reside.

Land west of Fontwell Avenue, Eastergate

Sustainability Statement

i | Table of Contents

1 | EXECUTIVE SUMMARY 1

2 | INTRODUCTION 3

3 | THE PROPOSAL 5

4 | PLANNING AND REGULATORY CONTEXT 7

5 | SUSTAINABILITY STATEMENT 11

6 | ENERGY STRATEGY 17

7 | CONCLUSION 23

APPENDIX A1 | SITE LOCATION PLAN 25

APPENDIX A2 | WATER USAGE CALCULATOR 27

APPENDIX A3 | DER/TER WORKSHEETS 29

APPENDIX A4 | GENERAL NOTES 37

ARUN DISTRICT COUNCIL BN/50/20/PL

Section 1

Executive Summary.

1 | Executive Summary

1.1 Iceni Projects Ltd was commissioned by Reside Developments Ltd to produce a Sustainability Statement for the proposed development of the Land to the west of Fontwell Avenue, Eastgate, West Sussex.

1.2 This application proposes the development of the site to provide 42 residential dwellings, of which approximately 30% will be provided as Affordable Homes, together with access, parking, landscaping and other associated works.

1.3 Sustainability is a core consideration of the application and has been considered from the outset. Resource and water efficiency have been maximised, whilst the production of waste and pollution is to be minimised, thus ensuring the impact of the proposal on its immediate surroundings and the environment as a whole is minimised.

1.4 Consideration has been given to the Arun Local Plan in the formulation of this strategy, aiming to minimise the environmental impact of the proposed development during construction and operation, and to ensure the development is constructed to rigorous sustainability standards.

1.5 The proposed strategy has been based around the objectives of the Arun Local Plan, particularly Policy D DM1. In summary, based on this strategy, the proposed development:

- Will promote walking and cycling, and deter private car ownership;
- Will minimise internal water consumption to 105 litres per person per day;
- Will incorporate measures to maintain and improve site biodiversity, including retaining the existing boundary vegetation and including biodiverse planting;
- Will reduce surface water runoff rates through the use of sustainable drainage measures, including permeable paving, soakaways, and an infiltration basin;
- Will minimise energy demand through the specification of low U-values, low air permeability and low thermal bridging to reduce heat loss; and
- Will utilise air source heat pump (ASHP) technology to serve the space and water heating demands of the proposed dwellings.

1.6 By designing to rigorous energy standards and employing ASHP technology to serve the space and water heating demands of the proposed dwellings, the application will respond directly to the standards set out by Arun District Council. These measures combine to provide a minimum carbon dioxide emissions saving of 13.7%, compared to the Part L:2013 baseline, exceeding the Arun District Council requirements through on-site means alone.

1.7 Overall, the proposals constitute sustainable development in accordance with national and local policy requirements, and will provide a development that seeks to promote these principles in operation.

ARUN DISTRICT COUNCIL BN/50/20/PL

Section 2

Introduction.

2 | Introduction

2.1 Iceni Projects have been commissioned by Reside Developments Ltd to produce a combined Sustainability and Energy Statement for the proposed residential development on the Land west of Fontwell Avenue, Eastergate, West Sussex.

2.2 The application site occupies an area of 1.55 hectares and is located west of the village of Walberton in West Sussex. The site is a flat, greenfield site that is currently in agricultural use and is well screened by trees and hedgerows.

2.3 Fontwell Racecourse is located immediately to the north of the proposed site, whilst a former equestrian centre, Northfields Cottage, is situated to the south. Fontwell Avenue forms the eastern boundary of the site, beyond which lies a stretch of predominantly large, 20th Century detached dwellings running in the north and south direction. To the west of the site is the Northfields Country House and its associated grounds.

2.4 This document details the sustainable design and construction measures adopted by the proposed development and gives an overview of the design proposals that will ensure the development operates in a sustainable manner over the lifespan of the scheme. The Sustainability Statement report headlines will provide a framework for the project team to operate consistently within sustainability guidelines set out by Arun District Council.

2.5 The report is structured to meet these guidelines as follows:

- Section 3 summaries the proposals;
- Section 4 discusses the planning context and policies which are relevant to sustainability;
- Section 5 discusses the development response to the policy drivers for sustainability;
- Section 6 discusses the development response to the policy drivers for energy; and
- Section 7 summarises the development's design response.



Figure 2.1 Aerial view of the site, marked in red

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Section 3

The Proposal.

3 | The Proposal

3.1 The description of development is as follows:

Full planning application for the erection of 42 no. dwellings with access, parking, landscaping and associated works.

3.2 The scheme comprises the following mix of residential dwellings:

- 4 no. 1-bedroom apartments
- 12 no. 2-bedroom houses
- 22 no. 3-bedroom houses
- 4 no. 4-bedroom houses

3.3 Example site sections are shown in Figures 3.1 and 3.2, whilst the illustrative masterplan is shown to the right in Figure 3.3. The site location plan is provided in Appendix A1.

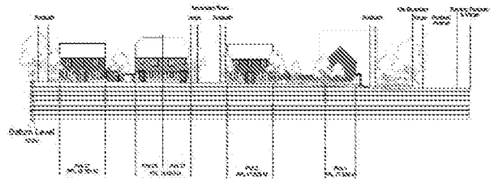


Figure 3.1 Example Site Section (North)

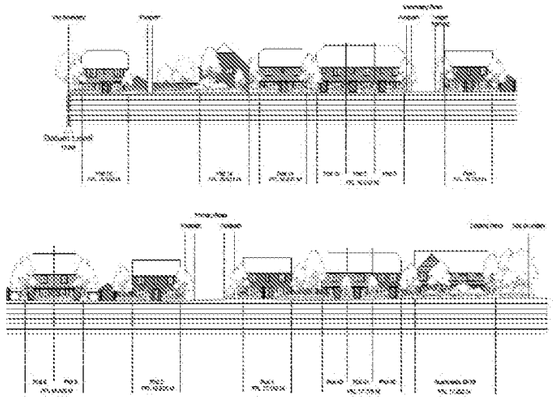


Figure 3.2 Example Site Sections (East)

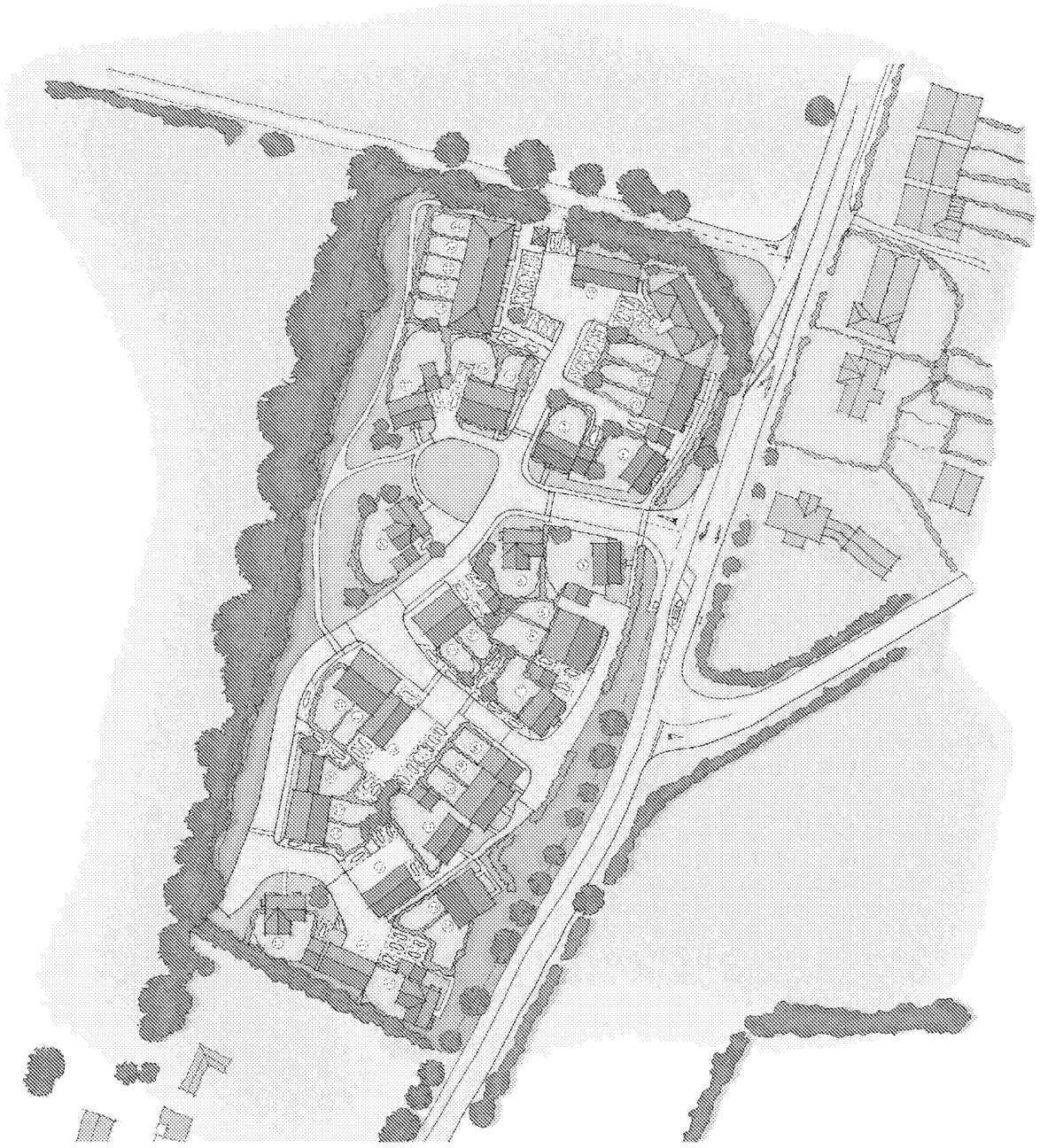


Figure 3.3 Illustrative Masterplan

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Section 4

Planning and Regulatory Context.

4.1 Sustainable development approaches are incorporated within policy and regulation at national and local levels, as set out within this section.

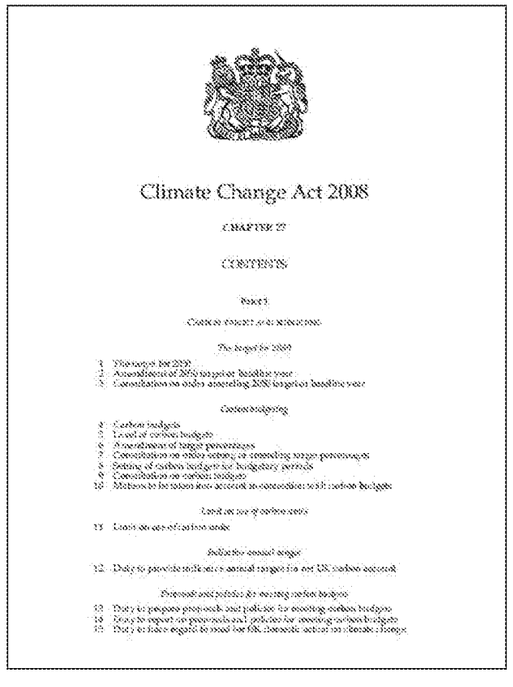
NATIONAL

Climate Change Act 2008

4.2 On 26th November 2008, the UK Government published the Climate Change Act 2008; the world's first long-term legally binding framework to mitigate against climate change. Within this framework, the Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target set out in the Energy White Paper, to 80% by 2050.

4.3 As required under Section 34 of the Climate Change Act, the Fifth Annual Carbon Budget was accepted by the Government in June 2016. This sets out a budget for UK emissions for the period 2028-2032.

4.4 Following a commitment in June 2019, the Climate Change Act has been amended to target net zero emissions by 2050.



Climate Change Act 2008

CHAPTER 27

CONTENTS

PART 1

CARBON TARGET AND REDUCTIONS

The target for 2050

1 The target for 2050
2 Amendment of 2050 target: baseline year
3 Consultation on orders amending 2050 target or baseline year

Carbon budgeting

4 Carbon budgets
5 Level of carbon budgets
6 Amendment of target percentages
7 Consultation on orders setting or amending target percentages
8 Setting of carbon budgets: supplementary provision
9 Consultation on carbon budgets
10 Matters to be taken into account in connection with carbon budgets

Credit for use of carbon units

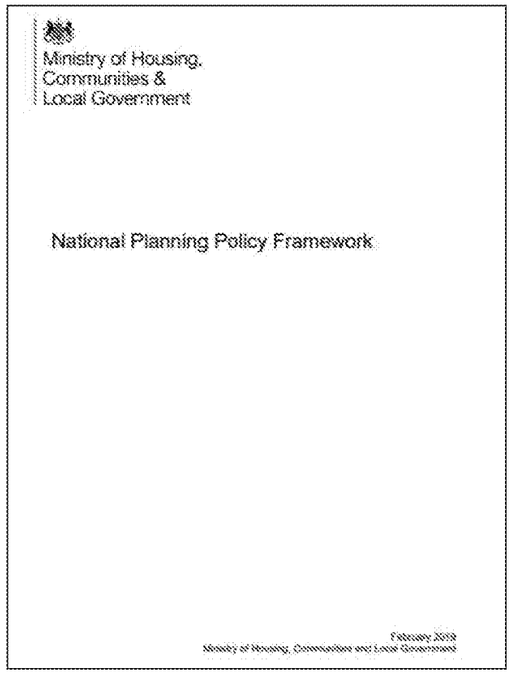
11 Credit for use of carbon units

Reduction annual target

12 Duty to provide reduction annual target for net UK carbon account

Proposals and policies for meeting carbon budgets

13 Duty to prepare proposals and policies for meeting carbon budgets
14 Duty to report on proposals and policies for meeting carbon budgets
15 Duty to have regard to need for UK domestic action to climate change



Ministry of Housing, Communities & Local Government

National Planning Policy Framework

February 2019

Ministry of Housing, Communities and Local Government

National Planning Policy Framework (February 2019)

4.5 The Department for Communities and Local Government determines national policies on different aspects of planing and the rules that govern the operation of the system. Accordingly, the National Planning Policy Framework (NPPF), which came into force in March 2012 and was updated in February 2019, aims to strengthen local decision making.

