

# THE ECO-OFFICE PROJECT: CREETOWN

## A Design Feasibility Study Report

commissioned by the

### Southern Uplands Partnership



southern uplands partnership

*living land, living community*

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**Important notes relating to this report.**

- **A design feasibility study report would not usually include elemental costs. These are present in this report because there is not, as yet, a reliable cost database for low-zero carbon buildings. This involved entering a more detailed level of design than is usual at feasibility study stage.**
- **Drawings are not to scale.**
- **Capital costs do not include professional fees.**

**If access to the report Appendices is required from constituted groups application should be made in writing to the Southern Uplands Partnership.**

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# **THE ECO-OFFICE PROJECT: CREETOWN**

## **DESIGN FEASIBILITY STUDY REPORT**

### **CONTENTS**

1. INTRODUCTION
2. THE REPORT SUMMARY
3. THE SITE
4. THE OUTLINE BRIEF DEVELOPMENT
5. THE OUTLINE DESIGN
6. CONSTRUCTION, RENEWABLE TECHNOLOGIES AND THE EXEMPLAR BUILDING
7. REPLICABILITY
8. THE INDICATIVE CONSTRUCTION BUDGET
9. ALTERNATIVE SCENARIOS
10. TOWARDS ZERO CARBON BUILDING: THE CASE FOR DEVELOPMENT
11. CONCLUSIONS and RECOMMENDATIONS
12. DESIGN BRIEF

### **APPENDICES**

- A. Design Feasibility Study brief
- B. The Outline Design Brief
- C. The Outline Specification
- D. The Indicative Construction Budget (IDB)
- E. The Renewable Energy Report
- F. Eco-Office – Integral Inclusion Of Artworks

## Section 1

### INTRODUCTION

#### 1.1 The Design Feasibility Study Brief

The Design Feasibility Study Brief calls for the development of a proposal with the Southern Upland Partnership (SUP), for a shared office/workspace facility with desk space to let. The intention is for the proposed development to provide affordable but high quality workspace that creates a serious business image. It is also intended to be a working demonstration site for sustainable/eco- building technologies and small scale renewable energy equipment for the general public. It is believed that these elements make the project unique in the Southern Uplands region.

A possible site in Creetown has been identified where, providing a business model can be replicated on other sites across the Southern Uplands, the first of several units will be built. The Design Feasibility Study has addressed some of the building construction issues related to this potential replication.

The full Design Feasibility Study Brief can be examined in full in Appendix A. The main aims and objectives are summarised as follows:

- Maximise the design potential of the site
- Examine renewable energy alternatives
- Consider the replicability of the proposal on other sites.
- Examine life cycle costing
- Establish planning requirements and other statutory obligations including compliance with disability access legislation (DDA)
- Assess the need for any additional consultants for the next design stage.

#### 1.2 Methodology

##### Description of the Outline Briefing and Design Process

The process of design is an iterative one where the ideas from previous work are tested on a range of variables. Decisions are made from which further ideas emerge and are tested against the same variables and possibly others which have become or are becoming relevant. Thus design is a constantly moving complex pattern of interconnected decision making. Building a brief with the construction client is the first stage of this process.

Throughout the design process, many briefs will be prepared as, stage by stage, the design work becomes more detailed. The Outline Brief is the first stage of a journey.

An Outline Brief is required in all design feasibility studies. An Outline Design, however, is usually the start of the next stage of design, proceeding on the basis of a construction cost per square metre. It is based on precedent costs of similar projects, and is given a longer period

for development than that available at feasibility study stage. However, the data base of previous costs for the construction methods examined in this study are not yet available and thus a more detailed examination at feasibility stage has been required in order to produce a realistic initial construction budget. The objective, therefore, of the Outline Design in this document has been to assist in the establishment of this budget. It should be read as an accurate diagram rather than a proposal.

During the outline briefing stage of this study the concept of an ‘exemplar’ low carbon emissions building gradually emerged as discussion progressed. In consultation with the Carbon Centre at the Crichton Campus (Glasgow University) in Dumfries, it was agreed that the development of the Outline Design for a building that would significantly lower the energy demand was preferable to a building built to current building standards.

**1.3** The Design Feasibility Study methodology can therefore be summarised as follows:

1. Developing the Outline Brief by:

- Testing the site development potential
- Testing the business requirements of the site

2. Testing the site with the feasibility study brief and outline brief information through an initial Outline Design process.

3. ‘Interrogating’ the Outline Design in order to arrive at a realistic construction budget for:

- A low carbon ‘exemplar’ building
- The same building built to current building standards with additional renewable technologies for public demonstration purposes

4. Testing the Indicative Construction Budget against other potential scenarios

5. Analysing the findings arising from the above processes in the light of the initial brief, forming conclusions and making recommendations.

