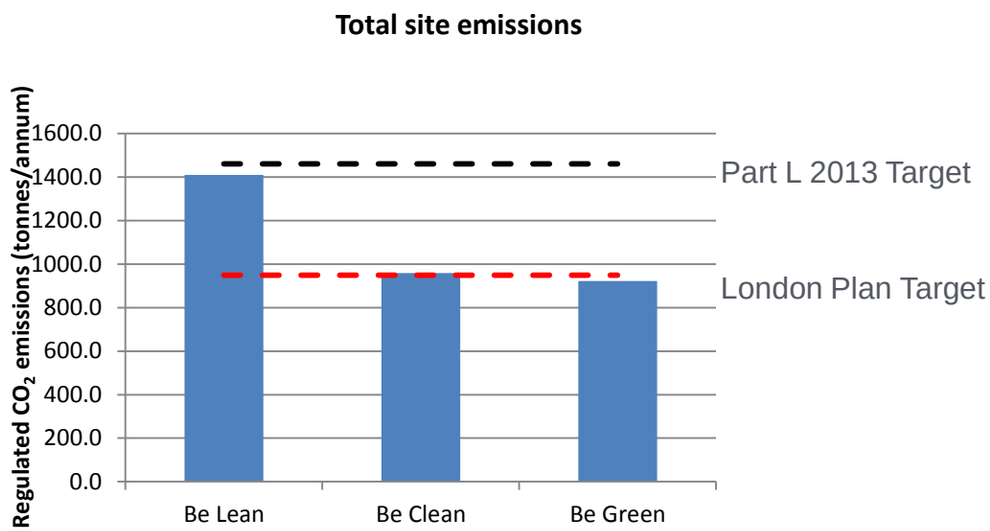
'Be Clean'

The feasibility of connecting to an existing heat network such as SELCHP and planned Heygate was first assessed inline with Policy 5.6 of London Plan. Connection to these networks was not considered feasible given distance, related cost, and level of available capacity. (See Appendix G)

A CHP led district heating network (DHN) is recommended for all dwellings including houses in FDS. A 500kWe system is recommended for the first development site which will achieve a notional saving of 32.%. in CO_2 emissions. An indicative layout of network is provided in Appendix D. Further details regarding CHP to be included can be found in 'Be Clean' section.

'Be Green'

The aim for a 20% reduction in CO_2 emissions from renewables in line with the Area Action Plan will not be achieved given the location of the site within an urban area and limited level of available roofspace. However, photovoltaic panels are recommended on the available unshaded roof space. Up to 697m^2 of roof area is suitable for photovoltaic panels and generating approximately 69MWh/yr. resulting in a 3.7% saving in emissions. Detailed roof plans showing area considered applicable for photovoltaic panels can be found in Appendix E.



	Carbon Dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013	1,460	723.2
After energy demand reduction	1,410	723.2
After CHP	958	723.2
After renewable energy	923	723.2

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	50	3.44
Savings from CHP	452	32.03
Savings from renewable energy	36	3.72
Total cumulative savings	**537**	**36.81**
Total Target Savings	**511.11**	35
Annual Surplus	**26.4**	

EXECUTIVE SUMMARY

The Masterplan application serves to support the remaining 2,745 units and commercial uses to be included in Masterplan.

Policy Target

All dwellings will be required to meet the 'Zero Carbon' target from 2016 onwards.

The exact details of this target have not been finalised however it is likely that dwellings will have to achieve a minimum Fabric Energy Efficiency Standard (FEES) given in kWh/m^2/year and reduce on-site emissions to a maximum Carbon Compliance (CC) in kgCO_2/m^2/year. The exact zero carbon definition for non-domestic elements has not been finalised it has therefore been assumed that any remaining emissions following energy hierarchy will along with remaining emissions from residential elements will also fall under an allowable solutions payment. Until the introduction of this policy we have assumed that the fall back policy requirement will be a 35% improvement in CO_2 emissions against Part L of Building Regulations.

The Energy Hierarchy

In line with the London Plan we have also followed the Energy Hierarchy for outline application within this report with the aim of adhering to FEES and CC.

'Be Lean'

The fabric values used for modelling outline were the same as those used for FDS. These values. were used as they are more efficient than draft specification for zero carbon homes provided by Zero Carbon Hub.

Both specifications can be found in Appendix B. The fabric values of notional building in Part L2a of Building Regulations were used for non-domestic elements as fabric standard is not likely to change for 'Zero Carbon'.

'Be Clean'

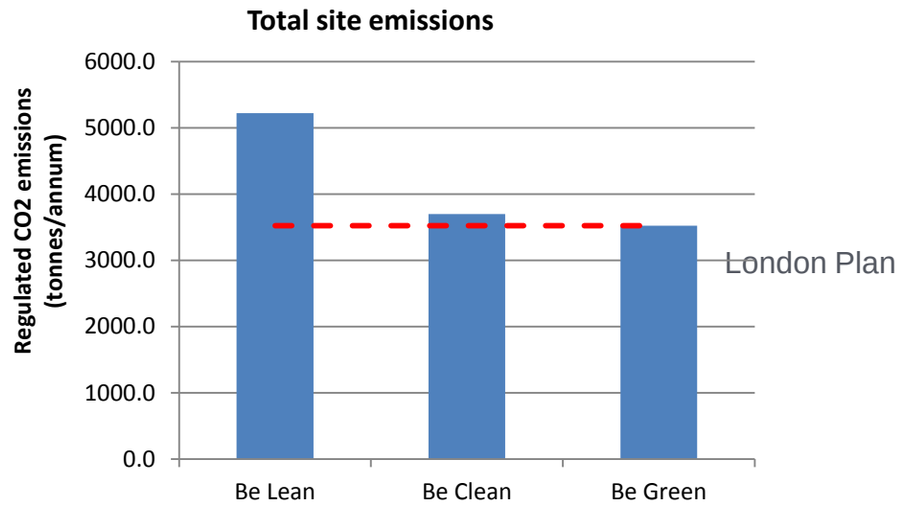
As previously mentioned the connection to an existing district network is not favoured given the distance, cost and available capacity, however contact with the nearby proposed Heygate site has confirmed they will consider the site for future connection , (Appendix D). It is anticipated that the heat network to be included in FDS will be extended to include the Masterplan. The indicative locations of the second energy centre and Pressure Reducing Station for Masterplan is shown in drawings in Appendix D.

Despite this it is intended to consider the energy strategy in detail at reserved matters taking into account changes in policy, technology and CO_2 emission factors.

The graph to right represents the level of emissions for the Masterplan based on the same construction as proposed for the FDS. All dwellings meet the draft CC target proposed by the Zero Carbon Hub.

'Be Green'

Once again the aim for a 20% reduction in CO_2 emissions from renewables in line with the Area Action Plan will not be achieved given the location of the site within an urban area and limited level of available roofspace. However, photovoltaic panels are recommended for inclusion on unshaded roof area. Indicatively a 296kWp (2,664m^2) system size could be deployed.



	Carbon Dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013	5,419	2,367.0
After energy demand reduction	5,172	2,367.0
After CHP	3,632	2,367.0
After renewable energy	3,496	2,367.0

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	248	4.57
Savings from CHP	1,539	29.77
Savings from renewable energy	136	3.7
Total cumulative savings	**1,896.7**	**35.5**
Total Target Savings	**1,896.7**	35%
Annual Surplus	**26.6**	

***remaining CO_2 reduction required to be met by rooftop photovoltaics.**

Allowable solutions payment		
Emissions following hierarchy	3,496	tCO_2
Assumed price per tonne	60	£
Total payment	6.29	£m

The allowable solutions payment is calculated based on the level of emissions following 'Be Lean', 'Be Clean', 'Be Green' hierarchy, which amounts to 3,496tCO_2. Assuming a price per tonne of £60 in line with recent government consultation.

1. INTRODUCTION

1.1 Site Review

WSP was commissioned by Notting Hill Housing Trust to develop an Energy Assessment for the Proposed Development at Aylesbury Estate in the London Borough of Southwark that would demonstrate how the development will provide heating and power and meet the energy and carbon emission targets set by national and local policy.

The Aylesbury Estate was constructed between 1966 and 1977 and is located south east of Elephant & Castle in the centre of London. The existing estate is spread across a 26.54 hectares site, 4.4hectares of which is the FDS.

The new development is expected to comprise a maximum of 3,575 dwellings spread across the redevelopment. This Energy Assessment serves to support the detailed planning application for the FDS that includes 830 dwellings and a community centre and the outline application for the remaining 2,745 included in Masterplan.
The dwellings to be included in FDS includes; 1 bedroom apartments (371), 2 bedroom apartments (264), 3 bedroom apartments (48), 2,3,4 bed maisonettes (100), and 4, 5 bedroom houses (47). A small community centre is also planned for inclusion. A full schedule of accommodation can be found in Appendix C.

Picture 1- Site Location & London Context

Picture 2- Site Location & Phasing

A full schedule of accommodation to be included in masterplan can be found in Appendix C. Included in the masterplan will be a mix on non-domestic uses including; 600 to 2,500 m^2 of employment use (B1); 600 to 3,000 m^2 of retail (A1/ A3/ A4) or workspace (B1); 200 to 500 m^2 of retail (A1); 300 to 600 m^2 of community use (D1); 2,000 to 3,000 m^2 medical centre (D1) 300 – 500 m^2 early years facilities (D1);

The methodology and recommendations for both detailed and outline are largely similar and as such there is significant overlap within this document however we have provided a separate outline section following that of the detailed.

1.2 Policy Context

The FDS policy context is as follows:

1.2.1 Part L of the Building Regulations 2013

The **TFEE** (Target Fabric Energy Efficiency) as calculated by SAP software (kWh/m^2/yr), with a 15% allowance.
This effectively requires a minimum level of building fabric energy efficiency for compliance and is detailed as thermal demand kWh/m^2/year.

The **TER** (Target Emission Rate) as calculated by SAP software (kg/CO_2/m^2/yr).

The Target Emissions Rate is a limit of kg CO_2 per m^2 based on regulated loads of building.

1.2.2 The London Plan 2011

Key policies within the London Plan relating to energy consumption and CO_2 emissions include;
Policy 5.2 Minimising Carbon Dioxide Emissions
Policy 5.3 Sustainable Design and Construction
Policy 5.5 Decentralised Energy Networks
Policy 5.6 Decentralised Energy in Development Proposals
Policy 5.7 Renewable Energy
Policy 5.9 Overheating and Cooling

The requirements detailed in London Plan include;
minimising carbon dioxide emissions in accordance with the following energy hierarchy:
1 Be lean: use less energy
2 Be clean: supply energy efficiently
3 Be green: use renewable energy

Achieve a 35% improvement on emissions against Part L of Building Regulations 2013.
Assess feasibility of connecting to existing heat network, if not feasible investigate practicality of including a CHP and a DHN. The feasibility of connecting to an existing heat network will be assessed and an outline given of potential CHP and related DHN network at the site. The feasibility of including on-site renewables should be carried out. The potential risk of overheating and need for cooling should be mitigated.

1.2.3 Southwark Local Plan

Policy 3.4 – Energy efficiency
Policy 3.5 – Renewable energy

The requirements of Southwark Local Plan are similar to those detailed in London Plan in that energy efficiency is prioritised however policy requires a 10% contribution to energy demand from on-site renewables.

1.2.4 Aylesbury Area Action Plan

BH6: a 20% reduction in emissions from renewable source.
BH7: Sustainable Design and Construction
All developments must connect to CHP system, or be able to connect to CHP when it becomes available. A contribution to emissions reduction should be achieved through on-site renewables in line with London Plan and homes must achieve a Code Level 4. This is equivalent to a 19% improvement on Part L of Building Regulations 2013.

1.2.5 Site targets

First Development Phase

- **Meet TFEE and TER requirements of Part L of Building Regulations**
- **Minimise energy consumption through energy efficiency,**
- **Investigate feasibility of connecting to existing heat network**
- **Investigate inclusion of DHN and connecting all dwellings to heat network.**
- **Provide a contribution to emissions reductions from on-site renewables, with a target of a 20% contribution.**
- **Achieve a 35% improvement on TER.**

1.2.6 Later Phases

Building Regulations

For later phases in development homes will have to comply with the '**Zero Carbon'** target from 2016 onwards. The exact definition of Zero Carbon has not been finalised, though the below represents the likely targets and requirements at the time of writing.

Each dwelling must meet the **Fabric Energy Efficiency Standard** as calculated by SAP software and given as a thermal demand limit depending on dwelling type and calculated in kWh/m^2/yr. The FEES will be higher for end of terrace and detached homes given the higher proportion of external walls than apartments and mid terrace dwellings.
Indicative FEES levels;

- Apartments & mid terrace: 39kWh/m^2/year
- Detached & end terrace: 46kWh/m^2/year

The exact regulations surrounding Zero Carbon target are not finalised for non-domestic however fabric standards will likely not exceed those detailed in current building regulations.