4.6 Paragraph 10 of the NPPF confirms that at the heart of this document is a *"presumption in favour of sustainable development"*, and that development proposals that accord with an up-to-date development plan should be approved without delay.

4.7 Paragraph 7 states that the purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

4.8 Achieving sustainable development means that the planning system has three overarching activities, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- **An Economic Role** - ensuring the provision of land and infrastructure needed to help build a *strong, responsive and competitive economy.*
- **A Social Role** - supplying the required amount of housing while at the same time ensuring and building *strong, vibrant and healthy communities.* Ensuring that the built environment is sited around accessible local services which help support a community's *health, social and cultural well-being.*
- **An Environmental Role** - ensuring development contributes to the protection and enhancement of the *natural, built and historic environment* through the improvement of biodiversity, minimising the use of natural resources and production of pollution / waste, and guaranteeing sufficient adaptation to climate change.

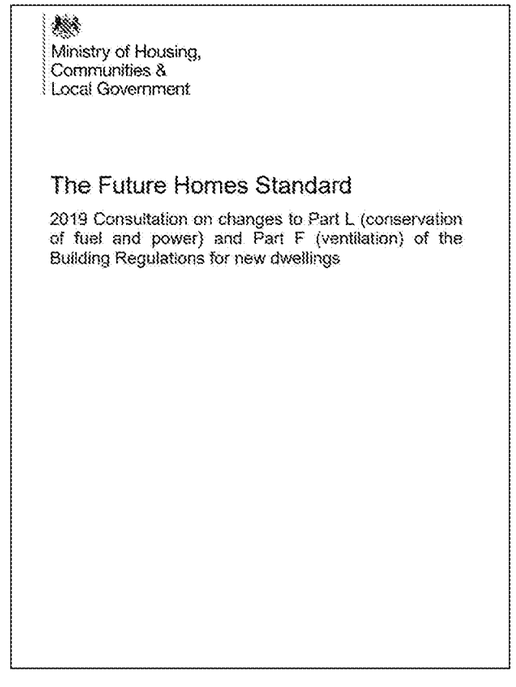
National Planning Practice Guidance

- **Climate Change** - advises how planning can identify suitable mitigation and adaptation measures in plan-making and the application process to address the potential for climate change.
- **Design** - design impacts on how people interact with places and can affect a range of economic, social and environmental objectives. The guidance states that planning policies and decisions should seek to ensure that the physical environment supports these objectives.
- **Natural Environment** - explains key issues in implementing policy to protect biodiversity, including local requirements.
- **Renewable and Low Carbon Energy** - the guidance is intended to assist local councils in developing policies for renewable energy in local plans, and identifies the planning considerations for a range of renewable sources.

Future Homes Standard 2025 (March 2019)

4.9 Within the Spring Statement 2019, The Chancellor announced the future introduction of the Future Homes Standard 2025. The Standard will mandate the end of fossil fuel heating systems in new homes from 2025 and target "world-leading levels of energy efficiency". In doing this, the Standard aims to utilise green technology to reduce environmental impacts, as well as reducing consumer energy bills.

4.10 This Standard is expected to build on the Prime Minister's Clean Growth Grand Challenge mission, which aims to at least halve the energy usage of new build properties by 2030. It also looks to halve the costs of renovating existing buildings to achieve a similar standard of energy efficiency as new buildings, whilst improving their quality and safety.



Ministry of Housing, Communities & Local Government

The Future Homes Standard

2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings

ARUN DISTRICT COUNCIL BN/50/20/PL

3 | Policy and Regulatory Context

LOCAL

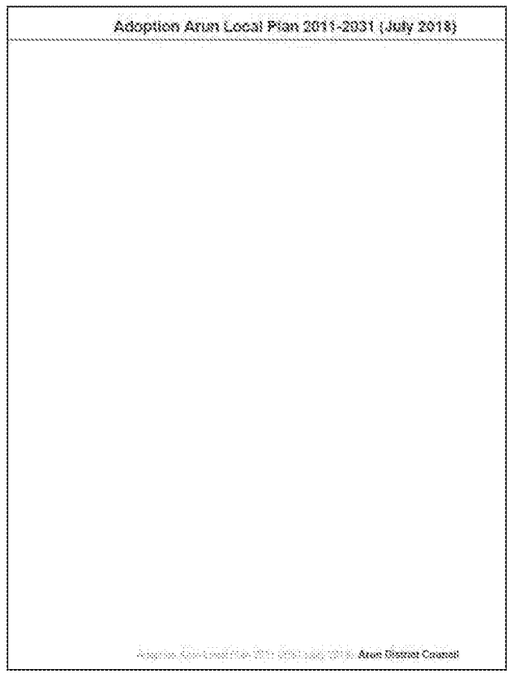
Arun Local Plan 2011-2031 (July 2018)

4.11 The Local Plan sets out the vision for the future of the District of Arun and guides development to achieve that vision. The Vision for the District is:

By 2031 Arun will be a safer, more inclusive, vibrant and attractive place to live, work and visit. Arun's residents will be healthier and better educated, with reduced inequalities between the most and least affluent.

4.12 The purpose of the Local Plan is to encourage sustainable development and manage future growth whilst ensuring that change across the District is appropriate to meet local need. The following policies are considered of great relevance to this proposal:

- **Policy SD SP1: Sustainable Development.** Introduces the Council's presumption in favour of sustainable development contained within the NPPF. The Council will work pro-actively with applicants to jointly find solutions which mean that proposals can be approved wherever possible and to secure development that will contribute to social, economic and environmental conditions.



- **Policy GI SP1: Green Infrastructure.** Requires the existing Green Infrastructure Network to be considered at an early stage of the design process for all major developments. These developments must be designed to protect, in particular from light pollution, and enhance existing Green Infrastructure assets and the connections between them.
- **Policy D DM1: Aspects of Form and Design Quality.** When considering any application for development the Council will have regard to the following aspects:

  a. Character: reflecting or improving on the character of the site and the surrounding area;

  b. Appearance/attractiveness: demonstrating a high standard of architectural principles to reflect the local area;

  c. Impact: having minimal impact to users and occupiers of nearby property and land;

  d. Innovation: embracing innovative design, new technologies and construction techniques;

  e. Adaptability: acknowledging diversity and difference;

  f. Crime prevention: providing security measure that make places feel safe;

  g. Trees and woodland: incorporating existing and new tree planting;

  h. Solar gain: maximising sunlight and passive solar energy;

  i. Public realm: providing or enhancing layouts, streets and public spaces so that they are attractive, socially inclusive, safe and adaptable;

  j. Layout - movement: utilising existing networks or improving access via a variety of integrated network to a range of locations and land uses;

  k. Layout - legibility: delivering or contributing to the ease of navigation within new or existing development schemes;

  l. Public art: incorporating public art where there is capacity to do so;

  m. Density: making efficient use of land whilst providing a mix of dwelling types and maintaining character and local distinctiveness;

  n. Scale: reflecting the character of the locality in terms of the scale of development; and

  o. Aspects of form and design quality: complying with the Arun District Council Design Guide.

- **Policy ECC SP1: Adapting to Climate Change.** States that the Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity. In order to achieve this, development must be designed to take account of the following issues:

  a. Location (in relation to flood risk and vulnerability to coastal erosion);

  b. Water efficiency;

  c. Shade, cooling, ventilation, solar gain;

  d. Connectivity to the green infrastructure network;

  e. Layout and massing;

  f. Resilience of buildings and building materials to extreme weather events; and

  g. Capacity of drainage systems and incorporation of Sustainable urban Drainage Systems (SuDS).

- **Policy ECC SP2: Energy and Climate Change Mitigation.** All new residential and commercial development will be expected to be energy efficient and to demonstrate how they will:

  a. Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;

  b. Use design and layout to promote energy efficiency; and

  c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

  All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

- **Policy ENV SP1: Natural Environment.** Arun District Council will encourage and promote the preservation, restoration and enhancement of biodiversity and the natural environment through the development process and particularly through policies for the protection of both designated and non-designated sites. Where possible it shall also promote the creation of new areas for habitats and species.
- **Policy ENV DM5: Development and Biodiversity.** Development shall, in the first instance, seek to achieve a net gain in biodiversity and protect existing habitats on site. They shall also however incorporate elements of biodiversity, including green walls, roofs, bird and bat boxes as well as landscape features minimising adverse impacts on existing habitats. Development schemes shall also be appropriately designed to facilitate the emergence of new habitats through the creation of links between habitat areas and open spaces. Together these provide a network of green spaces which serve to reconnect isolated sites and facilitate species movement.
- **Policy W SP1: Water.** Arun District Council will encourage water efficiency measures in order to protect the District's water resources and enhance the quality of the water environment which supports a range of habitats and ecosystems. Development will be encouraged to make active use of surface water as a design feature and permitted where it identifies measures to improve and enhance waterbodies, coastal habitats or provides additional flood relief.

The Council will also support development that:

a. Is appropriately located, taking account of flood risk and promotes the incorporation of appropriate mitigation measures into new development, particularly Sustainable Drainage Systems that reduces the creation and flow of surface water and improves water quality;

b. Reduces the risk to homes and places of work from flooding whilst increasing biodiversity; and

c. Delivers a range of community benefits including enhancing the quality of life and providing greater resistance to the impact of climate change.

- **Policy QE SP1: Quality of the Environment.** The Council requires that all development contributes positively to the quality of the environment and will ensure that development does not have a significantly negative impact upon residential amenity, the natural environment, or upon residential amenity, the natural environment or upon leisure and recreational activities enjoyed by residents and visitors to the District.

The location of existing industrial and commercial uses, including waste management uses, must be taken into consideration when assessing proposals for development sensitive to noise, light, odour and outputs to air. This is to ensure that land allocated for these uses are protected and to ensure that the amenity of new developments and facilities is safeguarded from the impacts of incompatible land uses.

ARUN DISTRICT COUNCIL BN/50/20/PL

Section 5

Sustainability Statement.

5 | Sustainability Statement

5.1 This Sustainability Statement for the proposed development of the Land west of Fontwell Avenue is divided into two main parts:

- The sustainable development response of the overall development has been assessed using guidance provided in Policy D DM1 of the Arun Local Plan and associated documents.
- The carbon dioxide (CO_2) emissions reduction strategy for the proposed dwelling is based on the Energy Hierarchy to provide a rigorous methodology. This strategy, which maximises cost-effective opportunities for emissions reductions, is detailed in Section 6 of this report.

5.2 An overview of the proposed sustainable design and construction features for the scheme, which address the policy requirements of the NPPF and Arun District Council's collection of policy documents, is provided within this section under the following headings:

- Reducing pollution
- Adapting to the effects of climate change
- Protecting and enhancing biodiversity
- Health and well-being
- Materials and waste

5.3 Issues relating to energy conservation and renewable follow in a dedicated section.

Reducing Pollution

Air Pollution

5.4 The proposed development does not fall within an Air Quality Management Area (AQMA), however to ensure the impact of the proposed development on local air quality is minimised, the following measures will be implemented:

- The employment of air source heat pump (ASHP) systems to serve both space and water heating demand within the dwellings will eliminate the need to burn fossil fuels on-site to provide domestic heat, and thus eliminating related pollutants; and
- The provision of footpaths throughout the development, bike spaces and measures to encourage active travel will encourage future residents to reduce their reliance on conventional petrol and diesel cars, thus reducing combustion engine-related emissions.

Noise Pollution

5.5 To ensure that intrusive levels of noise are not experienced by future residents of the proposed development, the following measures will be incorporated:

- Trees and hedgerows are to be replanted along the eastern boundary of the site which, combined with additional planting, will aid in reinforcing the vegetated buffer that is able to absorb noise pollution from the road;
- Double glazing will be employed on all dwelling facades, as well as measures to minimise air permeability. This will aid in mitigating noise break-in from the surroundings to the habitable spaces of the proposed residences; and
- Air source heat pumps (ASHP) systems that are quiet in operation will be specified, with additional acoustic measures considered as the design progresses, if necessary.

Land Contamination

5.6 The Preliminary Land Investigation Report, prepared by Soils Limited in February 2020, concludes that there is no risk of contamination on the site. However, should any contaminated soil or materials be discovered on the site, it is recommended they be quarantined,. An appropriate third-party Environmental or Engineering Consultant, as well as the Local Authority, should then be consulted to implement a suitable mitigation strategy,

Light Pollution

5.7 In order to limit the impact of the proposals in terms of light pollution,it is recommended within the Ecological Impact Assessment, provided by Lizard Landscape Design and Ecology in March 2020, that external lighting is provided in accordance with Guidance Notes 08/18 'Bats &Artificial Lighting in the UK'. This includes minimising the levels of light within the vicinity of the retained mature trees and hedgerows, as well as angling the light downwards and away from these ecological features.

Water Pollution

5.8 Although no waterbodies are located within a relevant distance of the proposed site to be impacted with respect to water pollution, the site does fall within a Special Protection Zone (SPZ)1. This indicates that the Secondary A aquifers that are present within both the underlying bedrock and superficial deposits, as illustrated in Figure 5.1, are considered as a potential source of drinking water. In order to safeguard the quality of these aquifers during the construction phase, the following measures will be implemented as part of a Construction Environmental Management Plan (CEMP):

- Use of oil separators;
- Clear marking and signage of drainage stems;
- Provision of bunding for on-site fuel or oil deliveries; and
- Provision of bunding for areas of cleaning activity,

5.9 During the operation of the development, a surface water management plan will be implemented, and the proposed sustainable drainage system will employ on-site attenuation to aid in mitigating the contamination of the underlying aquifers.