The reader should be aware that as consultation proceeded, the concept of an exemplar low carbon building was adopted for primary examination. The Design Feasibility Study is fully applicable to a proposal built to current Building Standards with additional renewable energy technologies for demonstration purposes. The study leaves open the decision of how a proposed building would be built. The intention of the study is examine the feasibility of developing a Low Carbon Building (LCB) on the site in Creetown and, by so doing, providing enough information to enable that decision to be made.

#### **1.4 How to Use This Report**

A summary of the Design Feasibility Report can be found in Section 2.

The reader is encouraged to read the report as a whole, in the order that it has been presented.

Acronyms are in evidence throughout the report although an attempt has been made to limit their use.

## Section 2

### REPORT SUMMARY

2.1 The purpose of the development is to provide flexible workspace for start-up and developing businesses and thus assist the economic development of the local area.

2.2 The Southern Uplands Partnership's (SUP) aspirations at the outset were for a building proposal that would:

- 'Showcase/renewable technologies for public demonstration and education, in such a way that would attract visitors
- Be ideally self- sufficient in energy and demonstrate low carbon building, with the use of local materials if possible
- Be 'adaptable' to other sites in the region

These initial aspirations were developed in consultation with SUP and the concept of an 'exemplar' building gradually emerged. In consultation with the Carbon Centre at the Crichton Campus (Glasgow University) in Dumfries, it was agreed that the development of the Outline Design for a building that would significantly lower the energy demand was preferable to a building built to current building standards.

2.3 The methodology by which an examination of these aspirations took place was by, firstly, developing the Outline Design Brief in consultation with the Business Consultants and the SUP and secondly, by testing this agreed brief in an Outline Design process, which progressed to an Initial Construction Budget (ICB).

2.4 The intention of SUP to progress the findings of the DFS to the next stage of building design with an application for 100% grant aided finance, also informed the study.

2.5 The objectives of the Design Feasibility Study have been met by:

- The development of an Outline Design (OD) of a building that could be developed on the Creetown site. This is described in Sections 4&5
- The preparation of Outline Specifications. These are summarised in section 6, with detailed specifications in Appendix C
- The establishment of an Initial Construction Budget (ICB) . This is addressed in Sections 8&9. The elemental breakdown of costs can be found in Appendix D.
- The preparation of Generic Plans – Diagram 7.0 in Section 7 demonstrating how the development of dimensional co-ordination of the OD by means of a structural grid aids the replication of the building on other sites. A further examination of Replicability issues is to be found in the same section.
- The preparation of cost information relating to developing on other sites, found in Section 9



2.6 In addition, a case has been made in Section 10 for the development of the Eco-Office Project to go forward as a Low - Zero Carbon building, on the basis of its' potential to be an exemplar building that demonstrates how building construction choices can reduce carbon emissions, and provide an environment for the efficient employment of Renewable Energy Technologies.

## **2.7 A summary of the findings, conclusions and recommendations of the Design Feasibility Study is as follows:**

1. Sufficient information for the Outline Design specified to current building standards to progress to funding application if so desired, is available from this study.
2. A strong case for a Low Carbon building at Creetown can be made on the grounds of carbon emissions and the potential benefits to SUP as an organisation and to the local economy. The case cannot be made on the grounds of capital cost alone, but an analysis of the life cycle costs improves the cost/benefit ratio.
3. The study established that the accommodation functions and standards for a shared workspace facility as found in the Outline Design can be sized to any site, or resized for the existing one.
4. The Outline Design Brief, the principles of construction used in the Outline Design and Outline Specifications and guidance from the Initial Construction Budget found in this report could all be transferred to other sites. Additional input from construction professionals will be required, to address other site specific issues and, in consultation with SUP, decisions arising from the findings of this report.
5. It is recommended that a decision is taken, informed by information contained in this report and further research by SUP, whether:

A future site or sites should be developed as a series of one off projects that employ the same principles of building construction and specifications that have been developed in the Outline Design process for the site at Creetown, or standard specifications, with professional fees for the second and subsequent projects negotiated accordingly.

Or

The Design Brief for the next phase of design is predicated upon substantial pre-fabrication methods that will be required to be adapted to more than one site, without substantial design changes. This approach is considered to be feasible only if a 'rolling' programme of construction can be initiated.

## **Section 3**

### **THE LOCATION AND THE SITE**

#### **3.1 The Location**

Creetown, originally Ferrytown of Cree, is a small community of about 750 people in Dumfries and Galloway (South West Scotland), on the north side of the Solway Firth. It was once a fishing village and at one end of a ferry across the River Cree estuary to the former county town of Wigtown. It is best known for its Country Music Festival, Gem Rock Museum and for being a location for the film *The Wicker Man*. Creetown is about halfway between Dumfries and Stranraer, set back from the A75 trunk route. The village has an active Local Initiative and Community Council.