Carbon Compliance must be achieved and is given in kg/CO_2/m^2/yr, and will be a set limit per house type. These targets will also be a set limit depending on dwelling type with a more achievable target for apartments than detached houses. No preliminary targets have been given for high rise apartment blocks
Indicative Carbon Compliance levels;

- Residential blocks: 14kgCO_2/m^2/year
- Semi detached: 11kgCO_2/m^2/year
- Detached: 10kgCO_2/m^2/year

2 Site Energy Demand, Baseline & Be Lean Emissions

2.1 Baseline Emissions

In line with London Plan guidance the first stage in an energy assessment is to ascertain baseline site energy consumption and related emissions.

This was calculated using SAP accredited software (Plan Assessor v6) for each of the dwelling types planned for inclusion at the site. The SAP models were based on site layouts received which detailed dimensions of dwellings, as shown in Appendix F.

The baseline model for each home type was developed using the National Home Energy Assessor (NHER) Plan Assessor v6.0 using values of notional 2013 building as detailed in SAP2012 . These specifications are used as a guide to achieve both Target Emissions Rate (TER) and Target Fabric Energy Efficiency (TFEE), and thus compliance with Part L of Building Regulations 2013.

Baseline Carbon Emissions

Baseline regulated and unregulated emissions for each dwelling type were extrapolated for the number of each type present at the site to give total site emissions, as shown in **Table 1.** A full schedule of accommodation can be found in Appendix C.

Picture 3- Example block and Passive Measures

2.2 'Be Lean' Emissions

We have allowed for the inclusion of a number of efficiency measures in design of dwellings that goes beyond specifications detailed for notional building within Part L of Building Regulations.

The following measures are included in design;

- ❑ **High performance building fabric**
- ❑ **High performance glazing**
- ❑ **100% low energy lighting**
- ❑ **Improved air tightness.**

Further details of specification can be found in Appendix B.

2. 3 Overheating and Cooling

The Proposed Development will include measures detailed in cooling hierarchy of London Plan such as;

- ❑ **Green Roofs and**
- ❑ **Natural Ventilation**
- ❑ **Recessed fenestration, 2/3 glazing and balconies**

The majority of roof space is planned to include extensive green roofs while intensive green roofs will be included on tower blocks.

The example building shown highlights several examples of passive cooling measures including shading through balconies on most major windows, 2/3rds glazing, and in setting of windows from façade. The indicative glazing to floor area percentage of buildings within development is approximately 28%.

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Table 1 – Results, 'Be Lean'

Be Lean	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	50	3
Total Target Savings	**511.11**	35%

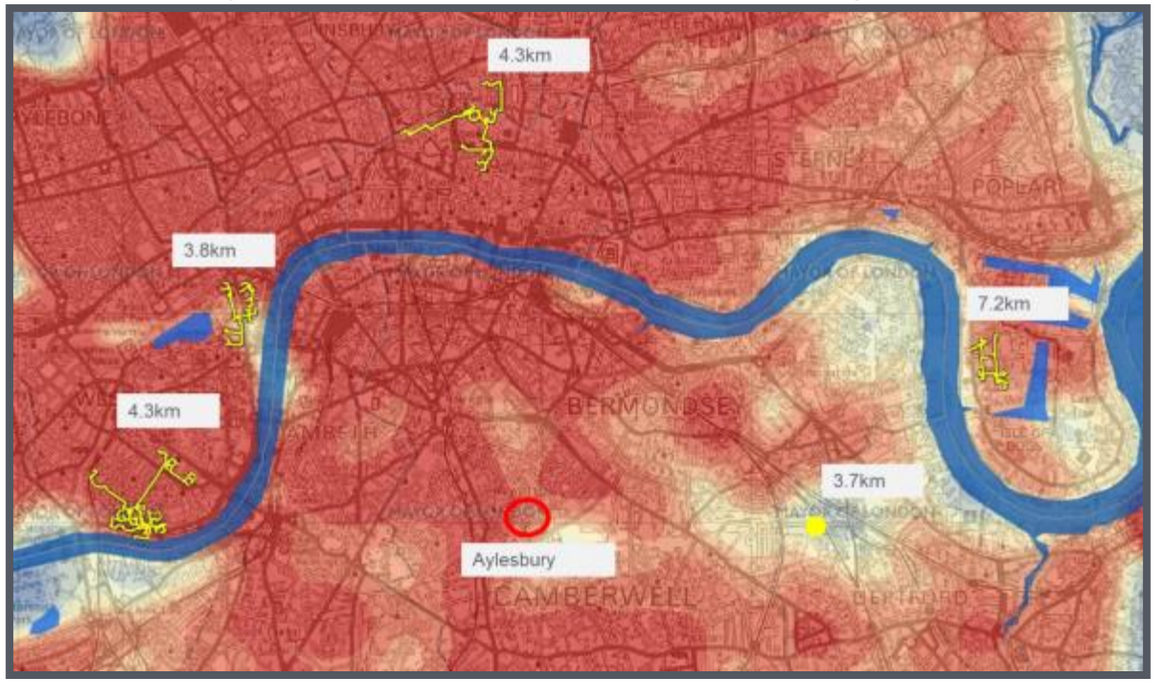
3 Be Clean

Following the application of efficiency measures (Be Lean) the next step is to consider which technologies can provide further improvement in CO_2 emissions. The recommended hierarchy is;

- ❑ Prioritise connection to existing heat networks
- ❑ Allow for connection to planned networks
- ❑ Include a site wide heat network

The below analysis is inclusive of both detailed and outline application.

Picture 4- Existing Heat Networks, and Site location, London Heat Map



3.1 Existing Heat Networks

It is evident from the above picture that there are no existing heat networks within close proximity of the development. The London Heat Map shown above indicates that the Pimlico and SEL CHP networks are closest to site however are approximately 3km from site. The networks on the opposite side of the River Thames have been ruled out on the basis of cost and technical feasibility, after correspondence with a network. The SELCHP facility in Greenwich is 3.7km from the site by road. Calculations indicate the cost of running a heating connection from there to the site would result in a cost of around £6m and have thermal losses of 33% for the FDS and 9% once the whole site is built. On the basis of the cost , complexity of building the pipe, thermal losses and opportunity to use the waste heat nearer the resource this connection is not proposed. Despite this an application form has been submitted re. the site connection to SELCHP .

Contact was sought with Lend Lease's Richard Henderson in relation to the planned Heygate scheme and he indicated that there was capacity for up to 260 residential units. The Heygate scheme was in the process of agreeing a 3rd party operator so was not in a position to provide any further information. In light of this and the fact that the Heygate development is nearest to the later development phases it is not intended to propose connection for the FDS but to consider it for the later phases. We have provided the Heygate site with details of the Aylesbury Estate for future engagement. The location of the Heygate and FDS and outline are shown in Picture 6, the length of pipework required to connect FDS is approximately 947m while the later phases of outline are within 300m of development.

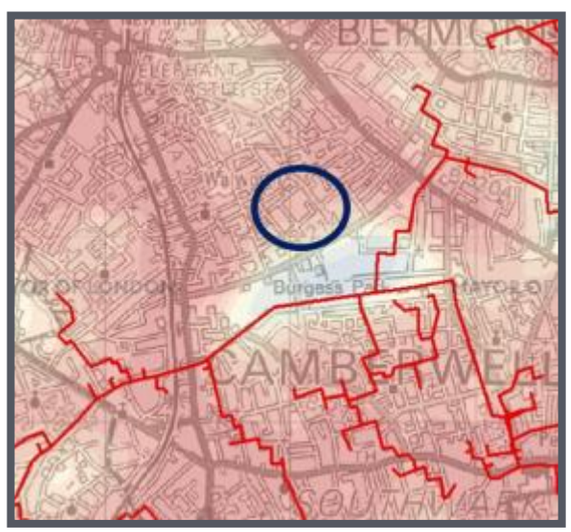
3.2 Cost of Connection

The estimated cost of connecting to the SELCHP network is £1,600 per m based on discussions with the Pimlico DHN (Appendix D).

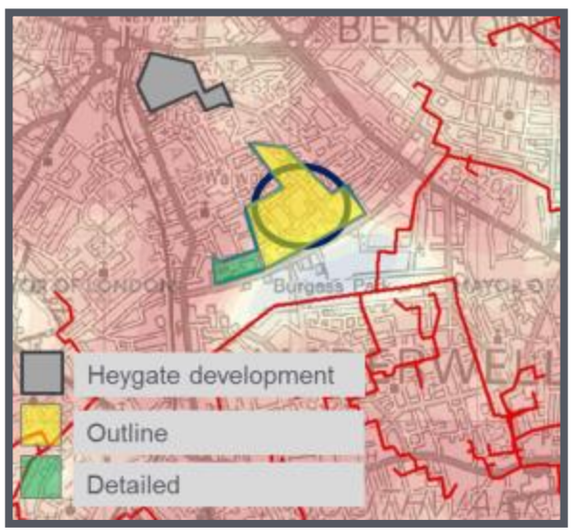
3.3 Potential Heat Networks

The below pictures indicates potential heat networks that may be developed within close proximity of development site. Again, there are no potential networks planned running directly adjacent to site, with the exception of the Heygate.

Picture 5- Potential Networks 2005 Study



Picture 6- Potential DH Networks & Heygate



3.4 Combined Heat and Power & Site Wide Heat Network

As connection to an existing or planned heat network has been ruled out for the FDS due to cost of connection, potential losses and available capacity Decentralised Energy has been considered in line with London Plan Policy 5.6. The Proposed Development is of sufficient scale given number and density of dwellings in FDS to allow for the inclusion of a CHP with a thermal density of around 85kWh/m^2/yr.

It is estimated that a 500kWe system with a thermal output of 2,359MWth per annum could meet up to 65% of thermal demand, assuming plant will run for an estimated 5,000 hours per annum. This will connect to a thermal store that will also be fed by a gas-fired boilers for top-up support. The exact size of thermal store will be dependent on the preferred operating methodology of 3rd party operator. This system and a DHN serving the FDS is expected to save up to **452tCO$_2$ per year.** (CO_2 emission factors today)

This plant and associated equipment will be located within the basement of Block 5. The area reserved for the energy centre (229m^2) can be seen in Appendix D. An indicative pipe layout is also shown in Appendix D.

It is expected the operator of the CHP will monitor operation of plant and related emissions limits and report on data in an annual maintenance report. This along with other details regarding commercial operation of plant will be confirmed at a later stage as final operator is not known. The Air Quality chapter of the EIA includes the assumed representative plant.

The proposed district network will be developed underground and run alongside road network. The pipework will connect to buildings underground and will therefore not require any façade alteration or have any external visual impact.

The proposed system is more expensive than a comparable solution using gas fired boilers in each block in both capital expenditure and overall 30 year WLC basis, (assuming one replacement of primary asset.) as below. See Appendix G.

Figure 1 – Modelled Thermal Demand Profile of FDS.

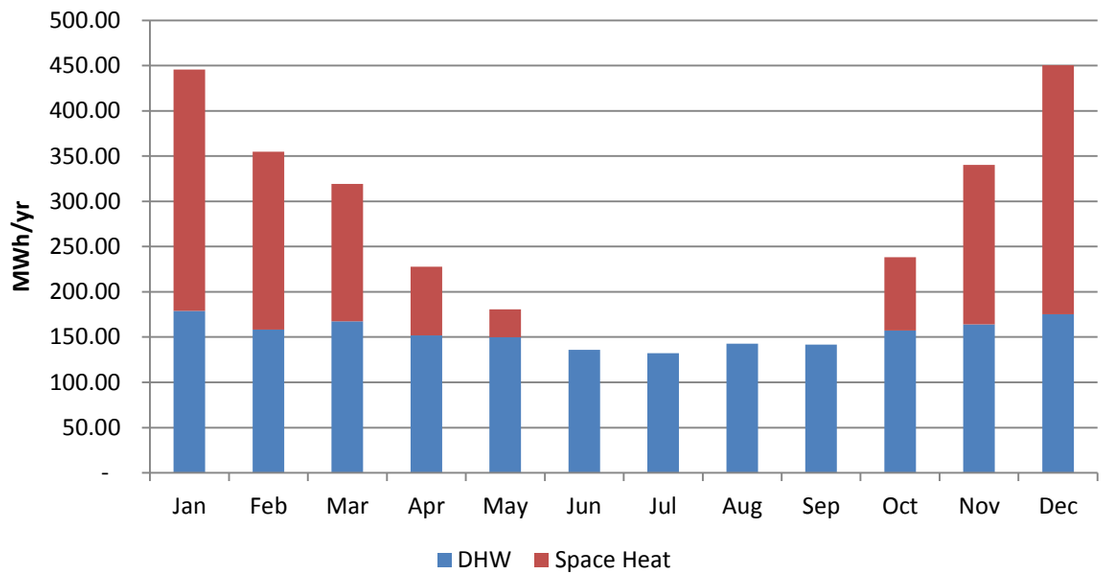


Table 3 – Financial Modelling

	Capex (exc. HIUs)	Opex (annual)	Net Fuel Costs (Annual)	30 year cost	30 year cost inc. inflation
CHP/boilers - DHN	£ 1,243,500	£ 33,262	£ 112,204	£ 5,607,503	**-£ 7,359,996**
Individual block boiler	£ 135,000	£ 7,506	£ 127,943	£ 4,198,475	**-£ 5,125,297**
SELCHP connection	£ 6,101,000	£ 5,725	£ 251,566	£13,819,728	**-£15,264,805**

Table 4 – Results, 'Be Clean'

Be Clean	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	50	3
Savings from CHP	452	32
Total Target Savings	**511.1**	35

4 Be Green

In line with Policy 5.7 renewable energy technologies have been considered to provide a reduction in expected carbon dioxide emissions with a target of 20%.