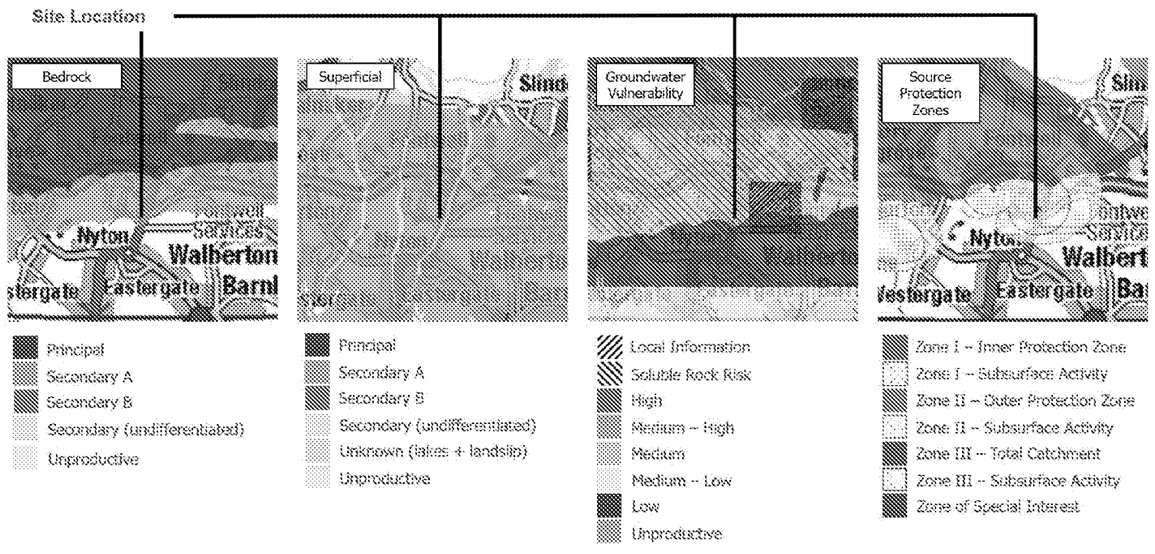


Figure 5.1 Underlying aquifers and water vulnerability

ARUN DISTRICT COUNCIL BN/50/20/PL

5 | Sustainability Statement

Adapting to the Effects of Climate Change

Conserving Water Internally

5.10 With water resources becoming increasingly scarce as the climate continues to change, internal water consumption should be as efficient as possible. The dwellings will target a maximum daily water consumption of 105 litres of water per person, based on the DCLG water efficiency calculator for residential dwellings. The full details of the water calculation are provided in Appendix A2.

5.11 The following form a basis for the residential dwellings to be provided as part of the proposals, subject to change at later, detailed design stages:

- Low volume dual-flush toilets of 6/3 litres;
- Hand wash basin with flows no higher than 5 litres/minute, and rates not exceeding 6 litres/minute for kitchen sinks;
- Baths (where fitted) with a capacity to overflow not higher than 160 litres; and,
- Showers with a flow rate of 8 litres/minute using a flow restrictor.

5.12 Whilst unlikely to be specified by the developer, to further reduce internal water consumption, it is recommended that washing machines with a water consumption no higher than 8 litres/kg, and dishwashers with a water consumption no higher than 1 litre/place setting, are selected by future residents.

Conserving Water Externally

5.13 To achieve water savings outside the home, the following measures are proposed:

- Provision of external water butts to collect rainwater for garden irrigation and other external uses; and
- The incorporation of drought-resistant planting within the landscaping scheme to reduce the volume of water required for upkeep of landscape planting throughout the development.

Reducing the Risk of Flooding

5.14 As shown in Figure 5.2, the proposed development site falls wholly in Flood Zone 1. This indicates that there is a very low risk of flooding from fluvial or tidal sources within the site boundary.

5.15 The risk of surface water flooding within the proposed development site is also shown to be very low, as displayed in Figure 5.3. However, Fontwell Avenue (A29), which forms the eastern boundary of the site, is shown to contain areas at risk of flooding from surface water sources. This risk is shown to vary from low to high, with the centre of the carriageway demonstrated to be at medium risk of flooding.

5.16 Whilst it is anticipated that the risk of surface water flooding identified on Fontwell Avenue will be contained within the road network, the use of landscaping and the integration of an effective drainage strategy is proposed to ensure surface water is managed on-site to reduce burden on the surrounding drainage infrastructure. Furthermore, the incorporation of the soft landscaping, proposed as part of the Landscape Strategy, will positively contribute to the management of the 5mm storm event, limiting runoff for the typical, everyday rainfall event.

5.17 As detailed within the Flood Risk and Drainage Assessment, prepared by Paul Basham Associates in March 2020, surface water is to be managed on-site through the employment of permeable paving, soakaways and an infiltration basin. The employment of this sustainable drainage system is anticipated to aid in the management of surface water runoff, post-development. Through managing surface water in this way, the risk of flooding within the site itself, as well as within the surrounding area, will be sufficiently mitigated.



Figure 5.2 Site-specific fluvial/tidal flood risk



Figure 5.3 Site-specific surface water flood risk

Mitigating Overheating

5.18 In order to protect the development against overheating in the future, a number of key design features have been proposed to ensure the proposals are resilient to increased temperatures which may be experienced as a result of climate change. A summary of the measures to be included to reduce the risk of overheating is provided below.

Minimisation of internal heat generation through energy efficient design

- Heat gain from lighting is kept to a minimum via an energy-efficient lighting design solution.
- The availability of natural light is maximised by optimising the light transmittance of the glass elements of the facade.
- Heat gains from equipment will be minimised through the specification of low energy systems.
- The scheme will use air source heat pumps for heating and hot water. This is a low temperature distribution system, leading to lower internal heat gains from distribution pipework.

Reduction of the amount of heat entering the building in summer

- The building façades have a limited amount of glazing to mitigate direct solar heat gain while optimising daylight penetration.

Management of the heat within the building

- The proposed dwellings will have high ceilings, promoting increased air movement and stratification, whereby warmer air rises, thus aiding to mitigate overheating.

Passive ventilation

- Openable windows on multiple aspects across all floors will provide a passive ventilation strategy that utilises cross-flows to maximise the potential for natural ventilation across the scheme.

Mechanical and active cooling

- No cooling is proposed for the scheme.

ARUN DISTRICT COUNCIL BN/50/20/PL

Protecting and Enhancing Biodiversity

Protecting Features of Ecological Importance

5.19 The Ecological Impact Assessment, prepared by Lizard Landscape Design and Ecology in March 2020, confirms that the site is formed of common, widespread habitats of low ecological value. The floral diversity identified on the site was concluded to be generally very low, with the majority of the site dominated by heavily grazed improved grassland.

5.20 There are no designated sites located within a 2km radius of the proposed development site. The South Downs Natural Park is sited approximately 1km north of the site, whilst the Eartham Pit, Boxgrove and Fairmile Bottom Sites of Specific Scientific Interest (SSSIs) are located 3.1km north west and 4.1km north east of the proposed site, respectively. Although the site is located within the Impact Risk Zone (IRZ) of Fairmile Bottom SSSI, it is considered that the proposed scheme will not have a significant adverse impact on this statutory protected site.

5.21 Two Sites of Nature Conservation (SNCIs) are sited within the locality of the proposed scheme; Fontwell Racecourse SNCI is located 0.15km north west, and Slindon Bottom SNCI is sited 1km north of the proposed site. However, as the proposed scheme will fall neither adjacent to, nor within an SNCI, it is considered unlikely that the development will have an adverse effect on these sites. This is result of the distances between the proposed site and the SNCIs, as well as the lack of direct connectivity.

5.22 The vast majority of the site is dominated by improved grassland, whilst on the northern and eastern aspects, paddock field boundaries, formed of common hawthorn hedgerow, is present. The western boundary is formed of mature beech treeline, with occasional oak, sycamore and holly trees.

5.23 The site is considered to be of negligible value to reptiles, amphibians and badgers and dormice. The mature treeline on the western boundary of the site is considered likely to provide foraging and commuting opportunities for local bat populations. These mature trees, as well as the hedgerow present on the northern and eastern boundaries of the site, are also considered likely to provide opportunities to breeding and nesting birds.

5.24 To ensure the proposed development does not adversly affect species potentially using the site, a number of mitigation, compensation and enhancement measures are proposed, as follows:

- Works during the construction phase should be undertaken in accordance with the guidance provided within 'The Control of Dust and Emissions During Construction and Demolition' SPG, published by the Greater London Authority (GLA) in 2014. This considered as best practice in minimissing the impacts on surrounding designated sites and priority habitats.
- All retained trees and hedges should be protected with tree protective fencing in accordance with BS5837:2012, and all fuel and hazardous materials should be stored at least 5m from hedge and treelines.
- The proposed Landscape Strategy, addressed below, should replace lost habitats with further areas of amenity grassland, introduce shrub areas within private gardens, and provide new native tree planting, wildflower meadow and hedgerow planting within public open spaces. This will aid in increasing the overall biodiversity value of the site.
- Linear habitat features should be replaced as soon as possible to ensure disruption to foraging and commuting bat populations is minimised.
- External lighting should be provided in accordance with Guidance Notes 08/18 'Bats & Artificial Lighting in the UK' to minimise disruption to wildlife.
- The clearance of any hedges, shrubs or trees should take place outside of the bird nesting season or,where this is not possible, with the assistance of a Suitably Qualified Ecologist.
- The provision of nesting boxes for a variety of bird species, integrated bat boxes and hedgehog-friendly gravel boards across the site will aid in supporting local wildlife populations.

Landscaping and Green Infrastructure

5.25 As part of the proposed Landscape Strategy, devised by Fabrik in March 2020, soft landscaping is to be provided across four planting groups:

1. Neighbourhood Quarter Species - This group will comprise a combination of structural shrubs, ornamental grasses and perennial species.
2. Village Green Gateway Species - This group will comprise a mixture of native wildflower, shrub and tree species. Street trees will be provided along the central "Gateway" avenue.
3. Woodland Edge Species - This group will contain woodland tree species, accompanied by an ornamental woodland under-storey, as well as wildflower and bulb mixes.
4. Green Interface Species - This group will contain a mixture of native tree and shrub species, as well as bulb and seed mixes which will aid in enhancing the ecological corridors along the associated road corridors. Planting will also be included to supplement the sustainable drainage system that is also to be provided.

5.26 The proposed Landscape Strategy is illustrated in Figure 5.4 below, with the areas to which each of the groups detailed above are to cover also highlighted.

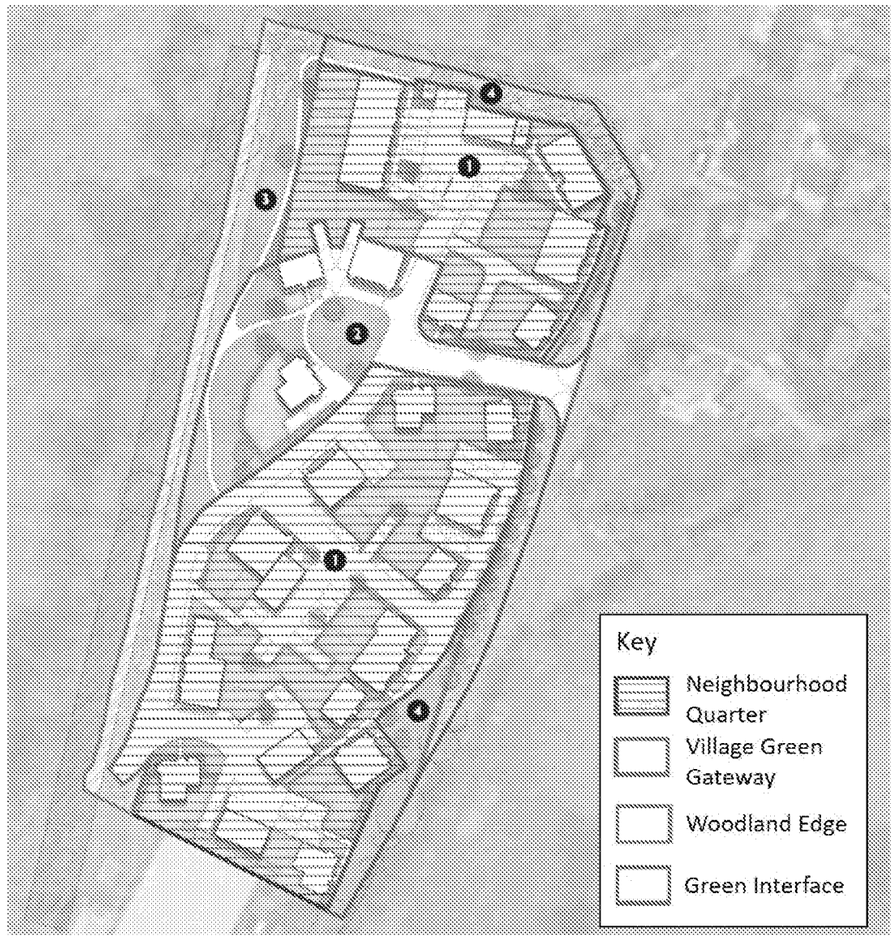


Figure 5.4 Proposed Landscape Strategy

ARUN DISTRICT COUNCIL BN/50/20/PL

5 | Sustainability Statement

Health and Well-being

Access to Nature

5.27 As part of the proposed Landscape Strategy, green infrastructure will be woven throughout the scheme. The existing vegetation at the site boundaries will be maintained and enhanced as far as possible, many of the streets will be lined with trees, a central Village Green with ornamental grass and wildflower planting will be provided, and private back gardens will be included with the majority of the proposed dwellings.

5.28 Through the provision of planting and soft landscaping in both private and public spaces across the scheme, future residents will have ample access to nature on their doorsteps. This will contribute to the health and well-being of the future residents by aiding in reducing stress and improving mental health.