Community consultation was undertaken by Creetown Initiative in 2007 to evaluate local peoples views on the future of the three halls in the village, with the development of the old Youth Club, the building that exists on the site chosen for this Design Feasibility Study, into a shared office development as an option.

As a result there is documentary evidence of support for the Eco Office project from the Creetown Community.

#### **3.2 The Site**

Site address:

Minnipool Place  
Creetown  
Newton Stewart  
Wigtownshire  
Scotland  
DG8 7

#### **3.2 Site Description**

The site is owned by the Creetown Community. It adjoins the boundary to a conservation area situated immediately to the North of it.

The site lies between an existing caravan site and residential properties. The access road, Minnipool Place, is parallel to the Northern boundary of the site and rises more steeply than the site itself. Thus a steep bank is in evidence between the access road and the site itself. The pedestrian and vehicular access point onto the site is situated at the North East corner of the site.

An existing single storey building, of concrete post and panel construction circa 1955, and surrounded with an asphalt car parking area occupies the northern end of the site. This has

been constructed on built up ground on a 'cut and fill' basis, the original ground having a gentle slope. The car parking area has been cut into this slope towards the Eastern boundary and the ground is banked up.

The Southern part of the site is untouched by development, is open in aspect and mainly gently sloping both to the South and from East to West, being higher on the East side. There is a more pronounced slope at the southern end rising more steeply towards the Eastern boundary.

#### Site boundaries

North: A post and wire fence in poor repair separates the site from Minnipool Place.

East: A row of mature deciduous trees approximately 10 metres in height is in evidence along most of the Eastern boundary moving toward bushes, shrubs and dense undergrowth towards the Southern end.

South: A timber fence hidden in dense undergrowth separates the site from an adjacent property.

West: Thinly spaced trees on both sides of a timber fence occupy this boundary on the South side and separate the site from a large garden and a property which is situated further down the hill. Towards the North, dense undergrowth provides privacy to the adjacent property which stands in close proximity to the site boundary.

### **3.3 Site Appraisal**

The site appraisal examined:

- Design Constraints
- Planning Issues
- Opportunities/potential
- Other Issues

The major design constraints on this site were:

- The boundary conditions relating to Planning approval all round
- Conditions for Renewable Energy Technology
- Site massing capacity/scale of development
- Vehicular access

#### Planning Approval

The site is in an area designated for mixed use. Therefore the proposed use of workspace is acceptable.

There is an expectation of good quality design and a two storey building or one that has a 'street frontage' is acceptable, providing the amenity to adjacent properties is retained.

## Boundary conditions- physical and planning

### North

An 18 Metre building line to the facing house in Minnipool Place is required.

### East

Mature trees, 10 metres high, located on the boundary line.

Remaining a 'good neighbour', by not blocking views was also a consideration although adjacent owners do not have legal rights in this matter.

### South

An 18 Metre building line to the house situate 2 metres South of the site boundary is required. This distance could be reduced with single storey development.

### West

A specific planning condition required the visual privacy to the garden of Church House, to the West of the site, to be retained

## Renewable Energy Conditions

### Sun Angles

Although the height and breadth of the mature trees on the Eastern boundary could be reduced, the sun angles, both vertical and horizontal, required for good solar access especially in winter were compromised by their presence. It was decided to retain them due to the amenity that they offered the site and privacy that they offered from the adjacent property.

### Wind Energy

There is no potential for wind energy due to the residential location of the site.

### Vehicular Access.

The site lines from existing access point would need improvement, with the pruning back of tree on the adjacent property, if the site were to be developed.

Due to the slope of the access road, a change of position of the access point onto the site, although possible, would prove expensive. Its existing position became a major design constraint.

The major design potentials were:

- A distant dramatic view
- The slope of the site

#### The View

A long distance view could potentially be seen, from a proposed building to the Cree estuary, from the South East corner. A view of this quality would considerably enhance the amenity and value of such a building.

#### The slope

The slope has the potential, by using a cut and fill method similar to the existing building, of improving building lines to the adjacent properties, required from a Planning perspective. Their amenity and privacy would thus be protected and the impact of the scale of a proposed building, which would be exacerbated by the slope of the site, would be considerably reduced.

#### Other Issues

##### Site Works

##### Demolition

The existing building and hard standing surrounding it require demolition

##### Drainage

The depth of the existing drainage on the site is above average to the slope down to the nearest manhole connecting the site drainage to the main sewer. It is assumed, for the purposes of this study, that an existing manhole could be converted to be used as disconnecting manhole. This assumption would require verification at a later stage.

##### Statutory Approvals

All the statutory agencies, including the Scottish Environmental Protection Agency (SEPA), have been informed of the site investigation for a proposed workspace development underway at feasibility study stage.