We have evaluated a range of technologies to assess their applicability to site including;

- ❑ Solar Photovoltaics
- ❑ Solar Thermal
- ❑ Biomass Heating
- ❑ Ground & Air Source Heat Pumps.
- ❑ Wind turbines

Site specific analysis for Solar Thermal, Biomass Heating, Wind turbines and Heat Pumps are shown in Appendix A as they are not recommended for the site. This applies to both the Detailed and Outline application at this stage.

Solar Photovoltaics

Photovoltaics are recommended for the Proposed Development to be installed on roofs within development.

Figure 7 shows the FDS site layout and the area considered applicable for photovoltaic development. The panels located on these roofs could be orientated due south or as same average orientation as buildings, assumed to be South East. These locations are considered to be largely free of shading as they are situated at front of multi-storey buildings, that face onto Burgess Park.

The majority of roof space in FDS has been highlighted for the inclusion of both intensive and extensive green roofs in line with local policy. Picture 8 is an example of photovoltaic panels deployed on extensive green roofs.

The area considered applicable on roofs of apartment buildings amounts to 697m^2 which allows for a 77kWp system to be installed. Drawings detailing these areas can be found in Appendix E.

The aim for a 20% reduction in CO_2 emissions from renewables in line with the Area Action Plan will not be achieved given the location of the site within an urban area and limited level of available roofspace.

The indicative system size on the available space of 77kWp is estimated to generate 69MWh/yr. This is based on data sourced from PV GiS that indicates a potential generation of 886kWh/kWp within London assuming panels are orientated to South East and at an inclination of 10 degrees. This allows for an annual saving in emissions of 36tCO_2.or 3.72%.

Figure 7- Site Layout and Indicative PV area.

Picture 8 – Green Roofs Intensive with Photovoltaic

Table 5 – Results, 'Be Green'

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	50	3.44
Savings from CHP	452	32.03
Savings from renewable energy	36	3.72
Total cumulative savings	**537**	**36.81**
Total Target Savings	**511.11**	35

5 Masterplan Energy Assessment

5.1 Baseline Emissions

The baseline site emissions for the Masterplan phase of development were calculated using the same methodology as previous detailed section. The SAP models were based on site layouts received for FDS as they are deemed representative of the size and type of unit to be included in Masterplan.

The specification for a zero carbon home as detailed by Zero Carbon Hub, which represents the recommended approach were used as a guide to achieve Carbon Compliance (CC) and (FEES) however the specification of FDS surpassed this so has been used in modelling of outline. Baseline regulated and unregulated emissions for each dwelling type were extrapolated for number and each type present at the site. Emissions for non-domestic elements were estimated through developing two Simplified Building Energy Models (SBEM) based on the two main use types (Offices and Retail), these were then extrapolated to give total emissions and then added to those related to domestic element to give total site emissions.

5.2 'Be Lean' Emissions

The efficiency measures modelled in design of Masterplan are those included in FDS and can be found in 'Site Energy Demand' section and Appendix B.

FEES

The level of energy consumption at site assuming all units meet the recommended threshold FEES amounts to 13,715MWh/year. The units do not meet the draft recommended FEES target however there are no targets for high rise apartments and calculation methodology has not been finalised and so this is not yet confirmed.

5. 3 Overheating and Cooling

The Masterplan is likely to incorporate the same measures as detailed for FDS including;

- ❑ **Green Roofs and**
- ❑ **Natural Ventilation**

The roof space of Masterplan will likely include a high level of both intensive and extensive green roofs in line with the cooling hierarchy.
The final glazing percentage for Masterplan elements is not known at this stage of the project

5.4 'Be Clean' Emissions

The connection to an existing heat network has been ruled out in detailed section, (Be Clean) with the exception of a possible partial connection to the Heygate development.
Inline with Policy 5.6 of the London Plan the inclusion of a CHP and district heating system for Masterplan is the likely approach to achieving compliance with targets. An area within Masterplan has been highlighted for development of a 2.5MW CHP energy centre (Appendix D).
It is expected that temporary plant in the form of gas-fired boilers will serve initial phases of development until 60% of the dwellings are occupied, (around early 2030), at which point the CHP led plant will provide the supply. It is intended should this network be developed to connect to all suitable buildings and FDS network. Given the extended timeline of the regeneration of the Aylesbury estate it is also important to allow flexibility to include other technologies that may be feasible at a later stage.
Several areas that may impact the inclusion of this are; changes to Policy, de-carbonisation of grid and technological changes.

5.5 'Be Green'

Photovoltaics panels are proposed as the recommended renewable energy technology for the later phases. It is assumed the available area will be the same ration as in the FDS indicatively a 296kWp (2,654m^2) system generating 262 MWh/yr. This will deliver a 3.7% reduction in CO2 emissions and meet the 35% CO2 emission reduction target but will not meet the 20% reduction target from renewables alone.

5.6 Carbon Compliance

The combination of the savings achieved through the hierarchy result in the site surpassing the CC target, as shown in Table 6.

Table 6 – Results, Outline

Carbon Compliance	Target kgCO$_2$/m^2/yr	Outline CC kgCO$_2$/m^2/yr
Residential Blocks	14	11.3
Semi-detached	11	10.1

5.5 Allowable Solutions

Under the proposed zero carbon methodology any remaining emissions following 'FEES and CC will need to be covered through Allowable Solutions.
This is likely to involve a payment into a carbon fund which will then invest in emission saving projects. The remaining annual level of emissions from site is multiplied by life of building, assumed to be 30 years to give the l level of emissions to be abated. The cost per tonne has not been finalised but consultation suggests £60. On this basis the allowable solutions payments for the outline application would be, £6.3m. It is suggested this may be used as a contribution to the on-site district heating network.

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	248	4.57
Savings from CHP	1,539	29.77
Savings from renewable energy	136	3.7
Total cumulative savings	**1,896.7**	**35.5**
Total Target Savings	**1,896.7**	35%
Annual Surplus	**26.6**	

Table 7 – Results, Outline

6 Results

6.1 Site wide strategy

Given the scale of the development we have recommended that a site wide district heating network be included in line with London Plan Policy 5.6. This will be made up of two energy centres, a 500kWe located in FDS and a larger 2.5MWe to be included in masterplan, these could be connected in final phase.

The remaining level of emissions saving required following efficiency measures and on-site district heating will be achieved through rooftop photovoltaic panels totalling 2840m^2.

6.2 FDS

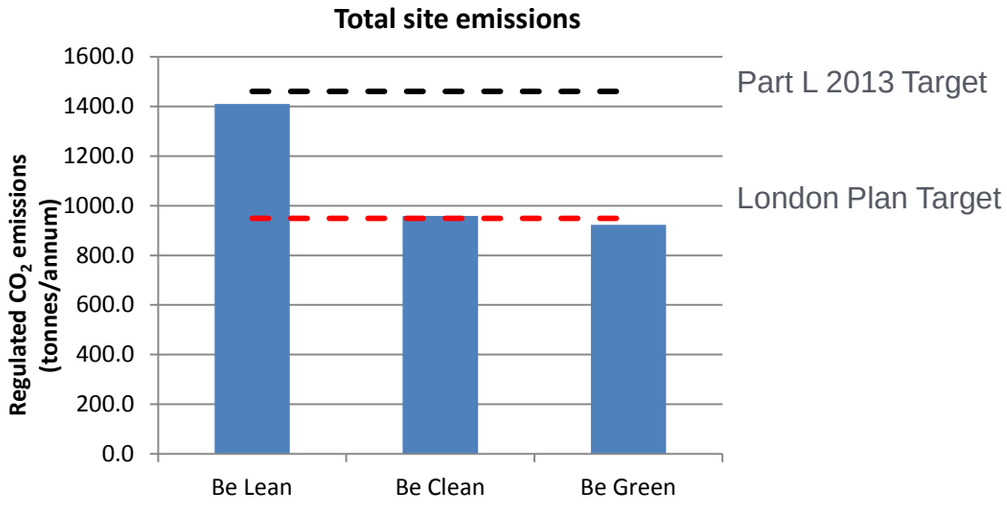
The recommended approach for adhering to London Plan targets for FDS is a combination of 'Be Lean', 'Be Clean', and 'Be Green' measures. A range of efficiency measures have been detailed that allow for a 3.4% saving in emissions. Following this we have outlined the feasibility of including a 500kWe CHP and district heating network. Finally up to 697m^2 of roofspace has been considered feasible for the inclusion of photovoltaic panels allowing for the remaining required 3.7% saving in emissions to be achieved.

6.3 Masterplan

The recommended approach for adhering to London Plan targets for Masterplan follows the same approach as that used in FDS and is a combination of 'Be Lean', 'Be Clean', and 'Be Green' measures. The same efficiency measures as detailed for FDS have been used in masterplan and allow for a 4.5% saving in emissions, following this we have outlined the feasibility of including a 2.5MWe CHP and district heating network. The remaining reduction in emissions required will be achieved through the inclusion of up to 2,664m^2 of photovoltaic panels.

6 Results

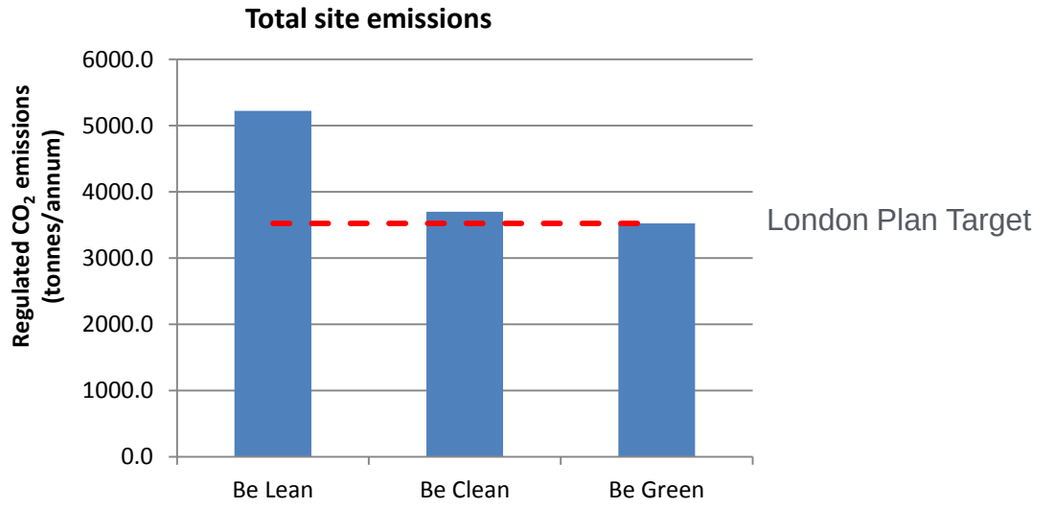
6.4 Detailed



	Carbon Dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013	1,460	723.2
After energy demand reduction	1,410	723.2
After CHP	958	723.2
After renewable energy	923	723.2

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	50	3.44
Savings from CHP	452	32.03
Savings from renewable energy	36	3.72
Total cumulative savings	**537**	**36.81**
Total Target Savings	**511.11**	35
Annual Surplus	**26.4**	

6.5 Outline



	Carbon Dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013	5,419	2,367.0
After energy demand reduction	5,172	2,367.0
After CHP	3,632	2,367.0
After renewable energy	3,496	2,367.0

	Regulated Carbon Dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	248	4.57
Savings from CHP	1,539	29.77
Savings from renewable energy	136	3.7
Total cumulative savings	**1,896.78**	**35.5**
Total Target Savings	**1,896.78**	35%
Annual Surplus	**26.6**	

Allowable solutions payment		
Emissions following hierarchy	3,496	tCO_2
Assumed price per tonne	60	£
Total payment	6.29	£m

Appendix A – Technologies Not Used

The following technologies were not considered feasible at site;

- ❑ Solar Thermal
- ❑ Biomass Heating
- ❑ Ground & Air Source Heat Pumps.
- ❑ Wind turbines

Solar Thermal;

Though feasible given available roof space within development it is expected that communal heating will provide domestic hot water demand therefore discouraging the inclusion of this technology. Should solar thermal panels be included they would reduce the emissions savings of CHP. Additionally, the free available unshaded roof area has been highlighted for the development of photovoltaics.

Biomass Heating;

This technology is not recommended due to additional air quality concerns involved when including this technology in an urban area. This fuel source is also not considered for CHP as a larger scale of plant is required before this is suitable. The additional burden of fuel storage and delivery would also hamper development.

Ground & Air Source Heat Pumps

As a district linked CHP is required both technologies are not suitable for inclusion at the development. Both technologies provide heat and would thus reduce level of emissions savings from CHP.

Wind Turbines

Wind turbines are not recommended for inclusion at the development given the low and wind resource in the area and due to the lack of clear space.