Air Quality

5.29 By encouraging future residents to reduce their reliance on conventional combustion-engine vehicles, and through the elimination of gas boilers on-site, the associated pollutants, such as sulphurous oxides (SOx) and nitrous oxides (NOx), will be minimised, thus contributing to improved local air quality.

5.30 The extensive planting, planned as part of the proposed Landscape Strategy, will also contribute to the improvement of local air quality. This will be supported through the delivery of additional green infrastructure, as well as the maintenance and enhancement of the existing boundary vegetation and the woodland present to the west of the proposed development site.

Communal Space

5.31 It is proposed that a Village Green will be provided at the heart of the scheme. This central open space will provide an area within the development where community events may be held, as well as providing space for informal play.

5.32 Including a central space in this way will provide a hub for the future residents, accessible for all. This will aid in encouraging placemaking and social interaction within the community.

Daylight

5.33 Access to daylight is associated with numerous health benefits, including improved sleep and mental health.

5.34 As is demonstrated within the proposed masterplan, the dwellings will be spaced an adequate distance from one another to ensure that overshading is minimised, and the levels of natural daylight availability within the dwellings is maximised.

5.35 The proposed fenestration will be balanced to provide optimal levels of daylight, whilst also mitigating the risk of overheating.

5.36 Areas of open space, both public and private, have been configured to ensure the levels of sunlight received are sufficient for creating desirable external environments.

Encouraging Active Living

5.37 As outlined within the Transport Statement, prepared by Paul Basham Associates Ltd. in March 2020, a footway is to be provided on the sourthern side of the proposed vehicle access from Fontwell Avenue. This footway is to be connected to a crossing point on Fontwell Avenue, which will provide pedestrian access to local services and amenities.

5.38 To ensure the safety of pedestrians using Fontwell Avenue, it is proposed that tactile paving, dropped kerbs and a pedestrian refuge island will be delivered as part of the pedestrian crossing. Furthermore, in line with the current speed limit on Fontwell Avenue, it has been ensured that visibility of the road and associated traffic is sufficient from the kerbline in both directions.

5.39 A network of footpaths are to be provided throughout the development, allowing permeability through the scheme for pedestrians.

5.40 The site is also well-placed in terms of distance from local amenities and services, which are accessible both by foot and bicycle. This will help to encourage future residents to travel via active transport methods, reducing reliance on the private car, and encouraging people to be more physically active.

5.41 A Travel Plan has been prepared by Paul Basham Associates, which details how the future residents' use of safe, healthy and sustainable travel options will be encouraged. As part of this Travel Plan, it is proposed that a voucher amount of £150 will be offered to each household towards the purchase of a new bike, a bus pass, or cycle training sessions. It is anticipated that the offer of this voucher, as well as the identification of alternative modes of transport, will aid in encouarging future residents to reduce their reliance on the private car.

Security

5.42 The integration of public space throughout the development, connected by a network of footpaths, and overlooked by the proposed dwellings, will provide natural surveillance.

ARUN DISTRICT COUNCIL BN/50/20/PL

Materials and Waste

Materials

5.43 The selection of materials is determined by a variety of factors, such as the architectural context, design rationale, embodied carbon and maintenance requirements. For the proposed development, consideration will be given to the lifecycle environmental performance with materials selected in consideration of the BRE's Green Guide to Specification, aiming for A or B rated materials wherever possible.

5.44 The use of locally sourced materials will be prioritised wherever possible to reduce the impacts associated with the transportation of materials. Using materials produced in the local area will also aid in developing the identity of the development, by ensuring it is in line with the local character and context.

5.45 During detailed design of the building fabric, consideration will be given to minimising the environmental impact of materials, by selecting non-toxic and robust materials to ensure longevity and a minimal impact on the health of occupants.

5.46 Timber will be selected and purchased in consideration of sustainability certification. It is intended that all structural timber elements along with any timber used for temporary uses, such as scaffolding, will be sustainably sourced, e.g. from FSC and/or PEFC sources.

Waste

5.47 During the construction phase, the principal contractor will be required to implement a Site Waste Management Plan (SWMP) which will detail who will be responsible for resource management, what types of waste will be generated, how the waste will be managed (e.g. reduced, reused or recycled), which contractors will be used, and how the quantity of waste generated by the project will be measured.

5.48 Arun District Council currently run a weekly refuse collection, and a fortnightly recycling collection. Items currently accepted for recycling include paper and card, foil, glass bottles and jars, metal cans and aerosols, cartons, and plastic bottles and containers. Arun District Council also offers residents free visitor experience days at the Ford Materials Recycling Facility, providing an opportunity to local residents to see how their materials are being recycled.

5.49 Through their waste contractor, Biffa, the Council also runs a Green Waste Club. Members of the Club are issued with individual, dedicated green waste disposal bins that are collected fortnightly by Biffa. The green waste is then processed into compost for both domestic and agricultural use, thus diverting it from landfill and ensuring it is re-used effectively.

5.50 To encourage a greater proportion of the operational waste to be diverted from landfill, it is proposed to provide dedicated space of sufficient size and in convenient locations for all dwellings. Internal storage will be considerate of the Building Regulations, Council, and other relevant requirements.

ARUN DISTRICT COUNCIL BN/50/20/PL

Section 6

Energy Strategy.

6.1 With reference to the policy requirements, guidance and industry best practice detailed in Section 4, a comprehensive energy and carbon dioxide (CO_2) emissions assessment has been carried out for the proposed scheme. The energy performance of the scheme has been analysed and evaluated against the most up-to-date iteration of Part L of the Building Regulations and pertinent Arun District Council policies, accounting for economic, technical and functional feasibility.

6.2 The proposed energy strategy is based upon the principles of the Energy Hierarchy on the basis that it is preferable to reduce carbon dioxide emissions through reduced energy consumption above decarbonisation through alternative energy sources.

6.3 The tiers of the Energy Hierarchy are:

- Be Lean | Use less energy
- Be Clean | Supply energy efficiently
- Be Green | Use renewable energy

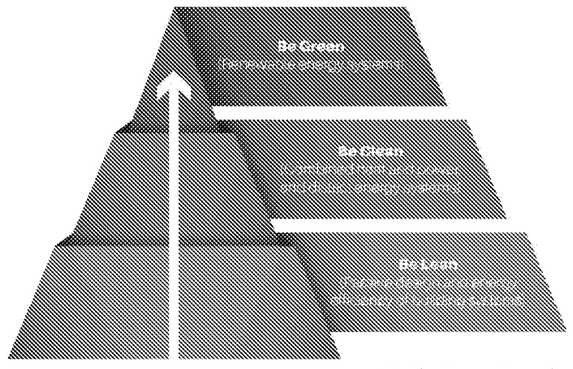


Figure 6.1 The Energy Hierarchy

6.4 Design recommendations were provided to Clague Architects, and preliminary design assessments were carried out to enable an energy strategy to develop from an early stage.

6.5 In order to maintain a degree of flexibility in meeting the 10% emissions reduction target, the measures outlined below describe a means of meeting the relevant target. Therefore, the final dwelling specification may be subject to change during detailed design.

'Be Lean' | Use Less Energy

6.6 Within the first stage of the energy hierarchy, it is proposed to incorporate high levels of passive and energy efficient design measures in order to reduce the development's energy consumption and associated CO_2 emissions.

6.7 Passive design utilises daylight, solar energy, shading and stack or wind driven ventilation to illuminate, heat, shade and, where necessary, ventilate/cool the building, thus requiring less (mechanical) energy, to achieve the performance standards for the health and well-being of the residents. This is known as a 'fabric first' approach due to the fact that design improvements to the building fabric should be the primary consideration in delivering carbon dioxide emissions.

6.8 Site characteristics relating to local climate, surroundings, scale and size of the development therefore influence the potential energy requirements and savings that can be achieved through consideration of this. The parameters that most influence the potential to utilise sunlight and solar gains are the orientation and layout of the buildings, however, these are typically influenced by factors other than energy efficiency or bioclimatic design considerations (e.g. aesthetics, function, etc.).

6.9 As shown in Figure 3.1, the dwellings proposed for the site comprise a range of orientations, driven by the layout of the masterplan to facilitate placemaking and good domestic design principles. Nonetheless, the fenestration of the proposed dwellings will provide a good balance of beneficial solar gain to offset heating demand and natural light, without the risk of overheating.

6.10 The proposed development also includes a wide range of energy efficiency measures, intended to reduce energy demand.

6.11 The following U-values are proposed as a means of limiting heat loss through the dwelling's building fabric:

Building Fabric Element	Part L1A:2013 backstop U-values (W/m²K)	Proposed U-values (W/m²K)
Ground floor	0.25	0.12
External wall	0.30	0.28
Flat roof	0.20	0.11
Sloped Roof	0.20	0.20
Window	2.00 (including frame)	1.40 (including frame)
Doors	2.00	1.00

6.12 The glazing will be double glazed, argon filled with a low emissivity coating. Although this has yet to be formally specified, it is expected that window U-values will be 1.4 W/m²K or better (including frame), with a g-value of 0.63, and light transmission of ~70% to improve natural daylight penetration.

6.13 A high level of airtightness is proposed, where a level equal to or below 5 $m^3/h/m^3$ shall be targeted, meaning that air infiltration between the internal and the external environment will be largely controlled, and space heating/cooling demand further reduced.

6.14 The other significant means of heat loss from dwellings is due to thermal (cold) bridging. This is typically a construction detail which has higher thermal conductivity than the surrounding materials, creating a path of least resistance for heat transfer. Thermal bridges result in an overall reduction in thermal resistance of the building elements and should be designed out where possible to minimise unwanted heat loss. In order to minimise heat loss through thermal bridges, accredited construction details have been assumed, with an equivalent y-value of 0.05.

6.15 High efficiency plant, equipment and controls are proposed to limit the energy consumed in order to provide the required level of indoor environmental performance and control. Performance efficiency values were tested and improved in energy models to benchmark the resulting predicted CO_2 reduction.

6.16 Additional energy efficiency measures that are proposed for the scheme include:

- Low energy LED lighting will be installed throughout the dwelling.
- All proposed dwellings will be provided with openable windows on multiple aspects to provide fresh air through natural ventilation.
- Energy management systems, such as smart meters, will be installed in all dwellings to enable future residents to monitor their energy usage, and therefore aid in reducing their energy consumption.
- Time and temperature zones, controlled by the suitable arrangement of plumbing and electrical services, will be employed in all dwellings to control heating consumption.

ARUN DISTRICT COUNCIL BN/50/20/PL

6 | Energy Strategy

'Be Clean' | Supply Energy Efficiently

6.17 The potential for the proposed development to incorporate a low carbon heating system has been reviewed for the scheme.

6.18 Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to a separate energy system. This in turn reduces the site-wide energy consumption and associated carbon dioxide emissions.

6.19 The potential integration of a district heating network or a conventional gas-fired combined heat and power (CHP) plant to provide low carbon heat and power on-site has been evaluated for the development, in compliance with industry best practice and appropriate planning policies.

District Heating Feasibility

6.20 The feasibility of a district heating network is heavily dependent on a location's heat demand. In turn, heat demand in the locality is dependent on building usage and the surrounding area density.

6.21 Figure 6.2, to the right, displays the development within its proposed surroundings. From this, it can be concluded that the site is situated in a fairly undeveloped area, with the primary land use being agricultural in nature, interspersed with low-density residential dwellings. It is therefore considered likely that the site lies within an area of low heat demand.

6.22 Based on this, there are likely no existing or planned district heating networks within close proximity to the development site. In addition, due to the relatively low density of the development and the cost of the infrastructure required to connect a rural location to a district heat network, it is not deemed cost effective to establish a district heat network on the site.

6.23 Based on the anticipated timescale of the proposed development and the predicted trajectory of the national electricity grid decarbonisation, the development of a combined heat and power (CHP) network powered by fossil fuels is not considered to be the most carbon efficient approach.

6.24 The incorporation of a gas-fired CHP network will lock the development into relatively carbon-intensive heating and hot water technology, and will not facilitate the transition to less carbon-intensive solutions. It is therefore recommended that air source heat pump (ASHP) systems are employed to service the space and water heat demand of the new dwellings. The incorporation of heat pump technology is discussed in greater detail in the 'Be Green' section.



Figure 6.2 Site and surroundings

'Be Green' | Utilise Renewable Technologies

6.25 The proposed development has given consideration to renewable energy technologies that may be applicable to deliver the required level of carbon dioxide savings over the Part L1A:2013 baseline, and the likely local effects on the environment.

6.26 In determining the appropriate renewable technology for the site, a number of factors including carbon dioxide savings, site constraints, and potential visual impacts have been considered. Further details of each technology and its associated assessment in relation to the proposed new dwelling are provided below.

- **Biomass** - This technology is not considered a practical solution for reducing carbon dioxide, in the view of limited options for domestic scale installations, storage space requirements for the combustible material, and the transport related carbon dioxide emissions which are not normally accounted for within energy modelling. Furthermore, high levels of nitrous oxide (NOx) and particulate matter (PMx) emissions are associated with the use of biomass fuel. As the proposed dwelling is located within a dense, urban area, permitted emissions will be restricted.
- **Air Source Heat Pumps (ASHP)** - given the site location and lack of existing or proposed heat networks, it is proposed that air source heat pump (ASHP) technology is incorporated within the development. It is proposed that highly efficient, individual ASHP systems are installed to serve both the space and water heating demands of all the proposed dwellings, including the apartments. Typical manufacturer specifications for the proposed systems quote a heating coefficient of 4.03, and a hot water coefficient of performance of 2.95. Whilst the specified system operates quietly, as the design progresses, it is recommended that acoustic measures to further limit the noise generated by the outside unit of the system during operation are considered.
- **Ground Source Heat Pumps (GSHP)** - Due to the nature of the proposed development, the site is not suitable for a horizontal ground collection loop. Furthermore, ground investigation and borehole drilling are likely to be cost prohibitive, and may not yield a suitable energy source. The use of ground source heat pumps for the proposed scheme is therefore not considered viable.
- **Photovoltaics (PV)** - Whilst the incorporation of this technology within the proposed development is technically feasible, it is presently rejected as the employment of air source heat pump technology to provide space and water heating for the dwellings will enable the scheme to achieve a carbon dioxide emissions saving that exceeds the 10% required by Arun District Council.
- **Solar Thermal Hot Water (STHW)** - This technology is presently rejected, as domestic hot water is proposed to be provided by a highly efficient air source heat pump system. In addition to this, hot water demand is considered to be outside the energy generating period for the solar thermal panels, meaning its ability to significantly reduce carbon emissions during operation is limited.
- **Wind Turbines** - This technology is rejected on the basis of its potential impact on visual amenity and relatively low efficiency from unpredictable, turbulent wind conditions associated with urban locations.