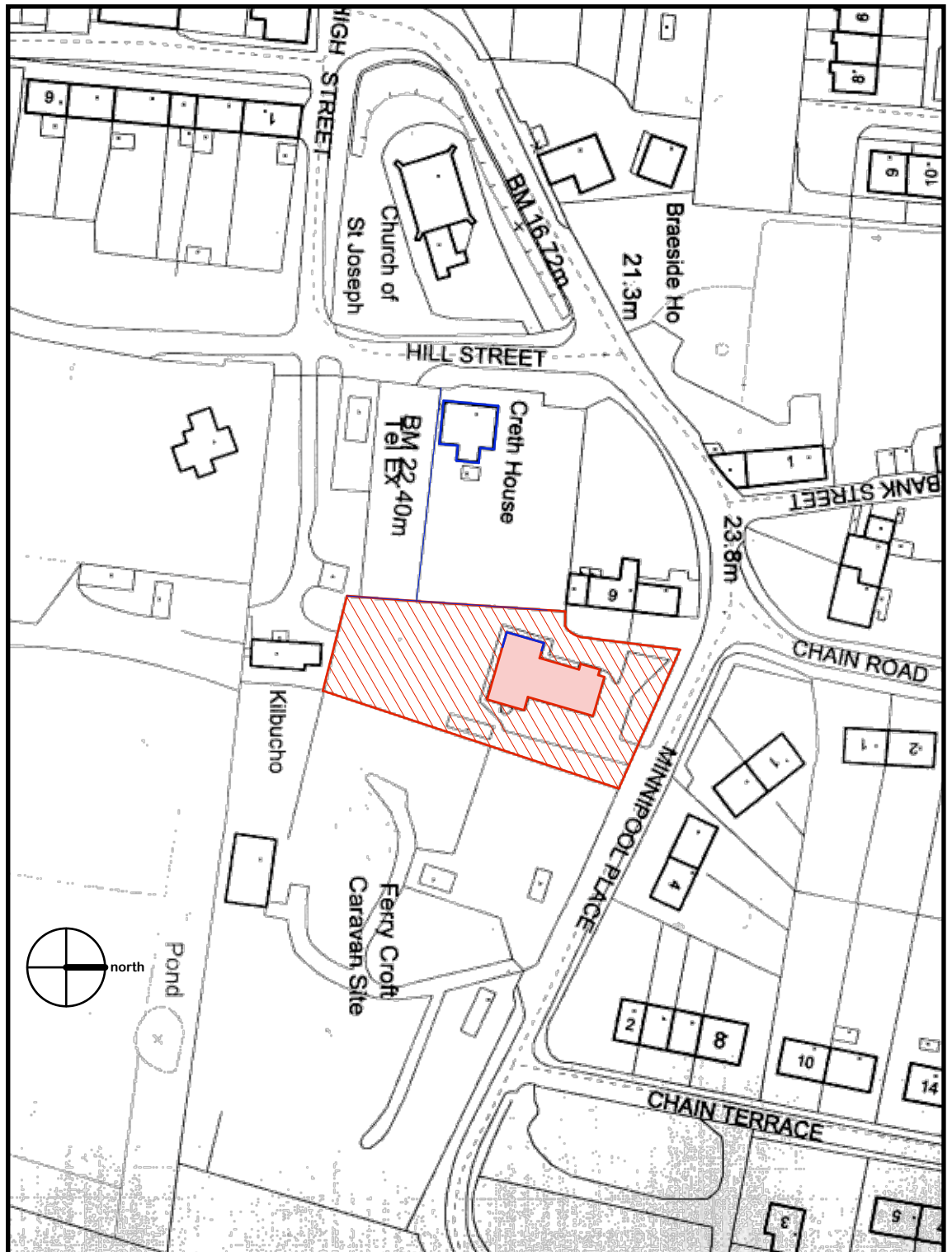
There is no known history of mine workings or hazardous materials on the site.

##### Further Investigations

The Outline Design in this study has been prepared from a site measured survey undertaken by the Architect. Site levels were assessed visually. This information is accurate enough for the progression of a Design Feasibility Study but would require the following investigations at the next stage of design.