Appendix B

Building Specification – Detailed & Outline

Fabric and System Values		
External Walls	0.18	u-value
Party Walls	0	u-value
Floors	0.18	u-value
Roofs	0.13	u-value
Solid Door	1.4	u-value
Windows	1.4	u-value
Thermal Mass	Lightweight	
Thermal Bridging	0.05	y-value
Permeability	3	
Heating System	LTHW DHN or Combi Boiler	
Heating System Control	Thermostat and TRVs	
Hot Water System	LTHW DHN or Combi Boiler	
Gas Boiler Efficiency	89.40%	
CHP Efficiency	82%	
CHP Heat Efficiency	46%	
CHP Electrical Efficiency	36%	
CHP Thermal Contribution	65%	

Building Specification – Zero Carbon Hub (Proposed)

Fabric and System Values		
External Walls	0.18	u-value
Party Walls	0	u-value
Floors	0.18	u-value
Roofs	0.13	u-value
Solid Door	1.4	u-value
Windows	1.2	u-value
Thermal Mass	Lightweight	
Thermal Bridging	0.072	y-value
Permeability	5.2	

Approved Document Part L2a (Non-Domestic)

Building Element.	**(Notional)**
External Walls (W/m²K)	0.26
Floors (W/m²K)	0.22
Roof (W/m²K)	0.18
Window (W/m²K)	1.6
Openings %	80% of facade area
Heating (Mains Gas)	0.92
Air Permeability (m³m²h)	3-5
Ventilation	Fan coil

Appendix C

Schedule of Accommodation – First Development Site

AYLESBURY REGENERATION

REVISED PLANNING APPLICATION FEBRUARY 2015

REV J 03/02/2015

				FLATS								MAISONETTE & DUPLEX					HOUSES							
				1B	2B3P	2B3P +	2B4P	3B4P	3B5P +3B6P	4B6P	4B7P	2B4P (M)	3B4P (M)	3B5P (M) 3B6P (M)	4B6P (M)	4B7P (M)	4B6P (H)	5B7P (H)	TENURE	GIA SQM*	GIA SQFT	NIA SQM	NIA SQFT	Net to Gross*	WHEELCHAIR ADAPTABLE	WHEELCHAIR
BLOCK		UNITS	HR	2	3	4	4	5	5	6	6	4	5	5	6	6	6	7								
1A	5/6 storey	50	104	47	2	1	0	0	0	0	0	0	0	0	0	0	0	0	Extra Care	5239.6	56399	2976.9	32043	57%	0	0
1B	263.10sqm	0		COMMUNITY CENTRE																						
1C	10 storey	41	111	32	0	0	0	4	1	0	0	0	0	2	2	0	0	0	Target Rent	3376.8	36348	2629.1	28299	78%	0	0
1D	7 storey	24	73	3	19	0	0	0	0	0	0	0	0	0	2	0	0	0	S/O	2384	25661	1819	19580	76%	3	0
SUB PLOT 1 TOTAL		115	288	82	21	1	0	4	1	0	0	0	0	2	4	0	0	0		11000.4	118407	7425	79922		3	0
2A	4 storey	7	12	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LD	781.7	8414	500.4	5386	64%	0	0
2B	3/4 storey houses	22	145	0	0	0	0	0	0	0	0	0	0	0	0	0	9	13	Target Rent	3137.5	33772	3137.5	33772	100%	0	0
2B	3/4 storey houses	5	30	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	Private	615	6620	615	6620	100%	0	0
SUB PLOT 2 TOTAL		34	187	7	0	0	0	0	0	0	0	0	0	0	0	0	14	13		4534.2	48806	4252.9	45778		0	0
3A	3/4 storey houses	13	83	0	0	0	0	0	0	0	0	0	0	0	0	0	8	5	Rented	1706	18363	1706	18363	100%	0	0
3A	3/4 storey houses	7	44	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	Private	1016.8	10945	1016.8	10945	100%	0	0
3B	5/6 storey	20	60	11	2	0	0	0	0	0	0	3	0	4	0	0	0	0	S/O	1853.2	19948	1464.6	15765	79%	0	0
SUB PLOT 3 TOTAL		40	187	11	2	0	0	0	0	0	0	3	0	4	0	0	13	7		4576	49256	4187.4	45073		0	0
4A	20 storey	92	258	55	0	0	37	0	0	0	0	0	0	0	0	0	0	0	Private	8235	88641	5762.1	62023	70%	0	1
4B	6/10storey	48	194	0	4	5	22	0	3	0	0	11	0	3	0	0	0	0	Market Rent	5182.1	55780	4077.8	43893	79%	0	5
4C	7 storey	26	79	12	3	0	7	0	0	0	0	2	0	2	0	0	0	0	S/O	2586	27835	1878.6	20221	73%	4	0
4D	10 storey	36	144	0	14	2	4	0	12	0	0	2	0	2	0	0	0	0	Target Rent	4210	45316	3177.2	34199	75%	2	4
4E	6 storey	19	60	9	0	0	8	0	0	0	0	0	0	2	0	0	0	0	Private	1757	18912	1314.9	14153	75%	0	0
SUB PLOT 4 TOTAL		221	735	76	21	7	78	0	15	0	0	15	0	9	0	0	0	0		21970.1	236484	16210.6	174489	74%	6	10
5A	18 storey	80	208	48	16	0	16	0	0	0	0	0	0	0	0	0	0	0	Private	6569.9	70718	4713.6	50737	72%	0	0
5B	6 storey	14	50	4	0	0	8	0	0	0	0	0	0	2	0	0	0	0	S/O	1621.4	17453	1158	12465	71%	0	0
5C	6/8 storey	45	155	18	1	4	7	0	0	0	0	4	0	11	0	0	0	0	Private	4433.4	47721	3452	37157	78%	3	2
5D	5/7 storey	33	92	19	6	4	0	0	0	0	0	0	0	4	0	0	0	0	Private	3058.4	32920	2272.1	24457	74%	6	2
5E	4/10 storey	65	238	23	3	2	6	2	12	0	0	4	0	13	0	0	0	0	Target Rent	6466.7	69607	5263.6	56657	81%	2	5
SUB PLOT 5 TOTAL		237	743	112	26	10	37	2	12	0	0	8	0	30	0	0	0	0		22149.8	238418	16859.3	181472	75%	11	9
6A	14 storey	64	186	36	0	0	24	0	0	0	0	2	0	2	0	0	0	0	Private	5402.8	58155	4036.8	43452	75%	0	0
6B	9 storey	35	109	12	10	0	9	0	0	0	0	2	0	1	1	0	0	0	Target Rent	3498.6	37659	2544.7	27391	73%	0	1
6C	8 storey	31	101	14	0	0	8	0	4	0	0	4	0	1	0	0	0	0	Private	3027.6	32589	2280.4	24546	75%	0	0
6D	10 storey	45	144	21	8	0	2	0	10	0	0	0	0	4	0	0	0	0	Target Rent						0	0
6D	Ground Floor Units	8	39	0	0	0	0	0	0	0	0	1	0	7	0	0	0	0	S/O	4997.9	53797	3932	42324	79%	0	0
SUB PLOT 6 TOTAL		183	579	83	18	0	43	0	14	0	0	9	0	15	1	0	0	0		16926.9	182200	12793.9	137712	75%	0	1
TOTALS				1B	2B3P		2B4P	3B4P	3B5P	4B6P	4B7P	2B4P (M)	3B4P (M)	3B5P (M)	4B6P (M)	4B7P (M)	4B7P (H)	4B7P (H)		GIA SQM	GIA SQFT	NIA SQM	NIA SQFT			
TOTAL NO UNITS	830		371	106		158	6	42	0	0	35	0	60	5	0	27	20	830	81157.4	873571	61729.1	664447		20	20

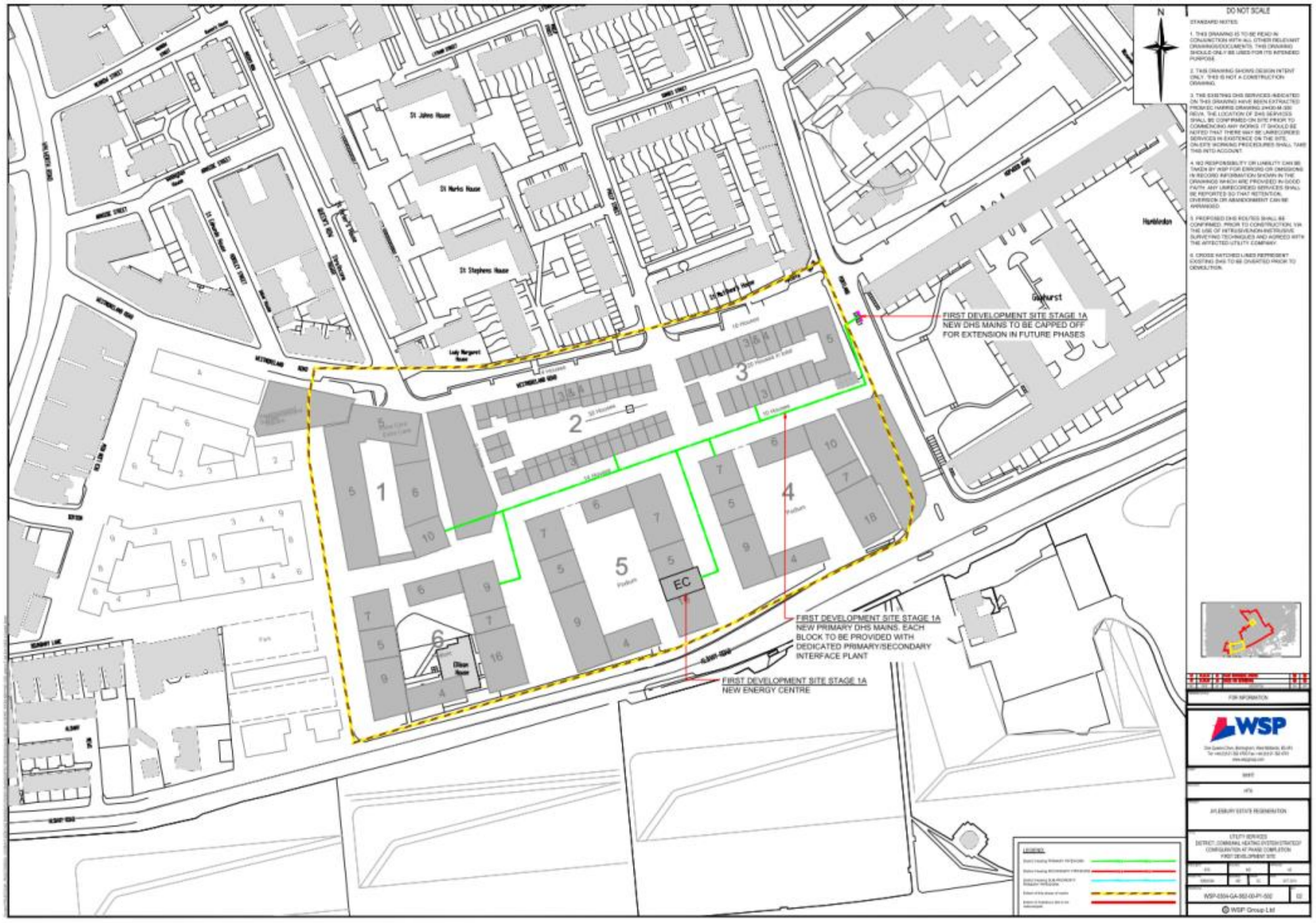
Appendix C

Schedule of Accommodation – Masterplan

TOTAL			
FLATS	MAIS	HOUSES	Total
199	42	0	241
37	9	13	59
80	38	0	118
19	9	15	43
11	5	10	26
67	19	11	97
56	24	11	91
39	13	25	77
71	4	19	94
25	11	34	70
0	0	34	34
21	7	0	28
22	8	28	58
21	7	26	54
0	0	32	32
0	0	22	22
0	0	32	32
0	0	26	26
70	17	14	101
40	20	5	65
0	0	53	53
32	15	23	70
0	0	28	28
176	24	0	200
128	50	0	178
94	36	0	130
44	15	24	83
124	37	0	161
87	33	0	120
21	4	8	33
0	0	42	42
99	41	0	140
118	9	0	127
1,701	**497**	**535**	**2,733**