ARUN DISTRICT COUNCIL BN/50/20/PL

Energy Assessment Results

6.27 Energy modelling of the proposed scheme has been undertaken using the Standard Assessment Process (SAP) for two of the proposed dwellings. The locations of these dwellings are given in Figure 6.3, with further details given in the table below.

Dwelling Type	Plot Number	Aspect
1-Bed Apartment	36	SW, NE
3-Bed House	10	SE, SW, NW

6.28 The images provided in Figures 6.4 and 6.5 depict the form of the sampled dwellings.



Figure 6.3 Sampled dwellings

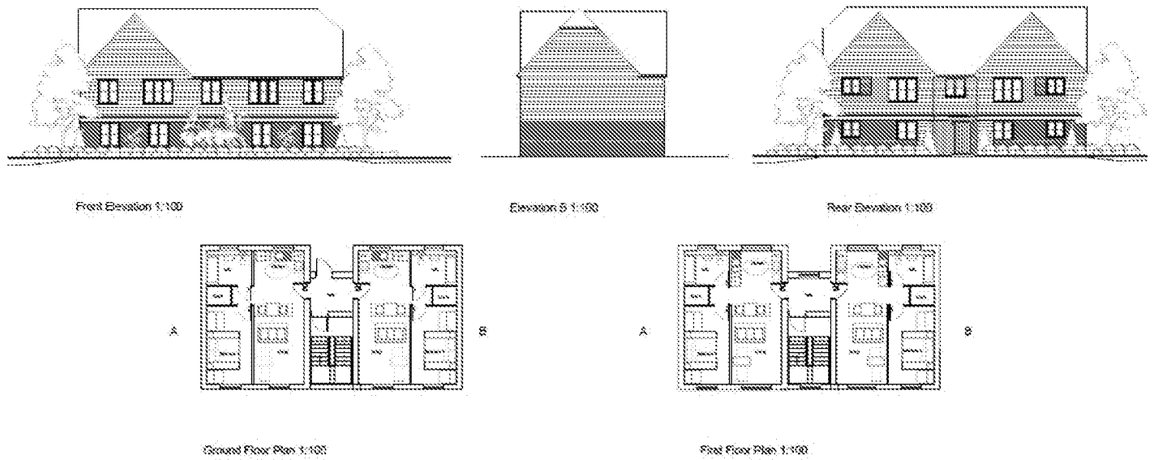


Figure 6.4 Proposed Apartment Block

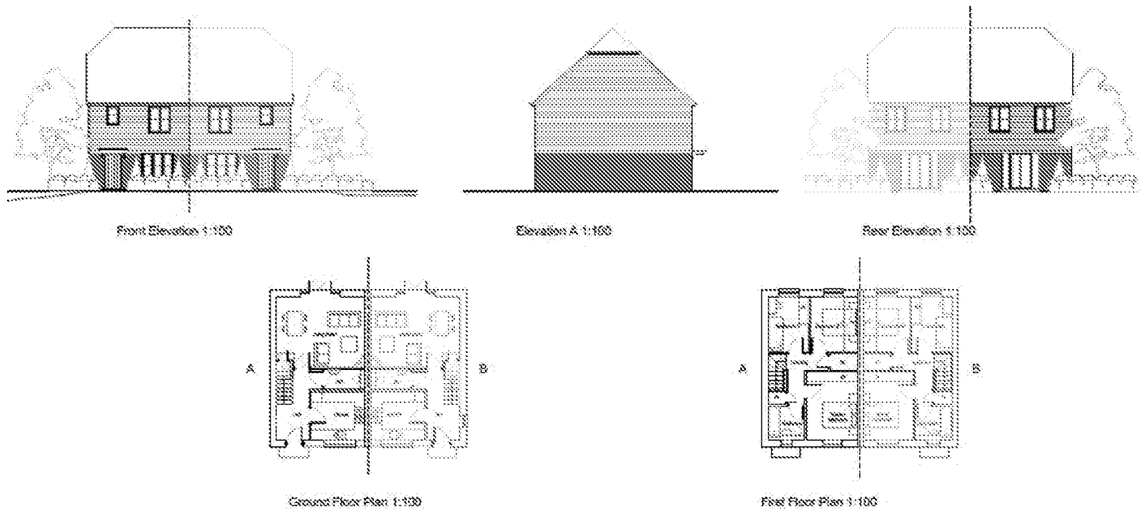


Figure 6.5 Proposed 3-Bed Dwelling

6.29 The carbon dioxide emissions for the sampled dwellings are shown in the table and Figure 6.6, below. DER and TER worksheets showing the performances of the modelled dwellings are provided in Appendix A3.

6.30 The analysis shows that the proposed dwellings will achieve a minimum on-site carbon dioxide emissions saving of 13.7% through energy efficiency measures and renewable technologies. As the tested dwellings provide a representative sample of the proposed development, it is expected that the savings presented within this assessment may be scaled across the development as a whole. This exceeds the requirements set out with the Arun District Council policies.

Dwelling Type	TER: Baseline: Part L:2013 Emissions ($kgCO_2/m^2$ per annum)	DER: Baseline: Part L:2013 Emissions ($kgCO_2/m^2$ per annum)	Emissions Savings ($kgCO_2/m^2$ per annum)	Emissions Savings (%)
1-Bed Apartment	28.89	24.94	3.95	13.7%
3-Bed House	25.50	18.11	7.39	29.0%

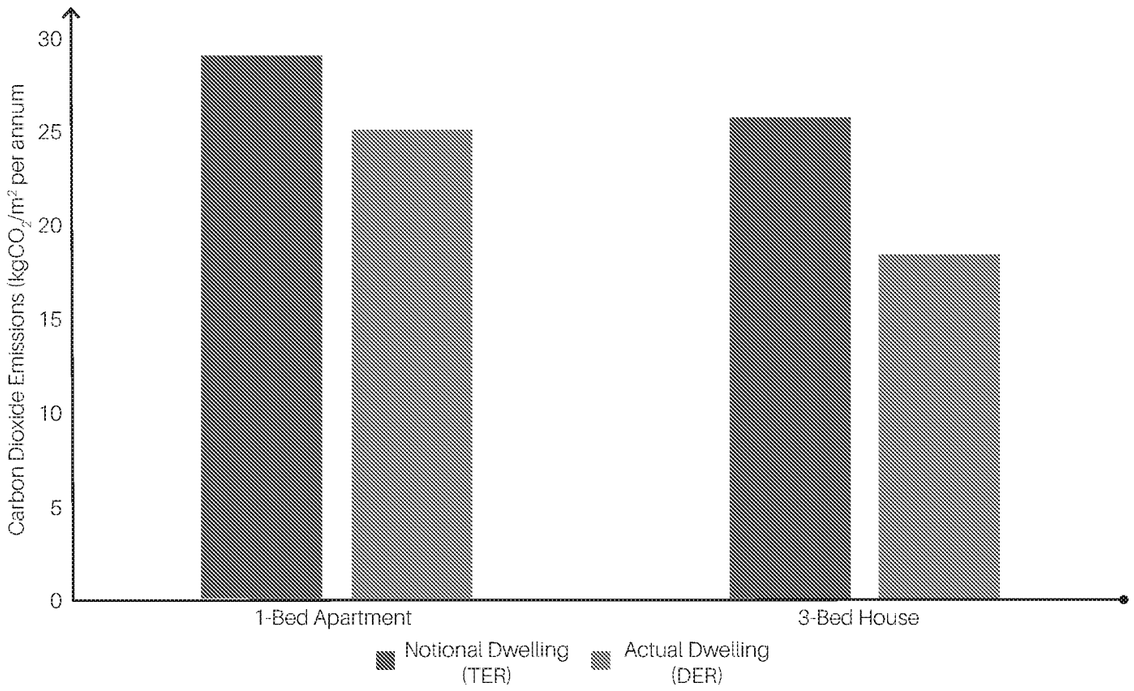


Figure 6.6 Regulated Carbon Dioxide Emissions

Section 7

Conclusion.

7 | Conclusion

7.1 This Sustainability Statement provides an overview as to how the proposed development at the Land west of Fontwell Avenue contributes to sustainable development in the context of the strategic, design and construction considerations.

7.2 Consideration has been given to the Arun District Council's Local Plan in the formulation of this statement. The overall development has been assessed using the guidance outlined in Policy D DM1 (Aspects of Form and Design Quality) of the Local Plan, providing a holistic sustainability approach for the proposals.

7.3 Sections 5 and 6 of this statement demonstrate that the siting and design of the proposals support relevant policy relating to sustainable development. This shows that the proposed development:

- Will promote walking and cycling, and deter private car ownership;
- Will minimise internal water consumption to 105 litres per person per day;
- Will incorporate measures to maintain and improve site biodiversity, including retaining the existing boundary vegetation and including biodiverse planting;
- Will reduce surface water runoff rates through the use of sustainable drainage measures, including permeable paving, soakaways, and an infiltration basin;
- Will minimise energy demand through the specification of low U-values, low air permeability and low thermal bridging to reduce heat loss;
- Will utilise air source heat pump technology to serve the space and water heating demands of the proposed dwellings; and
- Will exceed the Arun District Council carbon dioxide emissions reduction requirements through on-site means alone, with a minimum 13.7% reduction in CO_2 emissions following the Energy Hierarchy methodology.

7.4 The energy performance of the proposed development has been assessed assuming the employment of air source heat pump (ASHP) technology, as this is considered to be the best technology that is currently available. However, as shown in the Energy Strategy section (paragraph 6.26), it would also be possible to incorporate photovoltaic, ground source heat pump or solar thermal technology within the scheme. The situation is fluid, and different technologies can improve quickly. As such, flexibility needs to be retained for the final technology to be used. The following condition is therefore proposed:

"The new dwellings shall not be occupied unless and until the applicant has submitted a scheme for approval by the Local Planning Authority to demonstrate that the new houses will incorporate decentralised, renewable and low carbon energy supply systems. The approved scheme shall thereafter be implemented prior to occupation of the dwellings and any approved renewable energy supply systems shall be permanently retained and maintained in good working order thereafter. Reason: To ensure that the development is energy efficient and in accordance with Policy ECC SP2 of the Arun Local Plan."

7.5 Overall, the proposals for the scheme are in line with the principles of sustainable development, as well as the policy requirements of the NPPF and Arun District Council, and will provide a development that seeks to promote these principles in operation.

ARUN DISTRICT COUNCIL BN/50/20/PL

Appendix A1

Site Location Plan.



Proposed Residential Development

NOTES:

Do Not Scale.

Report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

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Rev	Date	Description
A	30/02/2020	First Issue
B	23/04/2020	Boundary Update
C	23/04/2020	Boundary Update

Project Title

Proposed Residential Development
Fontwell Avenue
West Sussex

Drawing Description

Site Location Plan

1.85 ha Boundary Line

Scale	Drawn by
1:1250 @ A1	AC
Date	Checked by
April 2020	CSS

CLAGUE ARCHITECTS

CANTERBURY LONDON HARPENDEN

Drawing Number	Revision
29662A_20	C

Appendix A2

Water Usage Calculator.

CSH Wat tool May 09

breglobal

Job no:	**19-S037**
Date:	**01/04/2020**
Assessor name:	
Registration no:	**N/A**
Development name:	**Land west of Fontwell Avenue**

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PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

		Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	House Type:																				
	Description:	Typical Unit																			
Installation Type	**Unit of measure**	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		**Dual**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Click to Select**		**Click to Select**		**Click to Select**	
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	5	9.48		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		**Bath & Shower**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**	
Bath	Capacity to overflow	160	17.60		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		**No**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**	
Washing Machine	Litres / kg		17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		**No**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**		**Select option:**	
Dishwasher	Litres / place setting		4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		**No**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00	**Select option:**	0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Calculated Use		114.3		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Normalisation factor		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	**Total Consumption**		**104.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	Mandatory level		Level 3/4		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		**109.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-

(BASIC CALC.)

Appendix A3

DER/TER Worksheets.