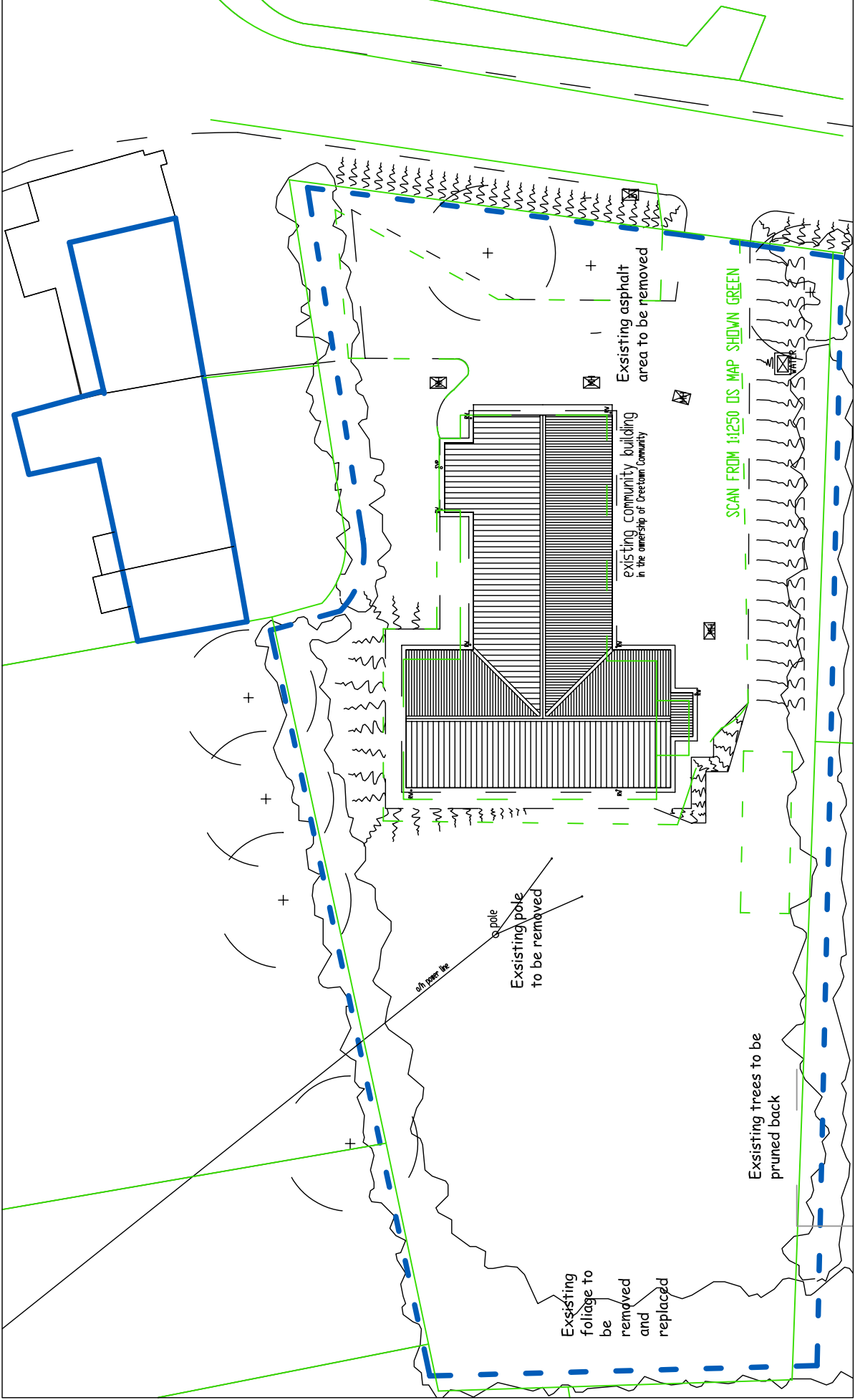
- A laser measured and levels site survey
- A soil survey and boreholes





### LOCATION PLAN • 1:1250

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Plotted scale 1:1250



3.2 Existing Site Plan 1:300



## Section 4

### OUTLINE BRIEF DEVELOPMENT

#### 4.1 The Starting Point

The Appendix to the Design Feasibility Study Brief (DFSB) contained information that required development into an Outline Design Brief. The complete DFSB is placed in Appendix A and the Appendix, that was an important starting point in the outline design process, is as follows:

##### 4.1.1 It is anticipated that the site and building together will:

- Provide a modern, comfortable, and flexible professional shared working environment and ancillary space for several organisations and individuals.
- Demonstrate, in a rural area that a community and socially inclusive facility enhances individual and group work opportunities and organisation by enabling networking and partnership working.
- Engage creatively with the local community during the design and construction phases and with subsequent management (consult with Andrew)
- Express the values of SUP as a socially enabling and environmentally responsible organisation.
- Generate sufficient income for the maintenance of the building and funds for SUP.
- Embody a conceptual and visual distinctiveness that will draw in and intrigue potential visitors, encouraging them to investigate more about sustainable building and the use of small scale renewable energy.
- Embody a sense of place by engaging with the landscape potential of the site
- Act as a vehicle for education and public interpretation of sustainable building, small scale renewable technologies and social enterprise.
- Embody means and processes for building replication on other future sites
- Be an exemplar of low carbon emissions building that minimises its ‘eco-footprint’ through:
  - Appropriate construction techniques and processes
  - The use of renewable technologies
  - Attention to the site potential

- Building design that supports the sustainable use of resources and recycling by the building occupants

It is therefore anticipated that the building design will:

## **4.2 Conserve Energy**

- Design to incorporate passive solar principles
- Airtight construction with controlled passive ventilation and heat recovery
- Mechanical ventilation with heat recovery where required
- Lobbies on all exits for heat retention in winter
- High thermal insulation, heat retaining glazing techniques, and avoidance of cold bridges
- Management of moisture movement through hygroscopic construction and ‘breathing’ walls
- Enhanced levels of natural day-lighting
- Low energy artificial lighting with control systems
- The inclusion of thermal mass

### 4.2.1 By means of the choice of building materials and building contractual arrangements

- Site specific and local materials
- Local building contractors and/or trades people where possible
- Potential engagement with local crafts people

### 4.2.3 By the addition of renewable technologies for:

- Water heating
- Space heating
- Consideration of site appropriate micro-energy generation

## **4.3 Reduce Construction Pollution**

### 4.3.1 By attention to toxicity in construction and use

- Designing out potentially toxic materials through the choice of non Volatile Organic Compounds (VOC) in building materials

### 4.3.2 By attention to construction waste management during the design process and construction

- Design for Deconstruction (ref: SEDA document)
- Use of natural, unbonded and recycled building materials

## **4.4 The Next Steps**

A detailed examination of the proposed accommodation took place in consultation with SUP and an outline brief gradually began to take shape.

## **4.5 The Emerging Outline Design Brief**

### 4.5.1 Functionality

The intention is to build on a site in Creetown, which will be a facility for the establishment of a 'workplace community' that will assist the economic regeneration of Creetown and its surrounding areas, by providing space for embryo businesses and potential development space, if available, for those further in their development cycle.

Workspace with supporting accommodation will be provided for rental as follows:

### 4.5.2 Open Office Space

Workspace from a single desk space to a group accommodation will be provided for rental. Separated by, and using movable screens and office furniture, including private and secure lockable storage for lap-top computers and business files. This will enable a flexible layout of accommodation. A number of small cubicle rooms will be immediately adjacent, in which business telephone calls or quick confidential business conversations can take place, will also be provided.

### 4.5.3 Closed Office Space

Dedicated single room offices for 2-6 people. More than one of the latter can be rented to provide a 'suite' of office space. This type of workspace could also be rented out to people who offer a service to the public, e.g. complementary health practitioners, health and beauty specialists, etc.

Office space of this type would also be available to statutory agencies for which a local presence in the Creetown area would be useful.

### 4.5.4 Central Services

The open office facility will have a central point for photocopying, printing, etc. which can also be used by the closed offices.

For security a reception point into the building will be electronically operated and a small reception desk will be available.

### 4.5.5 Clean Production Workspace

Available for people who make non-industrial artefacts on a small-medium scale - e.g. crafts-workers, model makers, soft toy production, etc.

### 4.5.6 A Kitchen/Common Room facility

To be available for all workspace users for breaks in the working day and a place where informal meetings can take place for networking or working practice. A dining table and

chairs and lounge seating will be provided for this purpose. There will also be informal meeting points for 2-3 people throughout the building.

#### 4.5.7 A Training Room for 20 people

With a movable screen to allow for meetings for 2 smaller groups

### **4.6 The ‘Vision’**

A workplace facility such as that described will attract people who can see the business benefit of working in a place where daily social contact, opportunities for networking, and mutually shared support and encouragement are available and in a building that supports, by reflecting a serious business intention and projecting a contemporary image, their business activity.

Precedents for this type of workplace environment indicate that a community emerges quite naturally in this type of setting and becomes a vibrant meeting place for people and ideas to flourish. The training room helps to service the learning and organisational needs of the whole workplace community.

### **4.7 The Business Consultant’s Requirements**

4.7.1 In order to consult with potential tenants it was necessary to have an idea of how much desk space would be necessary.

4.7.2 Studies of desk space environments indicated the following space standards per desk:

- Open office: 5m<sup>2</sup>
- Closed office: 6m<sup>2</sup>
- Clean Production Space (CPS): 8m<sup>2</sup>

4.7.3 However, at this point there was no indication of the potential size of the building other than it was desirable to know, from a Business Feasibility perspective, the maximum amount of desk space that could be yielded on the Creetown site.

4.7.4 It was proposed that the site at Creetown be tested through a preliminary design process to determine the maximum yield of desk space to let. This was the starting point of the examination of the accommodation requirement from a building design point of view and the testing of the site’s potential for development.

## 4.8 Testing the Site

4.8.1 In parallel with the initial brief building process, a detailed examination (in Section 3) of the Creetown site had taken place.

4.8.2 Sketch drawings were prepared which included a 2 storey element in order to maximise lettable space within the constraints that the site presented. These were derived from desk environments studies and an initial assessment of:

- The design issues for ‘workshop’ inclusion
- Ancillary space provision
- Potential public group access.
- Parking and planning issues

4.8.3 The sketch drawings were informally presented to the Dumfries and Galloway Planning Department in Castle Douglas at a pre-planning application meeting. It was established that 375m<sup>2</sup> was the maximum amount of lettable space that could be obtained on the Creetown site and the business consultants proceeded with their work on this basis.