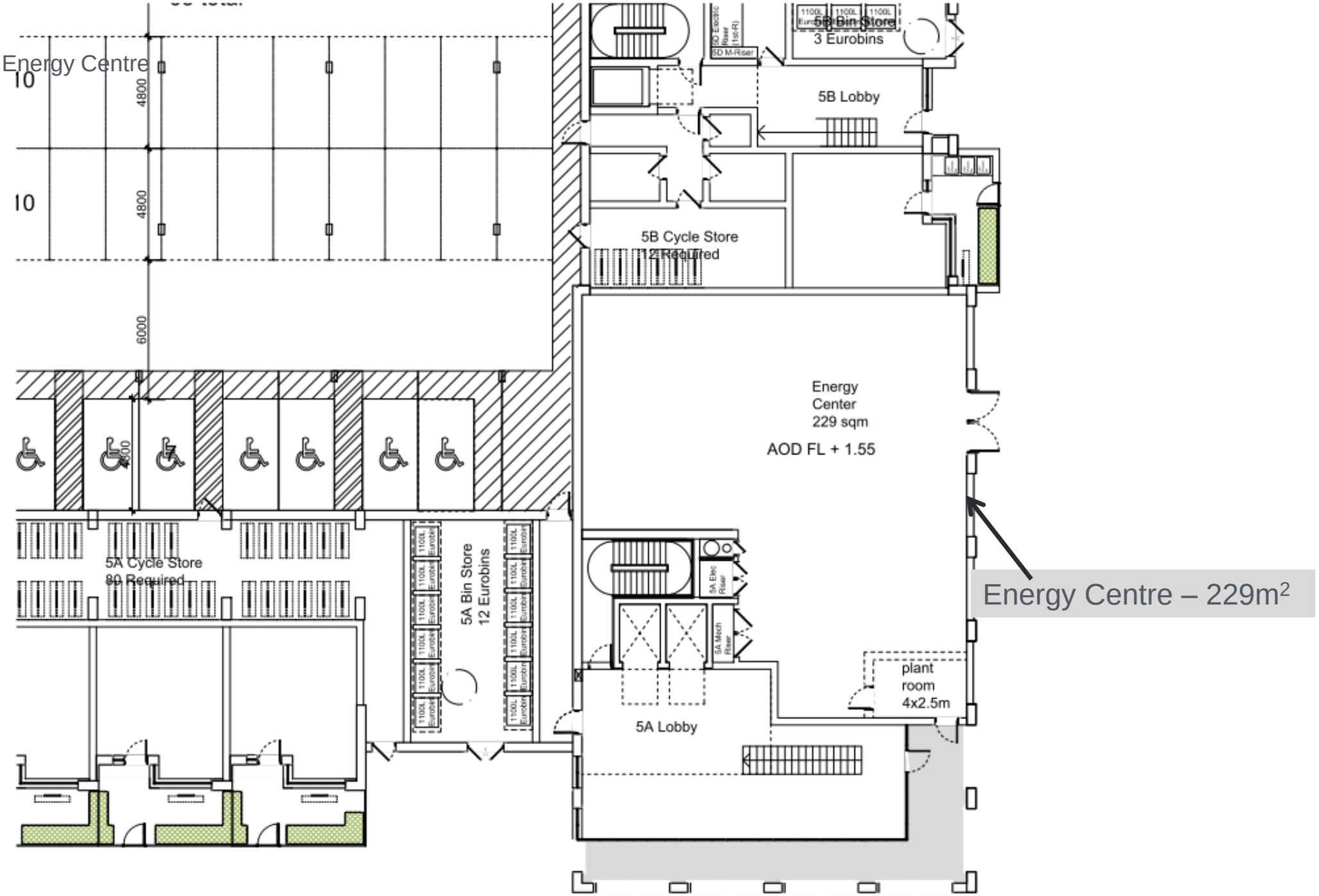
Appendix D

Location of FDS energy Centre and Indicative Pipe runs



Appendix D

Area dedicated to FDS Energy Centre



Appendix D

Correspondence with SELCHP & Heygate

Kilduff, Justin

From: Davis, Lynn <lynn.davis@veolia.com>
Sent: 19 August 2014 15:23
To: Kilduff, Justin
Subject: Re: FW: District Heating Network Enquiry

Hi Justin,

Thank you for your call earlier.
I am sorry that we are not currently in a position to provide you with the rough costings.
We hope to be able to be in position in September to do so.

Thank you for your interest and I will be in contact should I require any further details, or when I am able provide you with an estimate.

Kind regards,

Lynn

Lynn Davis BSc(Hons). MA.
Project Manager
United Kingdom

m. +44 (0)79 19 54 72 18

www.veolia.co.uk

On 19 August 2014 15:14, Kilduff, Justin <Justin.Kilduff@wspgroup.com> wrote:

Lynn,

Following on from our call could you confirm that the relevant people who can provide information on cost of connection and spare capacity at SELCHP are currently on leave and will not return until early September?

Kind regards

Justin Kilduff MSc BA

Consultant

Kilduff, Justin

From: Davis, Lynn <lynn.davis@veolia.com>
Sent: 20 August 2014 08:35
To: Kilduff, Justin
Subject: Re: FW: District Heating Network Enquiry

Hi Justin,

Unfortunately it will not be possible, I will contact you again after our internal meeting on 3r

Kind regards,

Lynn

Lynn Davis BSc(Hons). MA.
Project Manager
United Kingdom

m. +44 (0)79 19 54 72 18

www.veolia.co.uk

On 19 August 2014 15:53, Kilduff, Justin <Justin.Kilduff@wspgroup.com> wrote:

Lyann,

Thank you for providing the below,

Would it be possible to arrange a meeting with one of the relevant two people who are on leave up the first week of September?

It would be useful to make contact as we will likely be developing strategies for more developments London and would like to understand the considerations of connection in greater detail.

Kind regards

Justin

Kilduff, Justin

From: Henderson, Richard <Richard.Henderson@lendlease.com>
Sent: 27 August 2014 20:22
To: Kilduff, Justin
Cc: Evans, Barny
Subject: RE: Heygate and Ayelsbury Estate

Justin

Thank you for the background information set out below. We are anticipating completion of a concession agreement within the near term and once positioned to introduce the ESCO, I will get back to you at the earliest opportunity.

Regards
Richard

Richard Henderson | Senior Development Manager | Lend Lease - Elephant & Castle
Level 10, Hannibal House, Elephant & Castle Shopping Centre, New Kent Road, London SE1 6TE
T +44 (0)20 3697 6123 | M +44 (0)7770 466 716
richard.henderson@lendlease.com | www.lendlease.com

From: Kilduff, Justin [mailto:Justin.Kilduff@WSPGroup.com]
Sent: 27 August 2014 16:35
To: Henderson, Richard
Cc: Evans, Barny
Subject: RE: Heygate and Ayelsbury Estate

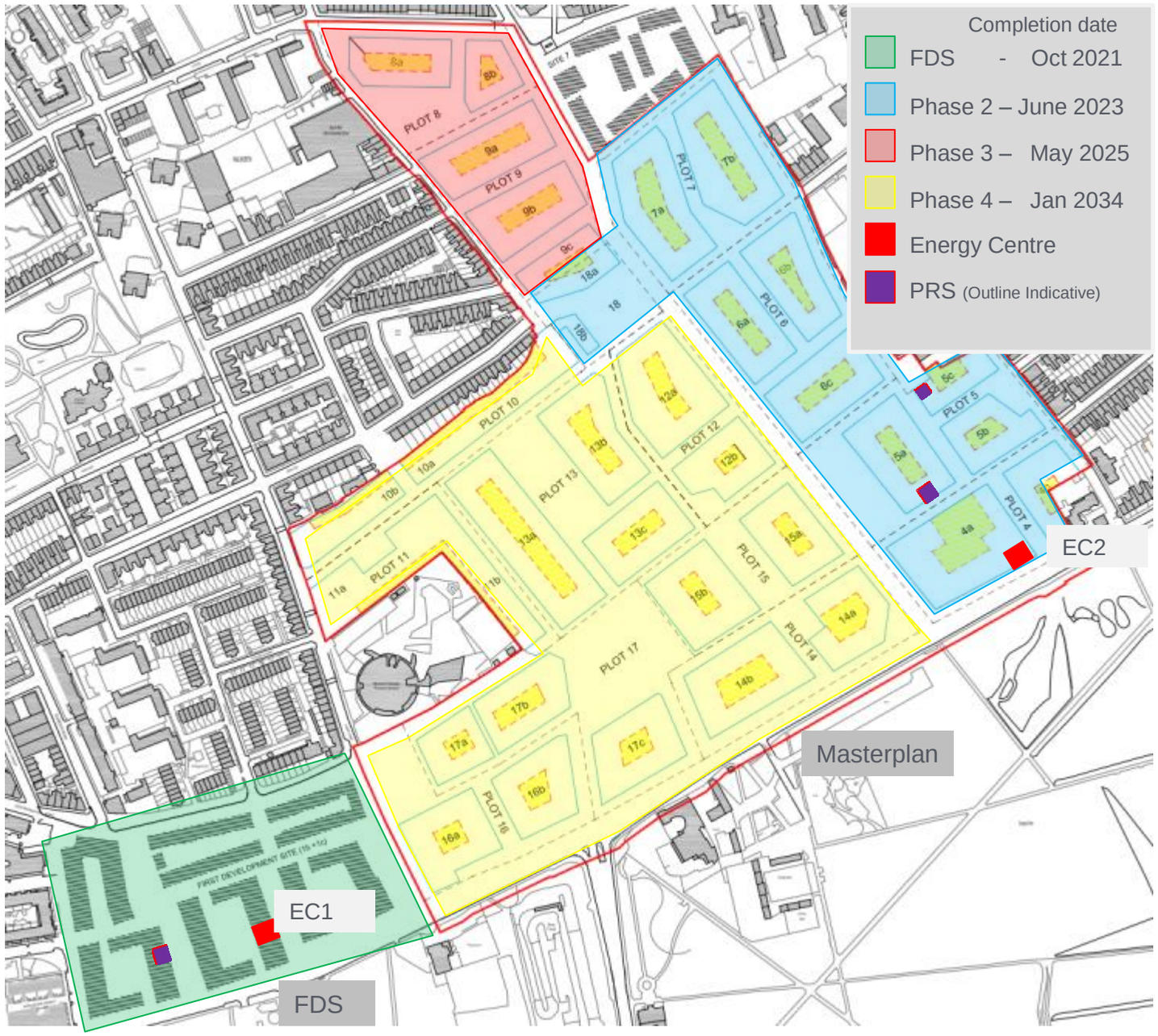
Richard

The location of your site in relation to the outline (yellow) and detailed (green) areas of Proposed Development are shown below.

The form has been completed and submitted.