DER WorkSheet: New dwelling design stage

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Address :

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.1	(1b) x	2.4	(2b) =	120.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+....(1n)	50.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+....(3n) =	120.24	(5)

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							1	x 10 =	10	(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) ÷ (5) =	0.20 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)		
Number of storeys in the dwelling (ns)		2 (9)
Additional infiltration	[(9)-1]x0.1 =	0.1 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)
If both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35		
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.33 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used		
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.28 (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 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

(22a)m=	0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33

Calculate effective air change rate for the applicable case

If mechanical ventilation: (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56

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

(25)=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56

ELEMENT	Gross area (m²)	Openings	Net Area A ,m²	U-value W/m² K	A x U kW/K	k-value kJ/m² K	A X k kJ/K
Window Type 1			3.8				
Window Type 2			9.7				
Floor			50.1	x 0.21			
Walls Type1	52.1	5.5	46.6	x 0.28	12.77		
Walls Type2	16.7	0	16.7	x 0.22	3.73		
Total area of elements, m²			113.9				

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 2.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 35.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e)) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.85 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.49 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.43	22.33	22.23	21.76	21.68	21.28	21.28	21.2	21.43	21.65	21.85	22.04

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	64.02	63.82	63.72	63.26	63.27	62.87	62.87	62.79	63.02	63.27	63.44	63.63

Average = Sum(39)m ÷ 12 = 63.36 (39)

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DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (39)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.26	1.26	1.26	1.26	1.27	1.27	

Average = Sum(40)m ÷ 12 = 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

Assumed occupancy, N 1.69 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.41 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.85	78.87	75.9	72.92	69.93	66.97	66.97	69.95	72.92	75.9	78.87	81.85

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm / 3600 kWh/month (see Tables 1b, 1c, 1d) Sum(44)m = 892.92 (44)

(45)m=	121.38	106.1	109.55	95.91	91.64	79.15	73.25	84.29	85.59	99.75	117.55	

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61) Total = Sum(45)m = 1184.21 (45)

(46)m=	18.21	15.92	16.43	14.39	13.75	11.87	10.99	12.64	12.84	14.96	17.63	

Water storage loss: Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter '110' litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.88 (55)

Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

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DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	171.93	151.82	160.1	144.43	142.19	128	123.83	134.64	134.01	149.72	157.17	168.1

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0

Output from water heater

(64)m=	171.93	151.82	160.1	144.43	142.19	128	123.83	134.64	134.01	149.72	157.17	168.1

Output from water heater (annual)₁₂ 1765.93 (64)

Heat gains from water heating, kWh/month 0.25 ´[0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	80.5	71.32	76.66	70.59	70.01	65.43	64.6	68.4	67.43	73.41	75.13	79.53

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	84.65	84.65	84.65	84.65	84.65	84.65	84.65	84.65	84.65	84.65	84.65	84.65

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.34	12.73	10.36	7.84	5.86	4.95	5.35	7.47	9.33	11.35	13.63	14.74

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.49	149.02	145.17	136.96	126.29	116.55	108	99.07	96.67	102	131.24	140.99

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72	-67.72

Water heating gains (Table 5)

(72)m=	108.6	106.88	103.31	98.48	95.31	90.87	87.1	91.93	93.65	98.67	104.34	108.89

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	318.83	317.04	307.24	291.66	276.16	261.07	251.19	258.09	264.05	279.8	297.81	311.01

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.8	x	11.28	x	0.63	x	0.7	=	12.1	(79)
Northeast 0.9x	0.77	x	3.8	x	22.97	x	0.63	x	0.7	=	24.67	(79)
Northeast 0.9x	0.77	x	3.8	x	41.38	x	0.63	x	0.7	=	44.45	(79)
Northeast 0.9x	0.77	x	3.8	x	67.96	x	0.63	x	0.7	=	73.02	(79)
Northeast 0.9x	0.77	x	3.8	x	91.35	x	0.63	x	0.7	=	98.12	(79)

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DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.8	x	97.38	x	0.63	x	0.7	=	113.1	(75)
Northeast 0.9x	0.77	x	3.8	x	91.1	x	0.63	x	0.7	=	105.8	(75)
Northeast 0.9x	0.77	x	3.8	x	72.63	x	0.63	x	0.7	=	84.34	(75)
Northeast 0.9x	0.77	x	3.8	x	50.42	x	0.63	x	0.7	=	58.56	(75)
Northeast 0.9x	0.77	x	3.8	x	28.07	x	0.63	x	0.7	=	32.6	(75)
Northeast 0.9x	0.77	x	3.8	x	14.2	x	0.63	x	0.7	=	16.49	(75)
Northeast 0.9x	0.77	x	3.8	x	9.21	x	0.63	x	0.7	=	10.7	(75)
Southwest 0.9x	0.77	x	2.7	x	36.79		0.63	x	0.7	=	30.96	(75)
Southwest 0.9x	0.77	x	2.7	x	63.67		0.63	x	0.7	=	53.58	(75)
Southwest 0.9x	0.77	x	2.7	x	85.75		0.63	x	0.7	=	72.16	(75)
Southwest 0.9x	0.77	x	2.7	x	106.25		0.63	x	0.7	=	89.41	(75)
Southwest 0.9x	0.77	x	2.7	x	118.01		0.63	x	0.7	=	99.3	(75)
Southwest 0.9x	0.77	x	2.7	x	118.15		0.63	x	0.7	=	99.49	(75)
Southwest 0.9x	0.77	x	2.7	x	113.91		0.63	x	0.7	=	95.89	(75)
Southwest 0.9x	0.77	x	2.7	x	104.39		0.63	x	0.7	=	87.86	(75)
Southwest 0.9x	0.77	x	2.7	x	92.85		0.63	x	0.7	=	78.15	(75)
Southwest 0.9x	0.77	x	2.7	x	82.27		0.63	x	0.7	=	69.26	(75)
Southwest 0.9x	0.77	x	2.7	x	77.42		0.63	x	0.7	=	65.18	(75)
Southwest 0.9x	0.77	x	2.7	x	44.07		0.63	x	0.7	=	37.1	(75)
Southwest 0.9x	0.77	x	2.7	x	31.49		0.63	x	0.7	=	26.51	(75)

Solar gains in watts, calculated for each month

(83)m=	39.46	78.36	118.81	166.38	210.59	220.6	209.46	169.17	120.6	82.85	56.68	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1020.1	1060.85	1026.05	992.15	960.43	953.94	926.58	903.5	880.67	847.7		(84)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.9	0.75	0.59	0.64	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.87	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.85	0.66	0.45	0.5	0.78	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.36	19.36	19.36	19.37	19.37	19.38	19.38	19.38	19.37	19.37	19.37	19.36	(90)

fLA = Living area / (4) = — 0.52 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 − fLA) × T2

(92)m=	20.46	20.46	20.45	20.46	20.46	20.46	20.46	20.46	20.46	20.46	20.46	20.46	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	20.45	20.45	20.45	20.46	20.46	20.46	20.46	20.46	20.46	20.46	20.46	20.46	(93)

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.88	0.71	0.52	0.58	0.83	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	960.43	982.07	418.64	437.5	421.24	334.93	238.45	245.39	329.81	355.74	347.26	346.23	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.8	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m− (96)m]													
(97)m=	1094.08	994.15	890.56	732.27	554.16	368.51	242.78	255.08	400.86	623.78	847.45	1034.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m − (95)m] x (41)m													
(98)m=	501.18	404.6	351.11	212.24	86.89	0	0	0	0	199.4	360.14	511.04	

Total per year (kWh/year) = Sum(98)15,912 = — 2630.49 (98)

Space heating requirement in kWh/m²/year — 50.66 (99)

Space cooling

Fraction of space cooled from secondary/supplementary system — 0 (202)

Fraction of space heated from main system(s) — (202) = 1 − (201) = 1 (204)

Fraction of total heating from main system 1 — (202) × (204) = 1 (206)

Efficiency of main space heating system — 100 (207)

Efficiency of secondary/supplementary heating system — 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	501.18	404.6	351.11	212.24	86.89	0	0	0	0	199.4	360.14	511.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													
	200.54	178.29	134.71	93.92	43.58	0	0	0	0	87.87	158.69	225.39	

Total (kWh/year) = Sum(211)15,912 = — 1103.00 (211)

Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) = Sum(215)15,912 = — 0 (215)

Water heating

Output from water heater (calculated above)

(216)m=	171.93	151.82	160.1	144.43	142.19	128	123.83	134.64	134.01	149.72	157.17	162.1	

Efficiency of water heater — 178.12 (216)

(217)m=	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	(217)

Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m

(219)m=	96.52	85.23	89.88	81.08	79.83	71.86	69.52	75.59	75.23	84.05	88.23	94.37	

Total = Sum(219)15,912 = — 991.4 (219)

Annual totals — **kWh/year** — **kWh/year**

Space heating fuel used, main system 1 — 1163.00

DER WorkSheet: New dwelling design stage

Water heating fuel used — 991.4

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year — sum of (230a)...(230g) = — 0 (231)

Electricity for lighting — 359.53 (232)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)		x	0.519	=	603.64	(261)
Space heating (secondary)	(215)		x	0.519	=	0	(263)
Water heating	(219)		x	0.519	=	514.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =					1118.18	(265)
Electricity for pumps, fans and electric keep-hot	(231)		x	0.519	=	0	(267)
Electricity for lighting	(232)		x	0.519	=	131.48	(268)
Total CO2, kg/year		sum of (265)...(271) =				1249.66	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =				24.64	(273)
El							(274)

TER WorkSheet: New dwelling design stage

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Address :

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.1	(1b) x	2.4	(2b) =	120.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+...(1n)	50.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+...(3n) =	120.24	(5)

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	x	0	+	0	=	0	x40 =	0	(6a)
Number of open flues	0	x	0	+	0	=	0	x20 =	0	(6b)
Number of intermittent fans							2	x10 =	20	(7a)
Number of passive vents							0	x10 =	0	(7b)
Number of flueless gas fires							0	x40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = — 20 (8)

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

Number of storeys in the dwelling (ns) — 2 (9)

Additional infiltration — (9)-1)x0.1 = — 0.1 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction — 0 (11)

If both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.42 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36 (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 7													
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18	

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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42

Calculate effective air change rate for the applicable case.

If mechanical ventilation: 0 (22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

(24a)m

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

(24b)m

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

(24c)m

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59

(24d)m

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59

(25)

ELEMENT	Gross area m²	Openings m²	Net Area A ,m²	U-value W/m² K	A X U W/K	k-value kJ/m² K	A X k kJ/K
Window Type 1			3.8				(27)
Window Type 2			2.7				(27)
Floor			106.95	x 0.13	= 13.9		(28)
Walls Type1	62.1	6.5	55.6	x 0.18	= 9.91		(29)
Walls Type2	16.7	0	16.7	x 0.18	= 3.01		(29)
Total area of elements, m²			118.8				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 26.34 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e)) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K indicative value: medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.97 (36)

If details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m × (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23.88	23.72	23.57	22.55	22.71	22.08	22.08	21.97	22.32	22.71	22.98	23.27

(38)m

Heat transfer coefficient, W/K (39)m = (37) + (38)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53.2	53.04	52.89	52.17	52.03	51.4	51.4	51.28	51.64	52.03	52.3	52.59

Average = Sum(39)m / 12 = 52.16 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.06	1.06	1.06	1.04	1.04	1.03	1.03	1.02	1.03	1.04	1.04	1.05

Average = Sum(40)m / 12 = 1.04 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)m

Assumed occupancy, N 1.69 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.41 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
81.85	78.87	76.0	72.92	69.85	66.97	66.07	69.05	72.02	75.0	78.87	81.85

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)m = 882.92 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm / 3600 kWh/month (see Tables 1b, 1c, 1d) (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
121.39	106.8	109.55	90.31	81.64	70.28	73.25	80.25	85.09	95	108.23	117.65

Total = Sum(45)m = 1159.55 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61) (46)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
18.21	15.72	16.43	13.55	12.25	10.54	11.36	12.04	12.76	14.25	16.24	17.65

Water storage loss:

Storage volume (including any solar or WWHRS storage within same vessel) 150 (47)

If community heating and no tank in dwelling, enter '110' in box (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33

(56)m

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33

(57)m

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)m

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

(61)m

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
167.98	148.25	156.14	140.6	138.24	124.17	119.87	130.68	130.19	145.76	153.34	164.15

(62)m

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

(63)m

Output from water heater

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
167.98	148.25	156.14	140.6	138.24	124.17	119.87	130.68	130.19	145.76	153.34	164.15

Output from water heater (annual)₁₂ = 1719.37 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
77.64	68.97	73.7	67.83	67.75	62.37	61.64	65.24	64.37	70.25	72.07	76.36

(65)m

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

Metabolic gains (Table 5), Watts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.85	84.85	84.85	84.85	84.85	84.85	84.85	84.85	84.85	84.85	84.85	84.85

(66)m

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14.36	12.75	10.38	7.86	5.86	4.95	5.35	6.45	8.33	10.83	13.63	14.74

(67)m

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
147.49	149.1	145.17	136.98	126.35	116.85	108.46	105.83	107.47	116.66	131.24	140.99

(68)m

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47	31.47

(69)m

Pumps and fans gains (Table 5a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	3	3	3	3	3	3	3	3	3	3

(70)m

Losses e.g. evaporation (negative values) (Table 5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72	-87.72

(71)m

Water heating gains (Table 5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
104.35	102.83	99.06	94.21	91.06	86.92	82.85	91.65	89.4	94.42	100.09	102.64

(72)m

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
317.55	315.79	305.99	290.4	274.91	259.82	249.94	254.84	262.8	278.55	296.56	309.76

(73)m

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast (Jan)	0.77	×	3.8	×	11.28	×	0.63	×	0.7	=	13.1	(75)
Northeast (Feb)	0.77	×	3.8	×	22.97	×	0.63	×	0.7	=	26.67	(75)
Northeast (Mar)	0.77	×	3.8	×	41.38	×	0.63	×	0.7	=	48.05	(75)
Northeast (Apr)	0.77	×	3.8	×	67.96	×	0.63	×	0.7	=	78.92	(75)
Northeast (May)	0.77	×	3.8	×	91.35	×	0.63	×	0.7	=	106.08	(75)