## 4.9 The Choice of a Low Carbon Building

4.9.1 The choice of a building as an exemplar building for the Outline Design Brief was the subject of informal discussion with SUP during the early briefing stages. It was decided, in consultation with the Carbon Centre at the Crichton Campus (Glasgow University) that the development of a Low Carbon (LC) facility had the best potential as an exemplar building. This reasons for this decision are examined in Section 6.

4.9.2 A brief for a Low Carbon building to be developed for the Outline Design, that would act as an exemplar in the region, went ahead on this basis. The Outline Design would also be costed as a building standards building, with demonstration renewable technologies, so that there would be options for future decision making.

4.9.3 As a result of the building’s exemplar status it is anticipated that small numbers of visitors would come on a pre-booked basis for training courses and/or ‘Seeing Is Believing Visits’ which are grant funded (Forward Scotland). It is therefore proposed that there will be a small exhibition area associated with the main entrance, explaining the technical aspects of the construction and renewable energy technology. The meeting and training room could be made available for them if required, and for business training opportunities and presentations. There will be guided tours of the building and the grounds. However, the workspace should be designed so that these visits do not disrupt working activity.

## **4.10\_The Development Potential Assessment**

4.10.1 The information required for the building consultants and the design requirements for a low carbon building established as a series of building ‘diagrams’, the production of which enabled a number of design variables to be examined. These variables were:

- Amenity issues for adjoining owners
- Disability access
- Solar access
- Daylighting
- Parking
- Construction issues (not visible on the “diagrams”)
- Fire access

4.10.2 The Development Potential Assessment (DPA) diagrams were presented at an interim project meeting. See Diagram 7.0 With the preliminary findings from the Business Consultants study, and in discussion with SUP, these diagrams helped to establish the size of the proposed building.

## **4.11 Finalising the Outline Brief**

4.11.1 It was established that between 40 - 45 desk spaces would be an optimum number of desks spaces for the Outline Design Brief.

4.11.2 This decision led to two accommodation schedules being produced. These contained the estimated space required for:

- Desk space and associated facilities
- Facilities for demonstration and education purposes
- Ancillary accommodation

4.11.3 The Outline Design Brief was now a document to which the Outline Design Process could now respond and is presented in its final form in Appendix B.

#### **4.12 Accommodation Schedule A**

<b><u>Accommodation</u></b>		P/Person M <sup>2</sup>
Open plan office for 20 desk spaces*	100m <sup>2</sup>	5
‘Closed’ office space (also flexible) for 14 desk spaces	84m <sup>2</sup>	6
Productive work space for 6 people	48 m <sup>2</sup>	8
<b>Total Workspace for 40 people</b>	<b>232m<sup>2</sup></b>	
Centralised facilities & office storage (?)	15m <sup>2</sup>	0.36
Kitchen & Informal Networking Space	20 m <sup>2</sup>	
2 meeting rooms for 8 people adjoined by movable partition ( to be used for training for 20 people) + chair store	44m <sup>2</sup>	
Exhibition space (For 10 people)	25m <sup>2</sup>	2.5m <sup>2</sup>
<b>Total Facilities Accommodation</b>	<b>336m<sup>2</sup></b>	
Ancillary Accommodation	112m <sup>2</sup>	
<b>TOTAL</b>	<b>448m<sup>2</sup></b>	