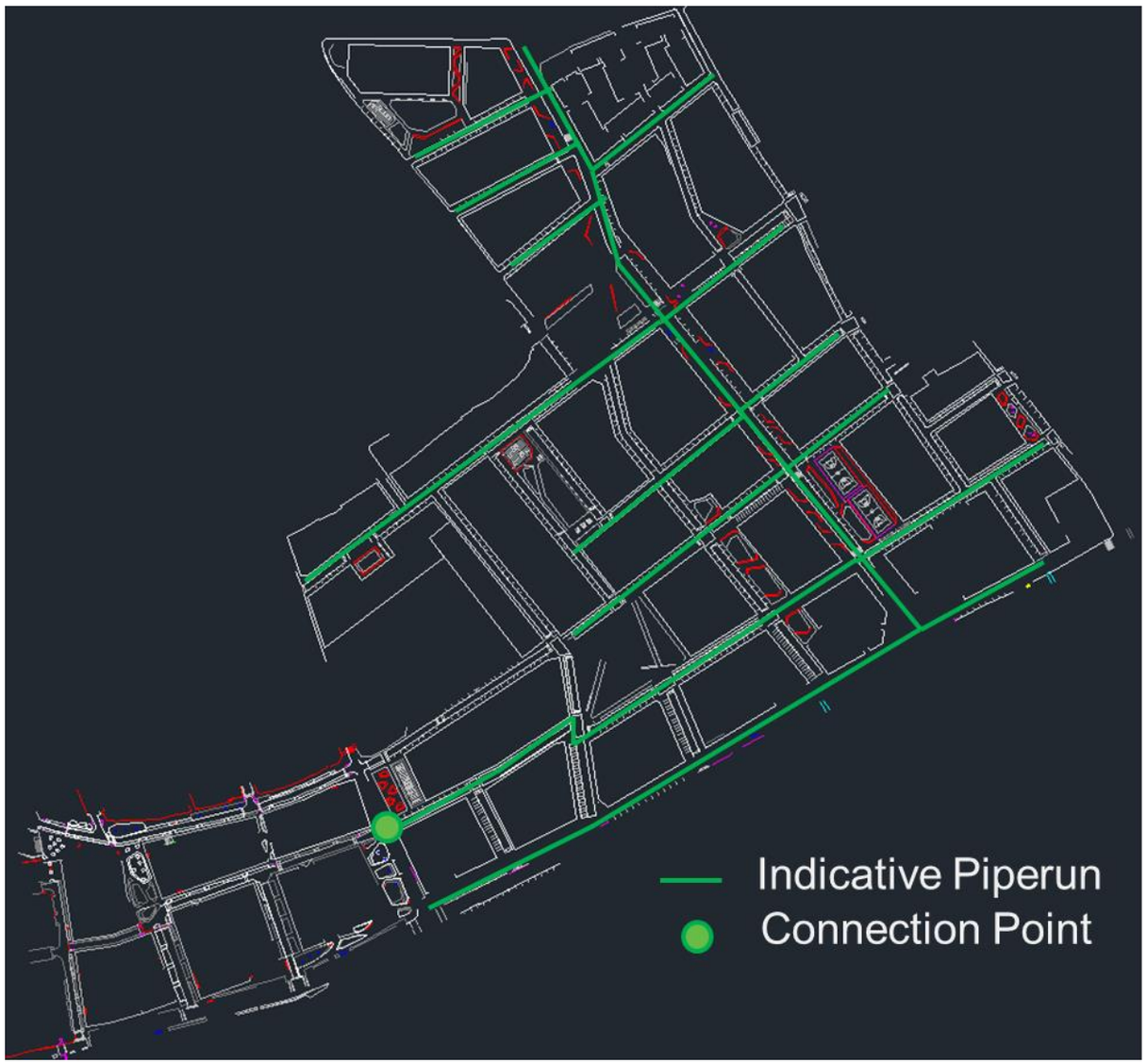
Appendix D

Indicative Location of Energy Centre and PRS



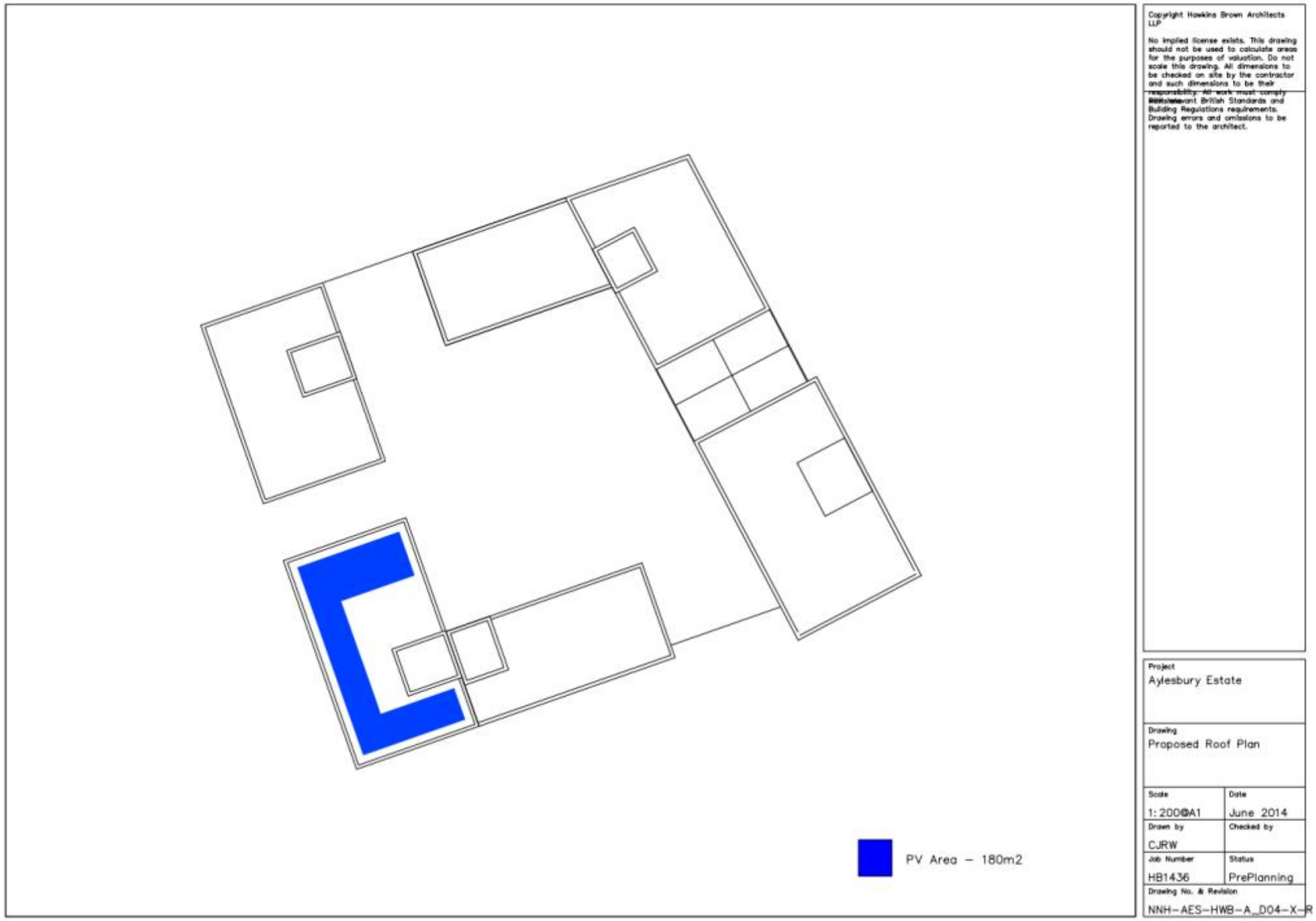
Appendix D

Indicative pipe runs ,Masterplan



Appendix E

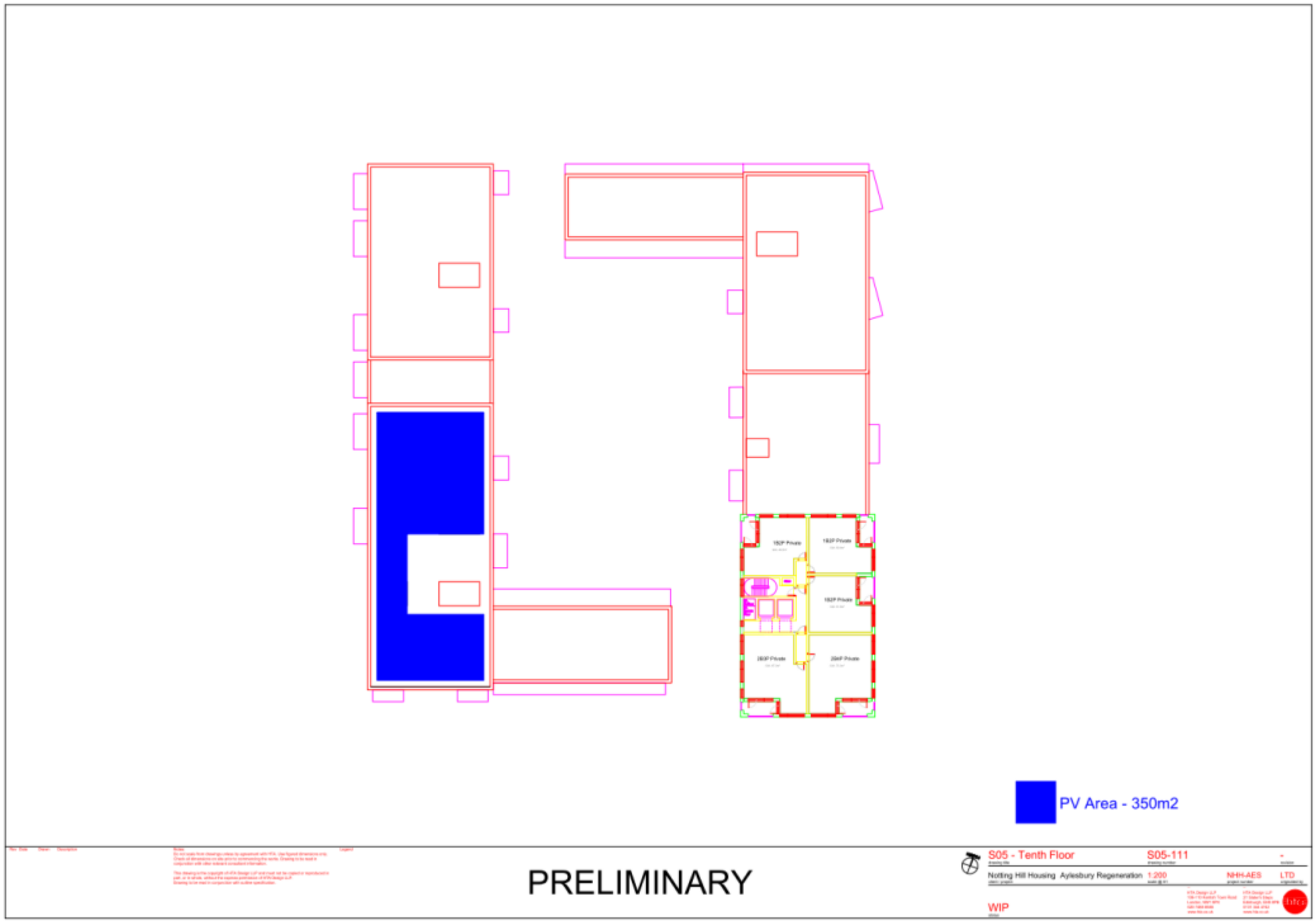
PV Area – Block 4 – 180m^2



Project	Aylesbury Estate
Drawing	Proposed Roof Plan
Scale	1: 200@A1
Date	June 2014
Drawn by	CJRW
Checked by	
Job Number	HB1436
Status	PrePlanning
Drawing No. & Revision	NNH-AES-HWB-A_D04-X-R