TER WorkSheet: New dwelling design stage

Northeast (Jun)	0.77	×	3.8	×	87.39	×	0.63	×	0.7	=	113.1	(75)
Northeast (Jul)	0.77	×	3.8	×	81.1	×	0.63	×	0.7	=	105.0	(75)
Northeast (Aug)	0.77	×	3.8	×	72.65	×	0.63	×	0.7	=	94.04	(75)
Northeast (Sep)	0.77	×	3.8	×	50.42	×	0.63	×	0.7	=	65.26	(75)
Northeast (Oct)	0.77	×	3.8	×	28.07	×	0.63	×	0.7	=	36.34	(75)
Northeast (Nov)	0.77	×	3.8	×	14.2	×	0.63	×	0.7	=	18.38	(75)
Northeast (Dec)	0.77	×	3.8	×	8.21	×	0.63	×	0.7	=	10.7	(75)
Southwest (Jan)	0.77	×	2.7	×	36.79	×	0.63	×	0.7	=	33.36	(79)
Southwest (Feb)	0.77	×	2.7	×	62.67	×	0.63	×	0.7	=	51.72	(79)
Southwest (Mar)	0.77	×	2.7	×	83.75	×	0.63	×	0.7	=	70.76	(79)
Southwest (Apr)	0.77	×	2.7	×	106.95	×	0.63	×	0.7	=	87.63	(79)
Southwest (May)	0.77	×	2.7	×	119.91	×	0.63	×	0.7	=	98.2	(79)
Southwest (Jun)	0.77	×	2.7	×	118.15	×	0.63	×	0.7	=	97.48	(79)
Southwest (Jul)	0.77	×	2.7	×	113.01	×	0.63	×	0.7	=	93.88	(79)
Southwest (Aug)	0.77	×	2.7	×	104.39	×	0.63	×	0.7	=	86.14	(79)
Southwest (Sep)	0.77	×	2.7	×	92.65	×	0.63	×	0.7	=	76.62	(79)
Southwest (Oct)	0.77	×	2.7	×	69.27	×	0.63	×	0.7	=	57.16	(79)
Southwest (Nov)	0.77	×	2.7	×	44.07	×	0.63	×	0.7	=	36.38	(79)
Southwest (Dec)	0.77	×	2.7	×	31.49	×	0.63	×	0.7	=	25.99	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m .. (82)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
93.46	78.96	58.81	39.34	210.59	28.06	23.64	29.17	39.72	52.82	66.83	

(83)m

Total gains – internal and solar (84)m = (73)m + (83)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
411.01	394.75	364.8	329.74	485.5	287.88	273.58	283.99	302.52	331.37	363.39	376.59

(84)m

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.99	0.98	0.95	0.85	0.67	0.5	0.54	0.8	0.96	0.99	1

(86)m

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
19.99	20.12	20.33	20.62	20.85	20.97	21	20.99	20.92	20.64	20.27	19.97

(87)m

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.03	20.03	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04

(88)m

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.99	0.97	0.93	0.8	0.55	0.39	0.44	0.72	0.94	0.99	0.99

(89)m

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
18.7	18.85	19.19	19.61	19.91	20.04	20.06	20.06	20	19.64	19.12	18.66

(90)m

fLA = Living area ÷ (4) = 0.62 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

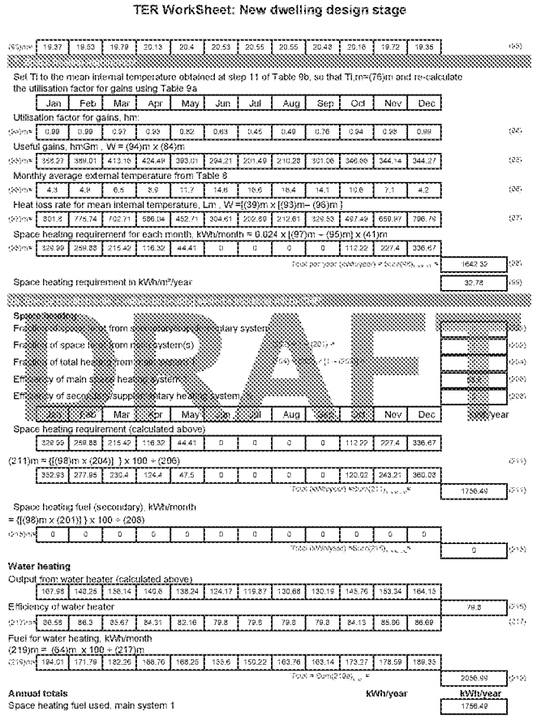
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
19.37	19.53	19.79	20.13	20.4	20.53	20.55	20.55	20.45	20.16	19.72	19.35

(92)m

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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Appendix A3 | DER/TER Worksheets



TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.97	19.93	19.79	20.13	20.4	20.53	20.55	20.55	20.42	20.18	19.72	19.35	

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:	0.99	0.99	0.97	0.93	0.82	0.63	0.45	0.49	0.76	0.94	0.98	0.99	
Useful gains, hmGm , W = (94)m x (84)m	355.21	389.01	413.16	424.49	393.01	294.21	201.49	210.28	301.06	346.88	344.14	344.27	
Monthly average external temperature from Table 8	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	
Heat loss rate for mean internal temperature, Lm , W=[(39)m x [(93)m– (96)m]	801.6	776.74	702.71	586.04	452.71	304.61	202.69	212.61	329.55	497.49	659.97	796.78	
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m	329.99	259.88	215.42	116.32	44.41	0	0	0	0	112.22	227.4	336.47	

Total per year (kWh/year) = Sum(98)15,912 = 1642.32 (98)

Space heating requirement in kWh/m²/year 30.76 (99)

Space heating:
Fraction of space heat from secondary/supplementary system (201)
Fraction of space heat from main system(s) (202)
Fraction of total heat from main system 1 (204)
Efficiency of main space heating system 1 (206)
Efficiency of secondary/supplementary heating system (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	329.99	259.88	215.42	116.32	44.41	0	0	0	0	112.22	227.4	336.47	

Total (kWh/year) = Sum(211)15,912 = 1756.49 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) = Sum(215)15,912 = 0 (215)

Water heating
Output from water heater (calculated above)

	167.99	140.25	138.14	140.6	138.24	124.17	119.87	130.68	130.19	145.76	163.34	164.15	

Efficiency of water heater 79.8 (216)

(217)	86.55	86.3	85.67	84.31	82.16	79.8	79.5	79.8	79.8	84.13	85.86	86.69	(217)

Fuel for water heating, kWh/month
(219)m = {(64)m x 100 ÷ (217)m

(219)	194.21	171.79	182.26	166.76	168.25	155.6	150.22	163.76	163.14	173.27	178.59	189.35	

Total = Sum(219)m = 2036.99 (219)

Annual totals kWh/year kWh/year
Space heating fuel used, main system 1 1756.49

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TER WorkSheet: New dwelling design stage

Water heating fuel used 2036.99
Electricity for pumps, fans and electric keep-hot
central heating pump: 30 (230c)
boiler with a fan-assisted flue 45 (230e)
Total electricity for the above, kWh/year 75 (231)
Electricity for lighting 253.32 (232)

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	379.4	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	444.31	(264)
Space and water heating	(261) + (263) + (264) + (265)				823.71	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	131.48	(268)
Total CO2, kg/year					994.12	(272)
TER					22.78	(273)

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DER WorkSheet: New dwelling design stage

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Address :

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	42.7	(1b) x	2.7	(2b) =	115.29	(3b)
First floor	42.7	(1c) x	2.7	(2c) =	115.29	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+....(1n)	85.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)....(3n) =	230.58	(5)

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							1	x 10 =	10	(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 and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 10 ÷ (5) = (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)
Number of storeys in the dwelling (ns) (9)
Additional infiltration [(9)-1]x0.1 = (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction (11)
If both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 (12)
If no draught lobby, enter 0.05, else enter 0 (13)
Percentage of windows and doors draught stripped (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] = (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used
Number of sides sheltered (19)
Shelter factor (20)
Infiltration rate incorporating shelter factor (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 7	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	

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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.12	1.18	

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.32	0.31	0.31	0.27	0.27	0.24	0.24	0.23	0.25	0.27	0.28	0.29	

Calculate effective air change rate for the applicable case
If mechanical ventilation: 0 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)
a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
If (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
If (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(24d)

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

(25)	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(25)

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ELEMENT	Gross m²	Openings m²	Net Area A, m²	U-value W/m2K	A x U W/K	k-value kJ/m² K	A X k kJ/K
Doors			1.8	x 1 =	1.8		(26)
Windows Type 1			5.1	x[1/(1.2+0.04)] =	10.74		(27)
Windows Type 2			5.4	x[1/(1.2+0.04)] =	7.18		(27)
Floor			42.7	x 0.12 =	5.124		(28)
Walls	96.7	15.6	81.1	x 0.28 =	22.71		(29)
Roof	42.7	0	42.7	x 0.2 =	8.54		(30)
Total area of elements, m²			182.1				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2
** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 56.37 (33)
Heat capacity Cm = S(A x k) (28)...(30) + (32) + (32a)...(32e) = 0 (34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)
For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.
Thermal bridges : S (L x Y) calculated using Appendix K 9.1 (36)
if details of thermal bridging are not known (36) = 0.05 x (31)
Total fabric heat loss (33) + (36) = 65.47 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)	41.89	41.74	41.6	40.91	40.75	40.18	40.12	40.07	40.41	40.78	41.04	41.31	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)	107.36	107.21	107.07	106.38	106.22	105.65	105.65	105.54	105.88	106.25	106.51	106.78	

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Average = Sum(39)...(39)12/ = 106.38 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.26	1.26	1.25	1.25	1.24	1.24	1.24	1.24	1.24	1.24	1.25	1.25	

Average = Sum(40)$_{Jan..Dec}$ /12 = 1.25 (42)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	

Assumed occupancy, N — 2.56 (43)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.84 (44)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(45)m=	104.43	100.63	96.84	93.04	89.24	85.44	85.44	89.24	93.04	96.84	100.63	104.43	

Total = Sum(45)$_{Jan..Dec}$ = 1136.26 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	154.87	135.02	139.77	125.98	116.69	92.8	93.5	102.26	108.57	129.03	139.11	149.88	

Total = Sum(45)$_{Jan..Dec}$ = 1569.46 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46)

(46)m=	23.23	20.22	20.97	18.9	17.5	15.13	15.13	15.38	16.29	19.35	20.12	22.5	

Water storage loss:

Storage volume (includes any solar or WWHRS storage within same vessel) — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.63 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = — 0.88 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0.88 (55)

Water storage loss calculated for each month (56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) × 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.28	21.01	23.28	22.51	23.28	22.51	23.28	23.28	22.51	23.28	22.51	23.28	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	203.42	181.11	190.32	170.77	167.47	149.81	144.04	157.84	157.49	177.08	187.03	200.53	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	203.42	181.11	190.32	170.77	167.47	149.81	144.04	157.84	157.49	177.08	187.03	200.53	

Output from water heater (annual)$_{12}$ — 2022.91 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	91.93	81.56	86.91	79.85	79.32	72.65	71.53	76.11	75.23	82.51	85.08	90.31	(65)

Include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	127.57	127.57	127.57	127.87	127.87	127.87	127.87	127.87	127.57	127.57	127.57	127.57	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.48	19.08	15.51	11.74	8.78	7.41	8.01	10.42	13.97	17.74	20.71	22.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	230.36	232.73	226.72	213.9	199.03	183.8	173.72	169.35	175.97	190.79	204.89	220.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	(71)

Water heating gains (Table 5)

(72)m=	123.57	121.37	116.92	110.83	106.61	100.95	99.14	102.3	104.45	110.9	118.13	121.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	486.76	494.56	480.42	467.03	474.48	457.32	437.84	444.01	453.79	479.79	508.18	525.01	(73)

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast$_{0.9x}$	0.77	×	5.4	×	36.79	×	0.63	×	0.7	=	80.72	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	63.67	×	0.63	×	0.7	=	139.63	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	85.75	×	0.63	×	0.7	=	188.09	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	106.25	×	0.63	×	0.7	=	233.02	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	119.01	×	0.63	×	0.7	=	261.01	(77)

DER WorkSheet: New dwelling design stage

Southeast$_{0.9x}$	0.77	×	5.4	×	118.15	×	0.63	×	0.7	=	184.98	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	113.91	×	0.63	×	0.7	=	187.99	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	104.39	×	0.63	×	0.7	=	172.25	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	92.85	×	0.63	×	0.7	=	153.23	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	80.07	×	0.63	×	0.7	=	114.31	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	44.07	×	0.63	×	0.7	=	72.73	(77)
Southeast$_{0.9x}$	0.77	×	5.4	×	31.49	×	0.63	×	0.7	=	51.96	(77)
Northwest$_{0.9x}$	0.77	×	5.1	×	11.29	×	0.63	×	0.7	=	27.83	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	33.97	×	0.63	×	0.7	=	56.05	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	41.38	×	0.63	×	0.7	=	102.45	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	67.96	×	0.63	×	0.7	=	168.22	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	91.35	×	0.63	×	0.7	=	226.12	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	97.38	×	0.63	×	0.7	=	241.07	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	91.1	×	0.63	×	0.7	=	225.52	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	72.85	×	0.63	×	0.7	=	170.79	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	50.42	×	0.63	×	0.7	=	124.81	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	28.07	×	0.63	×	0.7	=	69.48	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	14.2	×	0.63	×	0.7	=	35.15	(81)
Northwest$_{0.9x}$	0.77	×	5.1	×	9.21	×	0.63	×	0.7	=	22.8	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)$_{m}$ ... (82)$_{m}$

(83)m=	25.65	160.23	253.98	392.97	438.06	434.6	382.44	275.05	185.19	107.87	74.77		(83)

Total gains – internal and solar (84)m = (73)m + (83)m ...

(84)m=	512.41	654.79	734.4	860	912.54	891.92	820.28	719.06	639	587.66	582.95	525.01	(84)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.76	0.59	0.65	0.93	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.88	19.88	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.86	0.66	0.46	0.52	0.81	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.67	19.69	19.69	19.69	19.69	19.69	19.69	19.69	19.69	19.69	19.69	19.68	(90)

fLA = Living area / (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.12	20.12	20.12	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.12	20.12	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	20.12	20.12	20.12	20.13	20.13	20.13	20.13	20.13	20.13	20.12	20.12	20.12	(93)

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.87	0.65	0.49	0.55	0.83	0.97	0.99	1	(94)
Useful gains, hm:Gm , W = (94)m x (84)m													
(95)m=	523.93	651.49	655.22	709.48	803	579.8	388.12	391.92	525.18	546.41	510.06	488.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1698.28	1691.71	1438.39	1184.16	895.3	584.35	373.03	393.89	635.37	1012.18	1387.24	1700.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	873.73	699.02	597.48	348.86	150.51	0	0	0	0	346.53	691.56	893.97	

Total per year (kWh/year) = Sum(98)$_{Jan..Dec}$ = 4541.77 (98)

Space heating requirement in kWh/m²/year — 53.15 (99)

Space heating:

Fraction of space heat from secondary/supplementary system — (201)

Fraction of space heat from main system(s) — (202)

Fraction of total heating from main system 1 — (204)

Efficiency of main space heating system 1 — (206)

Efficiency of secondary/supplementary heating system — (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	kWh/month												kWh/year
Space heating requirement (calculated above)													
	873.73	699.02	597.48	348.86	150.51	0	0	0	0	346.53	691.56	893.97	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	274.61	219.7	187.79	109.64	47.31	0	0	0	0	108.91	185.5	280.87	

Total (kWh/year) = Sum(211)$_{Jan..Dec}$ = 1427.46 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) = Sum(215)$_{Jan..Dec}$ = 0 (215)

Water heating

Output from water heater (calculated above)

	203.42	181.11	190.32	170.77	167.47	149.81	144.04	157.84	157.49	177.08	187.03	200.53	

Efficiency of water heater — 178.12 (216)

(217)m=	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	178.12	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	115.22	101.67	106.85	95.87	94.02	84.11	80.87	88.61	88.41	99.41	105	112.55	

Total = Sum(219)$_{Jan..Dec}$ = 1172.77 (219)

Annual totals — **kWh/year**

Space heating fuel used, main system 1 — 1427.46

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Water heating fuel used — 1172.72

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year — sum of (230a)...(230g) = — 0 (231)

Electricity for lighting — 379.26 (232)

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	740.85	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	608.64	(264)
Space and water heating	(261) + (262) + (263) + (264)	=			1349.5	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	196.85	(268)
Total CO2, kg/year			sum of (265)...(271)	=	1546.35	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4)	=	18.11	(273)
El						

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Assessor Name: — Stroma Number:

Software Name: Stroma FSAP 2012 — Software Version: Version: 1.0.4.25

Address :

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	42.7	(1a) x	2.7	(2a) =	115.29	(3a)
First floor	42.7	(1b) x	2.7	(2b) =	115.29	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+....(1n)	85.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+....(3n) =	230.58	(5)

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents								x 10 =		(7b)
Number of flueless gas fires								x 40 =		(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = — 30 ÷ (5) = — 0.13 (8)

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

Number of storeys in the dwelling (ns) — 2 (9)

Additional infrastructure — (9a) x 0.1 = — 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction — 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 — 0 (12)

If no draught lobby, enter 0.05, else enter 0 — 0 (13)

Percentage of windows and doors draught stripped — 0 (14)

Window infrastructure — 0.25 - [0.2 x (14) ÷ 100] = — 0 (15)

Infiltration rate — (8) + (10) + (11) + (12) + (13) + (15) = — 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area — 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) — 0.38 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered — 2 (19)

Shelter factor — (20) = 1 - [0.075 x (19)] = — 0.85 (20)

Infiltration rate incorporating shelter factor — (21) = (18) x (20) = — 0.32 (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 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.41	0.4	0.4	0.36	0.35	0.31	0.31	0.3	0.32	0.35	0.36	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: — 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) — 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = — 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0

c) If whole house extract ventilation or positive input ventilation from outside

If (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0

d) If natural ventilation or whole house positive input ventilation from loft

If (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.88	0.88	0.88	0.84	0.84	0.82	0.82	0.82	0.83	0.84	0.84	0.87

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

(25)m=	0.88	0.88	0.88	0.84	0.84	0.82	0.82	0.82	0.83	0.84	0.84	0.87

ELEMENT	Gross area (m²)	Openings m²	Net Area A m²	U-value W/m2K	A x U W/K	k-value kJ/m² K	A X k kJ/K
Doors			1	x 1 =			
Windows Type 1			5.1	x(1/(1.4+1/5.04)) =	19.74		
Windows Type 2			5.4	x(1/(1.4+1/5.04)) =	7.16		
Floor			42.7	x 0.13 =	5.551		
Walls	96.7	15.6	81.1	x 0.18 =	14.6		
Roof	42.7	0	42.7	x 0.13 =	5.55		
Total area of elements, m²			182.1				

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) — (26)...(30) + (32) = — 45.7 (33)

Heat capacity Cm = S(A x k) — (28)...(30) + (32) + (32a)...(32e) = — 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K — Indicative Value: Medium — 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 4.55 (36)

If details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = — 50.25 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	44.5	44.25	44.01	42.85	42.64	41.63	41.63	41.44	42.02	42.64	43.07	43.53

(39)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	94.75	94.5	94.26	93.1	92.88	91.88	91.88	91.69	92.26	92.88	93.32	93.78

Average = Sum(39)m ÷ 12 = — 93.1 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)m ÷ 12 = — 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

Assumed occupancy, N — 2.56 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.04 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	104.43	100.69	96.94	93.04	89.24	85.44	85.44	89.24	93.04	96.84	100.63	104.43

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm / 3600 kWh/month (see Tables 1b, 1c, 1d) — Sum(44)m = — 1139.25 (44)

(45)m=	154.57	135.09	139.72	121.86	116.92	100.9	93.34	108.57	112.99	136.11	149.98	165.57

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61) — Sum(45)m = — 1685.82 (45)

(46)m=	23.33	20.27	20.97	18.28	17.54	15.13	14.00	16.29	16.95	20.42	22.5	24.84

Water storage loss: — 180 (47)

Storage volume (litres) including any solar or WWHRS storage within same vessel

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0.75 (55)

Water storage loss calculated for each month — (56)m = (55) x (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.46	177.54	186.37	166.93	163.52	145.99	140.09	153.88	153.66	173.12	183.21	196.58	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.46	177.54	186.37	166.93	163.52	145.99	140.09	153.88	153.66	173.12	183.21	196.58	

Output from water heater (annual) = 2042.36 (64)

Heat gains from water heating, kWh/month 0.25 ' [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	88.77	78.71	83.75	76.39	76.18	69.62	68.36	72.95	72.17	79.35	82	87.15	(65)

Include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	127.87	127.87	127.87	127.87	127.87	127.87	127.87	127.87	127.87	127.87	127.87	127.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	31.48	28.06	25.51	19.74	14.76	12.41	13.42	16.84	22.87	28.51	30.71	32.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	290.36	293.73	286.72	265.9	247.5	234.5	229.6	238.97	259.8	284.99	289.19	286.19	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	35.79	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	-102.3	(71)

Water heating gains (Table 5)

(72)m=	118.31	117.12	112.57	106.35	102.36	96.7	91.89	98.58	103.34	106.65	113.55	117.13	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	455.51	455.5	419.16	396.38	379.21	360.97	356.59	342.76	354.54	377.54	400.93	403.76	(73)

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	×	5.4	×	36.79	×	0.63	×	0.7	=	80.72	(77)
Southeast 0.9x	0.77	×	5.4	×	62.67	×	0.63	×	0.7	=	137.43	(77)
Southeast 0.9x	0.77	×	5.4	×	85.75	×	0.63	×	0.7	=	188.08	(77)
Southeast 0.9x	0.77	×	5.4	×	106.25	×	0.63	×	0.7	=	233.05	(77)
Southeast 0.9x	0.77	×	5.4	×	119.01	×	0.63	×	0.7	=	261.04	(77)

TER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	×	5.4	×	118.15	×	0.63	×	0.7	=	194.93	(77)
Southeast 0.9x	0.77	×	5.4	×	113.91	×	0.63	×	0.7	=	187.93	(77)
Southeast 0.9x	0.77	×	5.4	×	104.39	×	0.63	×	0.7	=	172.26	(77)
Southeast 0.9x	0.77	×	5.4	×	92.85	×	0.63	×	0.7	=	153.23	(77)
Southeast 0.9x	0.77	×	5.4	×	80.27	×	0.63	×	0.7	=	132.47	(77)
Southeast 0.9x	0.77	×	5.4	×	44.07	×	0.63	×	0.7	=	72.73	(77)
Southeast 0.9x	0.77	×	5.4	×	31.49	×	0.63	×	0.7	=	51.96	(77)
Northwest 0.9x	0.77	×	5.1	×	11.28	×	0.63	×	0.7	=	27.83	(81)
Northwest 0.9x	0.77	×	5.1	×	22.97	×	0.63	×	0.7	=	56.65	(81)
Northwest 0.9x	0.77	×	5.1	×	41.38	×	0.63	×	0.7	=	102.43	(81)
Northwest 0.9x	0.77	×	5.1	×	67.96	×	0.63	×	0.7	=	168.22	(81)
Northwest 0.9x	0.77	×	5.1	×	91.35	×	0.63	×	0.7	=	226.12	(81)
Northwest 0.9x	0.77	×	5.1	×	97.38	×	0.63	×	0.7	=	241.07	(81)
Northwest 0.9x	0.77	×	5.1	×	91.1	×	0.63	×	0.7	=	225.52	(81)
Northwest 0.9x	0.77	×	5.1	×	72.63	×	0.63	×	0.7	=	179.79	(81)
Northwest 0.9x	0.77	×	5.1	×	50.42	×	0.63	×	0.7	=	124.81	(81)
Northwest 0.9x	0.77	×	5.1	×	28.07	×	0.63	×	0.7	=	69.48	(81)
Northwest 0.9x	0.77	×	5.1	×	14.2	×	0.63	×	0.7	=	35.15	(81)
Northwest 0.9x	0.77	×	5.1	×	9.21	×	0.63	×	0.7	=	22.8	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m .. (82)m

(83)m=	89.65	160.58	283.93	402.37	462.93	436.06	405.98	356.03	282.64	187.87	104.77	74.77	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	545.16	616.08	703.1	798.75	842.14	797.03	762.57	698.79	637.18	565.41	505.7	478.53	(84)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.87	0.7	0.53	0.59	0.84	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.81	19.97	20.21	20.54	20.81	20.96	20.99	20.99	20.89	20.53	20.12	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.61	0.42	0.47	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.43	18.64	18.99	19.48	19.83	19.99	20.02	20.02	19.92	19.47	18.97	18.4	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.73	18.93	19.25	19.69	20.04	20.2	20.23	20.23	20.13	19.7	19.14	18.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	18.73	18.93	19.25	19.69	20.04	20.2	20.23	20.23	20.13	19.7	19.14	18.71	(93)

Set TI to the mean internal temperature obtained at step 11 of Table 9b, so that TI,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.44	0.5	0.75	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	531.59	608.46	689.28	754.01	699.37	494.67	330.87	348.21	485.97	537.55	507.34	466.85	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1367.35	1328.4	1302.19	1205	1134.57	914.68	833.4	860.88	996.57	1145.09	1124.02	1360.28	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	629.05	495.23	411.39	223.91	85.71	0	0	0	0	226.81	444.08	642.37	

Total per year (kWh/year) = Sum(98)m .. (98)m = 3160.52 (98)

Space heating requirement in kWh/m²/year 37.01 (99)

Space heating:

Fraction of space heat from secondary/supplementary system (201) = 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heat from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 (206) 90.8 (206)

Efficiency of secondary/supplementary heating system, % (208) 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	629.05	495.23	411.39	223.91	85.71	0	0	0	0	226.81	444.08	642.37	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	692.75	545.65	453.09	246.7	94.39	0	0	0	0	249.79	489.08	707.33	

Total (kWh/year) =Sum(211)$_{Jan}$..$_{Dec}$ = 3480.24 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) =Sum(215)$_{Jan}$..$_{Dec}$ = 0 (215)

Water heating

Output from water heater (calculated above)

	201.46	177.54	186.37	166.93	163.52	145.99	140.09	153.88	153.66	173.12	183.21	196.58	

Efficiency of water heater 79.8 (216)

(217)m=	87.65	87.41	86.67	85.8	85.18	79.8	79.8	79.8	79.8	85.66	87.09	87.74	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	229.85	203.11	214.54	194.54	191.53	182.94	175.53	192.84	192.56	202.34	210.36	224.04	

Total = Sum(219)$_{Jan}$..$_{Dec}$ = 2419.75 (219)

Annual totals kWh/year kWh/year

Space heating fuel used, main system 1 3480.24

TER WorkSheet: New dwelling design stage

Water heating fuel used 2419.75

Electricity for pumps, fans and electric keep-hot

central heating pump 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a) .. (230g) = 75 (231)

Electricity for lighting 379.28 (232)

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	×	0.216	=	750.13	(261)
Space heating (secondary)	(215)	×	0.519	=	0	(263)
Water heating	(219)	×	0.216	=	522.67	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1272.8	(265)
Electricity for pumps, fans and electric keep-hot	(231)	×	0.519	=	38.93	(267)
Electricity for lighting	(232)	×	0.519	=	196.85	(268)
Total emissions for the above	sum of (265) .. (268) =				1508.58	(272)
TER						(273)

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Appendix A4

General Notes.

Appendix A4 | General Notes

A4.1 The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Iceni Projects Ltd for inaccuracies in the data supplied by any other party.

A4.2 The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

A4.3 No site visits have been carried out, unless otherwise specified.

A4.4 This report is prepared and written in the context of an agreed scope of work and should not be used in a different context .Furthermore, new information, improved practices, and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

A4.5 The copyright in the written materials shall remain the property of Iceni Projects Ltd but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to Iceni Projects Ltd by the client of the outstanding amount.

A4.6 The report is provided for sole use by the client and is confidential to them and their professional advisors. No responsibility whatsoever for the contents of the report will be accepted to any person other than the client, unless otherwise agreed.

A4.7 These terms apply in addition to the Iceni Projects Ltd "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. ,In the event of a conflict between these terms and the said Standard Terms of Business, the said Standard Terms of Business shall prevail.). In the absence of such a written contract the Standard Terms of Business will apply.

ARUN DISTRICT COUNCIL BN/50/20/PL

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