Appendix E

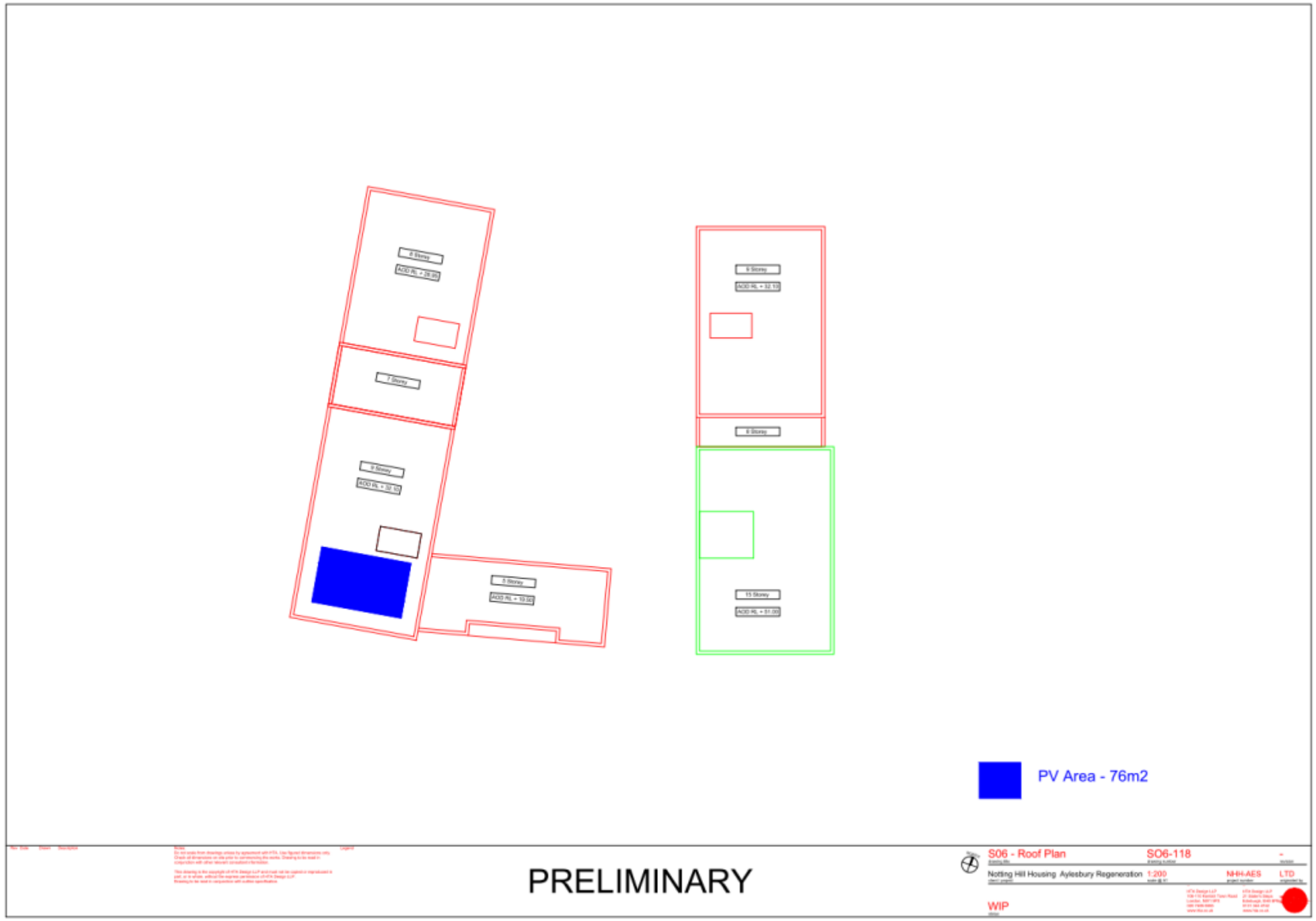
PV Area – Block 5 – 350m^2



WSP

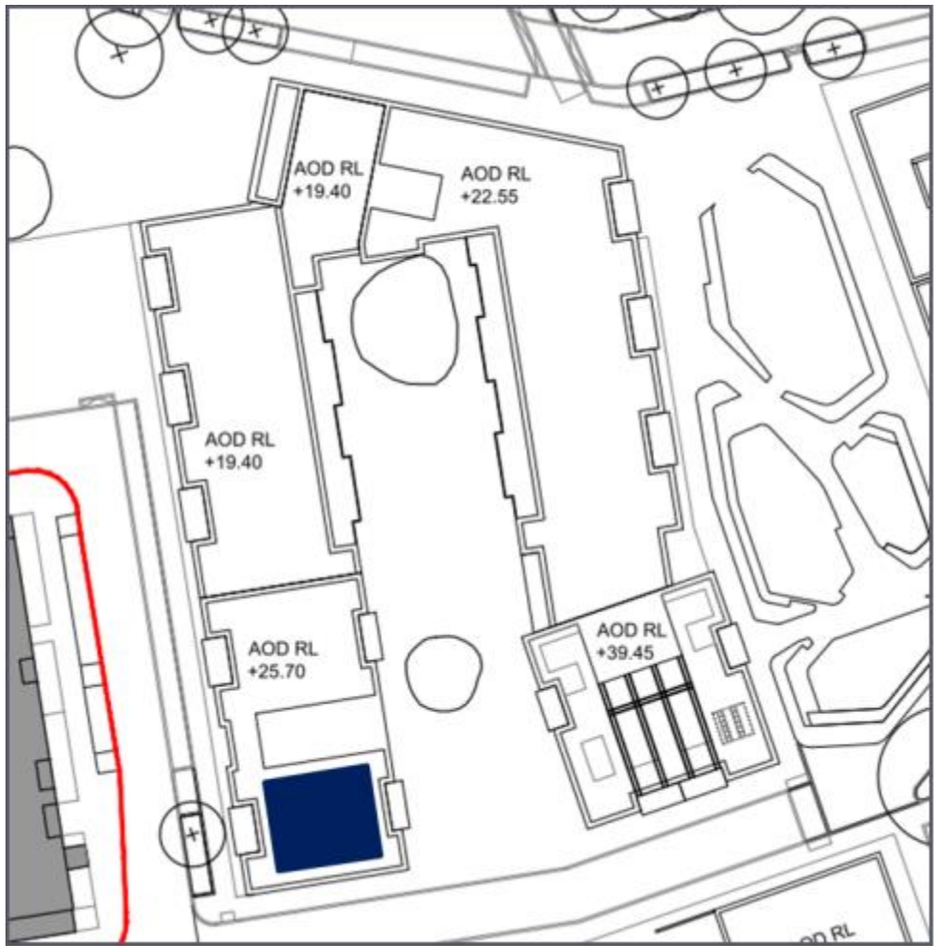
Appendix E

PV Area – Block 6 – 76m^2



Appendix E

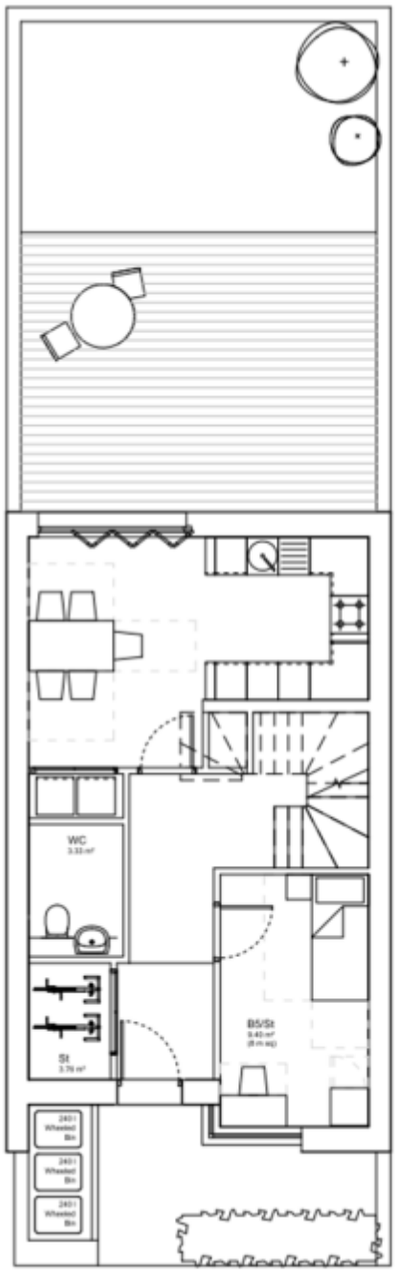
PV Area – Block 1 – 90m^2

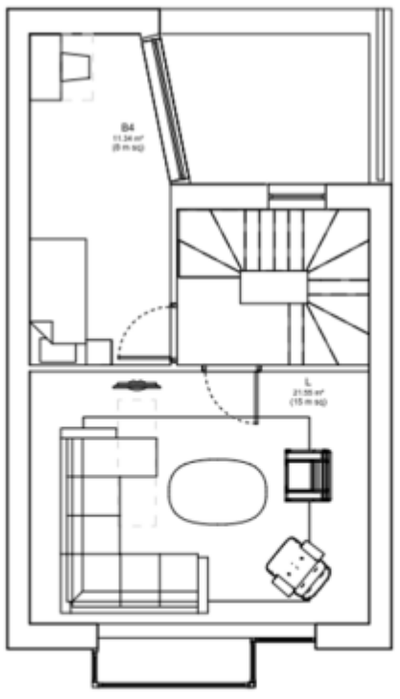


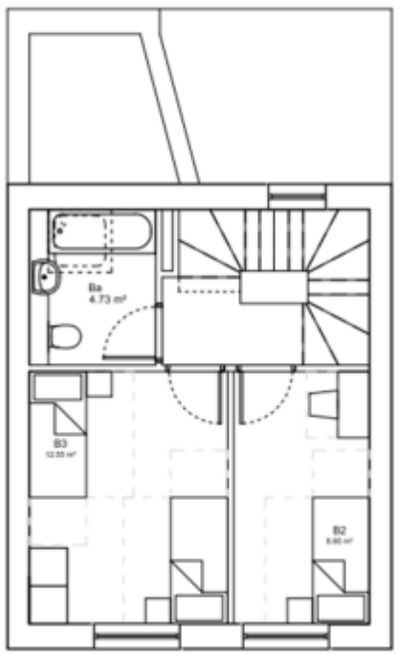
PV-area

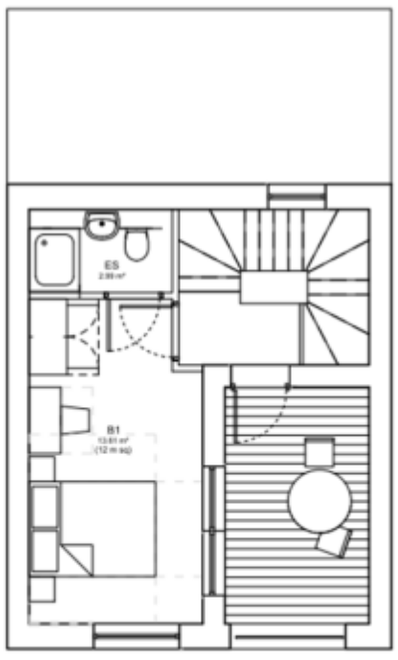
Appendix F

Layouts



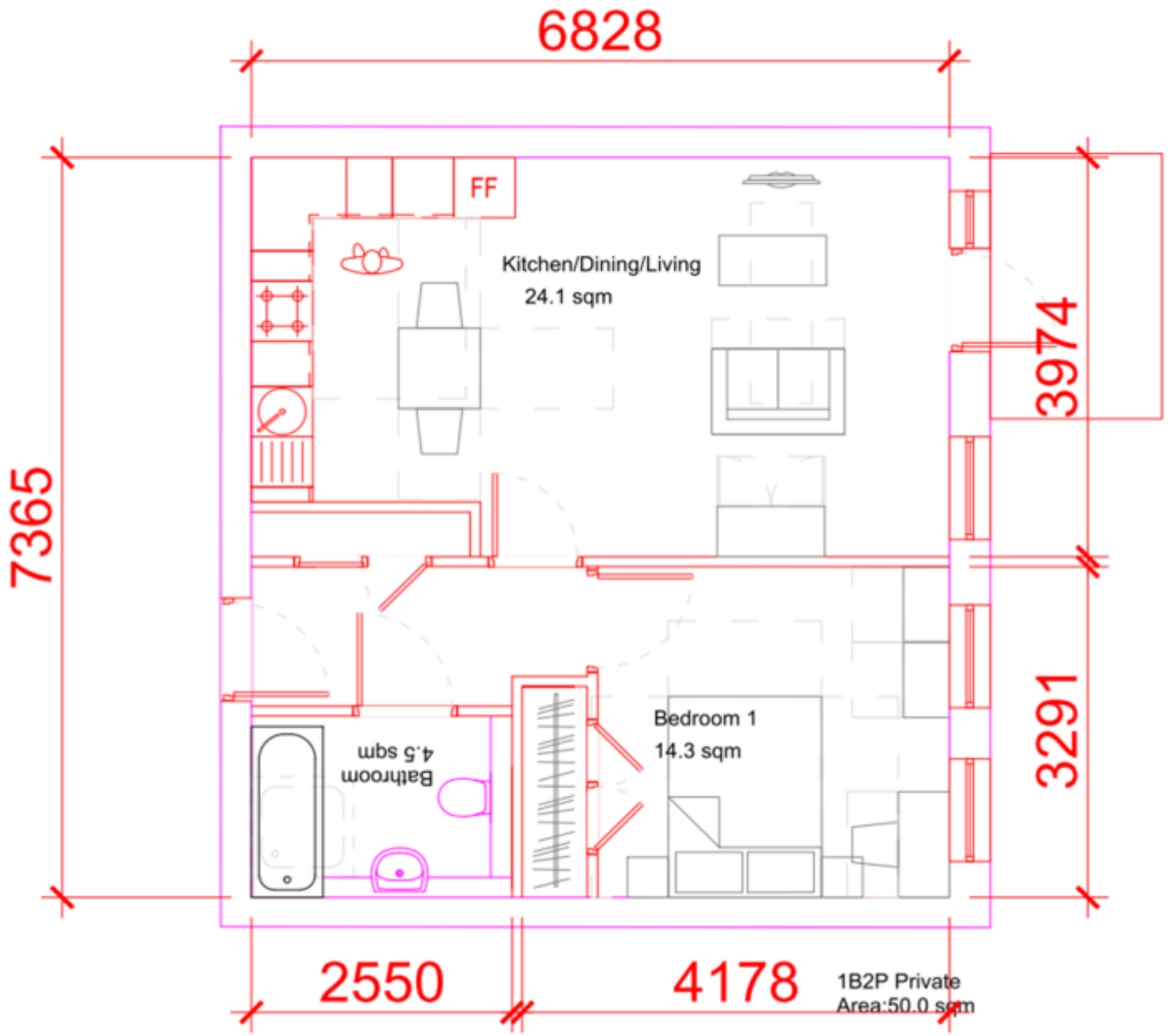






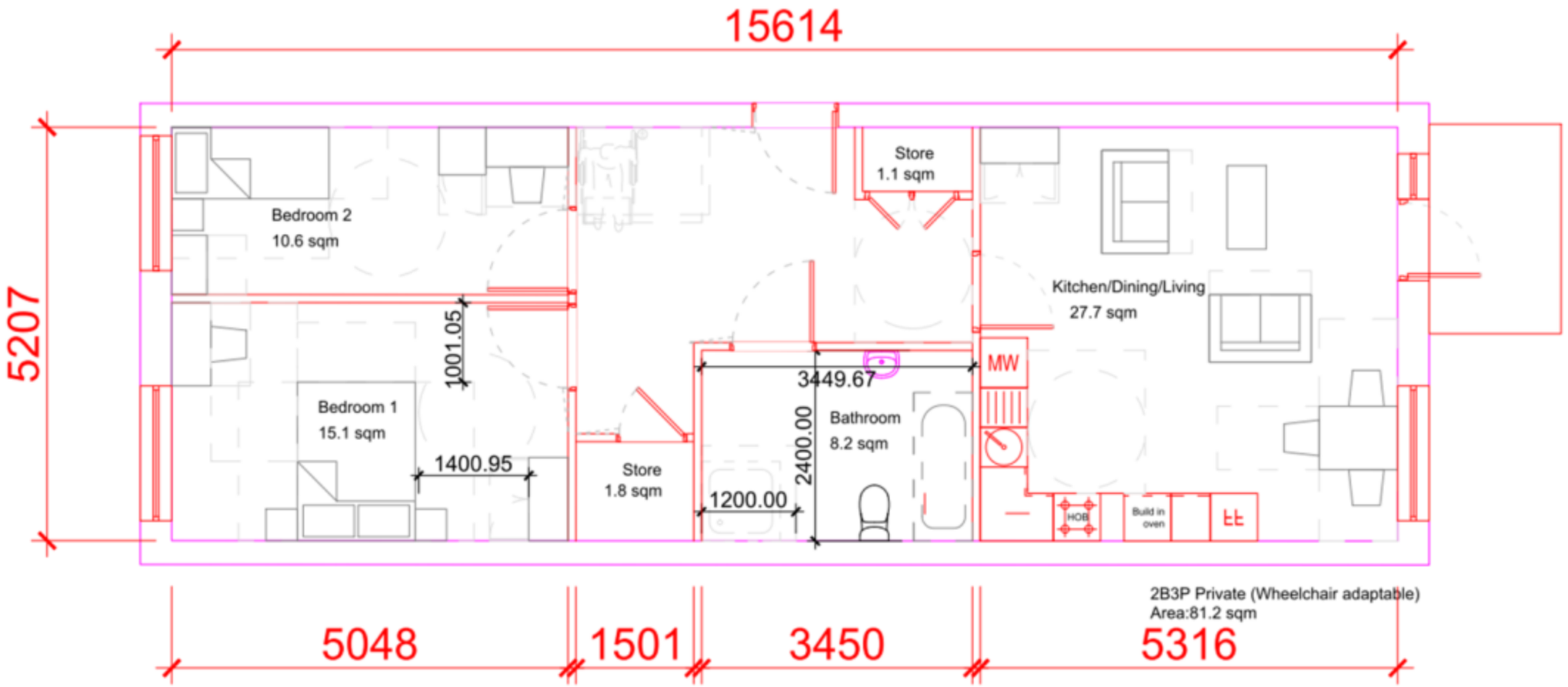
Appendix F

Layouts



Appendix F

Layouts



Appendix G – Financial Model for Detailed Application (FDS) Servicing Strategies

The model uses some simplifying assumptions, such as assuming that each solution can be applied from year 1 and one replacement of CHP or gas boilers during the 30 year period. This simplification favours district heating and connection to SELCHP as in each of these instances interim investment will be required in the form of temporary plant.

Model

CHP + Boilers + DHN	Build Phase	2014	2015	2016	2017	2018	2019	2020	2021	2022	2044
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
CHP/Boiler Capital Cost (£)	£ 1,243,500	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 33,262	33928	34606	35298	36004	36724	37459	38208	38972	60250
Fuel Cost (£)	0	217207	219118	221046	222992	224954	226934	228931	230945	232978	282505
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	105002	106787	108603	110449	112327	114236	116178	118153	120162	174112
Cash Flow	-1243500	-145466.76	-146258.38	-147049.79	-147840.87	-148631.53	-149421.66	-150211.14	-150999.88	-151787.75	-168643.19
Cumulative Cash Flow (£)	-1243500	-1388966.76	-1535225	-1682275	-1830116	-1978747	-2128169	-2278380	-2429380	-2581168	-7359996

Gas Boilers in Blocks	Build Phase	0	1	2	3	4	5	6	7	8	30
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
Boiler Capital Cost (£)	£ 135,000	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 7,506	7656	7809	7965	8125	8287	8453	8622	8794	13596
Fuel Cost (£)	0	127943	129069	130205	131351	132507	133673	134849	136036	137233	166406
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	0	0	0	0	0	0	0	0	0	0
Cash Flow	-135000	-135449	-136725	-138014	-139316	-140631	-141960	-143302	-144658	-146027	-180002
Cumulative Cash Flow (£)	-135000	-270449	-407174	-545189	-684505	-825136	-967096	-1110398	-1255055	-1401083	-5125297

SELCHP connection	Build Phase	0	1	2	3	4	5	6	7	8	30
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
Boiler Capital Cost (£)	£ 6,101,000	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 5,725	5840	5957	6076	6197	6321	6448	6577	6708	10371
Fuel Cost (£)	0	251566	253779	256013	258266	260538	262831	265144	267477	269831	327193
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	0	0	0	0	0	0	0	0	0	0
Cash Flow	-6101000	-257291	-259619	-261969	-264341	-266736	-269152	-271592	-274054	-276539	-337563
Cumulative Cash Flow (£)	-6101000	-6358291	-6617910	-6879879	-7144221	-7410956	-7680109	-7951700	-8225754	-8502293	-15264805

Summary

		Capex (exc. HIUs)	Opex	Fuel Costs	30 year cost	30 year cost inc. inflation
Option 1	**CHP/boilers - DHN**	£ 1,243,500	£ 33,262	£ 112,204	£ 5,607,503	**-£ 7,359,996**
Option 2	**Individual block boiler**	£ 135,000	£ 7,506	£ 127,943	£ 4,198,475	**-£ 5,125,297**
Option 3	**SELCHP connection**	£ 6,101,000	£ 5,725	£ 251,566	£13,819,728	**-£15,264,805**

Factors in Analysis

FDS Thermal demand (annual MWh)		3753	from Modelling
Lifespan of model (yrs)		30	GLA guidance
Cost of gas (£ per MWh)	£	30.00	Estimate
Cost of elec. Exported	£	55.00	Estimate
Cost of elec. (£ per MWh)	£	90.00	Estimate
Cost heat SELCHP (per MWh	£	41.89	VESS proposal Southwark
% thermal demand from CHP+boiler		65%	Modelling
CHP thermal efficiency		46%	Hoval
CHP electrical efficiency		36%	Hoval
Gas boiler efficiency		88%	Realistic
Gas consumption for CHP+boiler (MWh)		7240	network losses added here
Electrical saving from CHP (MWh		1909	Electricity exported at Wholesale
Gas consumption boiler only (MWh)		4265	
Thermal demand from SELCHP (MWh)		6005	Taking into losses on network
Gas cost for CHP	£	217,207	
Electrical cost saving from CHP	£	171,822	
Gas cost boiler only	£	127,943	
Cost of SELCHP heat	£	251,566	
Distance by road to SELCHP (m)		3700	
CHP cost (£ per kWe)	£	800	DECC
Gas boiler cost (£ per kW)	£	45	DECC via Poyry
Gas CHP size (kW)		500	
Gas boiler size (kW with CHP)		2,500	
Gas boiler size (kW alone)		3,000	
Capex CHP	£	400,000	
Capex gas boiler (with CHP)	£	112,500	
Capex gas boiler (alone)	£	135,000	
Lost flat space for energy centre (£)		£550,000	165m^2-50m^2 for gas boiler only
Cost of DHN (£ per m) internal site	£	500	Lowest DECC estimate
Total cost internal DHN	£	181,000	
DHN thermal losses W per m		38.67	Logstor calculation
Length of internal DHN (m)	£	362	Drawing - each way losses
Internal DHN thermal losses		6.54%	Pipe losses at 22W/m
Cost of DHN (£ per m) to SELCHP	£	1,600	Average of Pimlico DHU email
Total Cost of DHN to SELCHP	£	5,920,000	
External DHN % losses per annum		33.4%	Logstor Calculator
Gas boiler O&M (per MWh)	£	2.00	DECC via Poyry
CHP O&M (per MWh)	£	6.00	DECC
Internal DHN Pumping	£	15,999	Calculation
External DHN Pumping	£	5,725	Calculation
Investment Lifetime		30	
Inflation >RPI (O&M Costs)		2.00%	
Inflation (Electricity)		1.70%	
Inflation (Gas)		0.88%	

WSP

Appendix G – Financial Model for Outline Application (Whole Site) Servicing Strategies

The model uses some simplifying assumptions, such as assuming that each solution can be applied from year 1 and one replacement of CHP or gas boilers during the 30 year period. This simplification favours district heating and connection to SELCHP as in each of these instances interim investment will be required in the form of temporary plant.

Model

CHP + Boilers + DHN	Build Phase	2014	2015	2016	2017	2018	2019	2020	2021	2022	2044
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
CHP/Boiler Capital Cost (£)	£ 1,243,500	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 33,262	33928	34606	35298	36004	36724	37459	38208	38972	60250
Fuel Cost (£)	0	217207	219118	221046	222992	224954	226934	228931	230945	232978	282505
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	105002	106787	108603	110449	112327	114236	116178	118153	120162	174112
Cash Flow	-1243500	-145466.76	-146258.38	-147049.79	-147840.87	-148631.53	-149421.66	-150211.14	-150999.88	-151787.75	-168643.19
Cumulative Cash Flow (£)	-1243500	-1388966.76	-1535225	-1682275	-1830116	-1978747	-2128169	-2278380	-2429380	-2581168	-7359996

Gas Boilers in Blocks	Build Phase	0	1	2	3	4	5	6	7	8	30
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
Boiler Capital Cost (£)	£ 135,000	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 7,506	7656	7809	7965	8125	8287	8453	8622	8794	13596
Fuel Cost (£)	0	127943	129069	130205	131351	132507	133673	134849	136036	137233	166406
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	0	0	0	0	0	0	0	0	0	0
Cash Flow	-135000	-135449	-136725	-138014	-139316	-140631	-141960	-143302	-144658	-146027	-180002
Cumulative Cash Flow (£)	-135000	-270449	-407174	-545189	-684505	-825136	-967096	-1110398	-1255055	-1401083	-5125297

SELCHP connection	Build Phase	0	1	2	3	4	5	6	7	8	30
	0	1	2	3	4	5	6	7	8	9	31
Capital Costs											
Boiler Capital Cost (£)	£ 6,101,000	0	0	0	0	0	0	0	0	0	0
O&M (£)	0	£ 5,725	5840	5957	6076	6197	6321	6448	6577	6708	10371
Fuel Cost (£)	0	251566	253779	256013	258266	260538	262831	265144	267477	269831	327193
Income											
Electricity Price (p/kWh)		5.50	5.59	6.50	6.61	7.50	7.63	8.50	8.64	9.50	20.50
Electricity Abated (£)	0	0	0	0	0	0	0	0	0	0	0
Cash Flow	-6101000	-257291	-259619	-261969	-264341	-266736	-269152	-271592	-274054	-276539	-337563
Cumulative Cash Flow (£)	-6101000	-6358291	-6617910	-6879879	-7144221	-7410956	-7680109	-7951700	-8225754	-8502293	-15264805

Summary

		Capex (exc. HIUs)	Opex	Fuel Costs	30 year cost	30 year cost inc. inflation
Option 1	**CHP/boilers - DHN**	£ 4,055,000	£ 33,262	£ 399,550	£17,039,377	**-£21,778,576**
Option 2	**Individual block boiler**	£ 540,000	£ 7,506	£ 473,898	£14,982,112	**-£18,203,743**
Option 3	**SELCHP connection**	£ 6,825,000	£ 5,725	£ 668,314	£27,046,178	**-£30,767,781**

Factors in Analysis

Overall Thermal Demand (Annual MWh)		13,901	from Modelling
Lifespan of model (yrs)		30	GLA guidance
Cost of gas (£ per MWh)	£	30.00	Estimate
Cost of elec. Exported	£	55.00	Estimate
Cost of elec. (£ per MWh)	£	90.00	Estimate
Cost heat SELCHP (per MWh	£	41.89	VESS proposal Southwark
% thermal demand from CHP+boiler		65%	Modelling
CHP thermal efficiency		46%	Hoval
CHP electrical efficiency		36%	Hoval
Gas boiler efficiency		88%	Realistic
Gas consumption for CHP+boiler (MWh)		26283	network losses added here
Electrical saving from CHP (MWh)		7071	Electricity exported at Wholesale
Gas consumption boiler only (MWh)		15797	
Thermal demand from SELCHP (MWh)		15954	Taking into losses on network
Gas cost for CHP	£	788,476	
Electrical cost saving from CHP	£	636,424	
Gas cost boiler only	£	473,898	
Cost of SELCHP heat	£	668,314	
Distance by road to SELCHP (m)		3700	m
CHP cost (£ per kWe)		800	DECC
Gas boiler cost (£ per kW)	£	45	DECC via Poyry
Gas CHP size (kWe)		2,000	
Gas boiler size (kW with CHP)		10,000	
Gas boiler size (kW alone)		12,000	
Capex CHP	£	1,600,000	
Capex gas boiler (with CHP)	£	450,000	
Capex gas boiler (alone)	£	540,000	
Lost flat space for energy centre (£)		£1,100,000	330m^2-100m^2 for gas boiler only
Cost of DHN (£ per m) internal site	£	500	Lowest DECC estimate
Total cost internal DHN	£	905,000	Based on 5 times FDS
DHN thermal losses (W per m)		38.67	Logstor calculation
Length of internal DHN (m)	£	1,810	Based on FDS X 5
Internal DHN thermal losses		4.41%	Pipe spec. 22W/m
Cost of DHN (£ per m) to SELCHP	£	1,600	Average of Pimlico DHU email
Total Cost of DHN to SELCHP	£	5,920,000	
External DHN % losses per annum		9.0%	Logstor Calculator
Gas boiler O&M (per MWh)	£	2.00	DECC via Poyry
CHP O&M (per MWh)	£	6.00	DECC
Internal DHN Pumping	£	15,999	Calculation
External DHN Pumping	£	5,725	Calculation
Investment Lifetime		30	
Inflation >RPI (O&M Costs)		2.00%	
Inflation (Electricity)		1.70%	
Inflation (Gas)		0.88%	

WSP

Appendix H

SAP – Detailed & Outline

SAP Worksheet
Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	mr justin kilduff	Assessor number	1
Client		Last modified	13/08/2014
Address	1 1 1, London		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		55.08 (1a)	x	2.70 (2a)	=	148.72	(3a)
+1		33.08 (1b)	x	2.70 (2b)	=	89.32	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	88.16 (4)					
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =		238.03	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)	
Number of open flues	0	x 20 =	0	(6b)	
Number of intermittent fans	0	x 10 =	0	(7a)	
Number of passive vents	0	x 10 =	0	(7b)	
Number of flueless gas fires	0	x 40 =	0	(7c)	

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0 ÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

SBEM - Outline

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red

2.a Building fabric

Element	$U_{a\text{-Limit}}$	$U_{a\text{-Calc}}$	$U_{i\text{-Calc}}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	FF000000_W1_-1
Floor	0.25	0.22	0.22	FF000000_F_-1
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	FF000000_W1-W0
Personnel doors	2.2	2.2	2.2	FF000000_W1-W1
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-Limit}}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-Calc}}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-Calc}}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	10

2.b Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Fan Coil Units n CHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	4.5	-	1.8	0.6
Standard value	0.91*	N/A	N/A	1.6	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

WSP