Figures rounded up

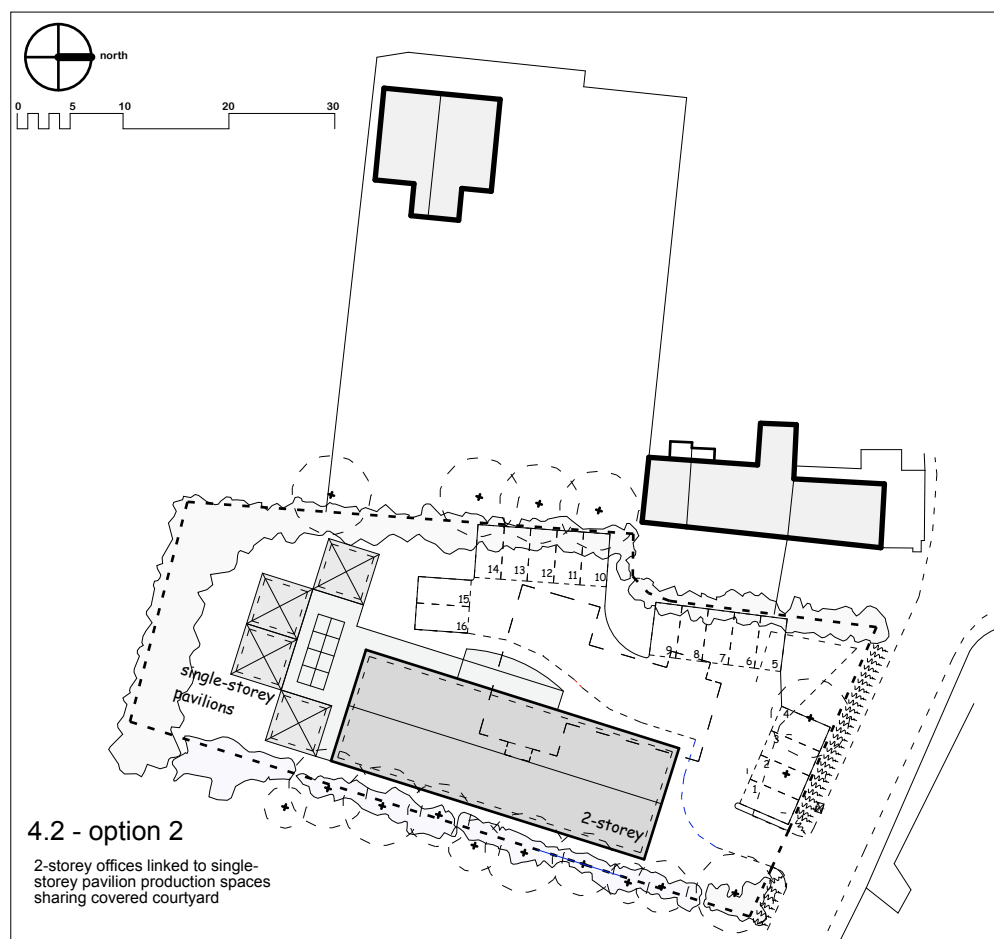
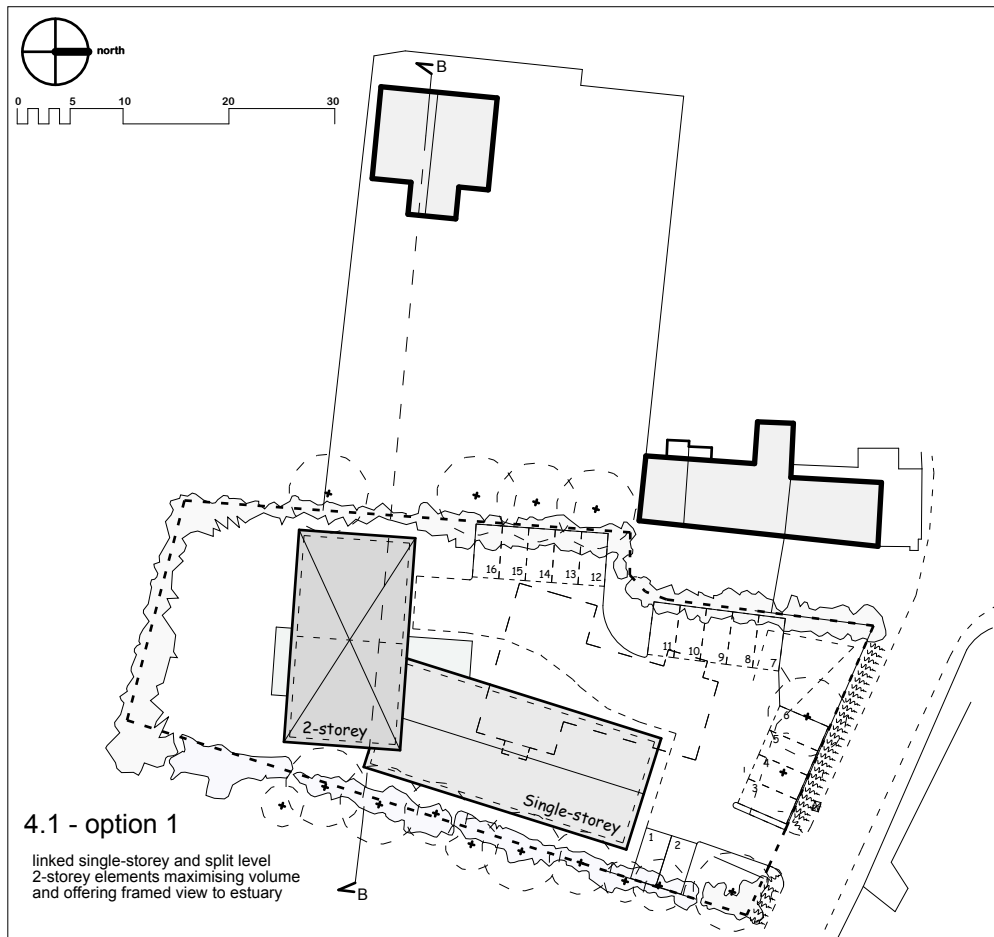
#### **4.13 Accommodation Schedule B**

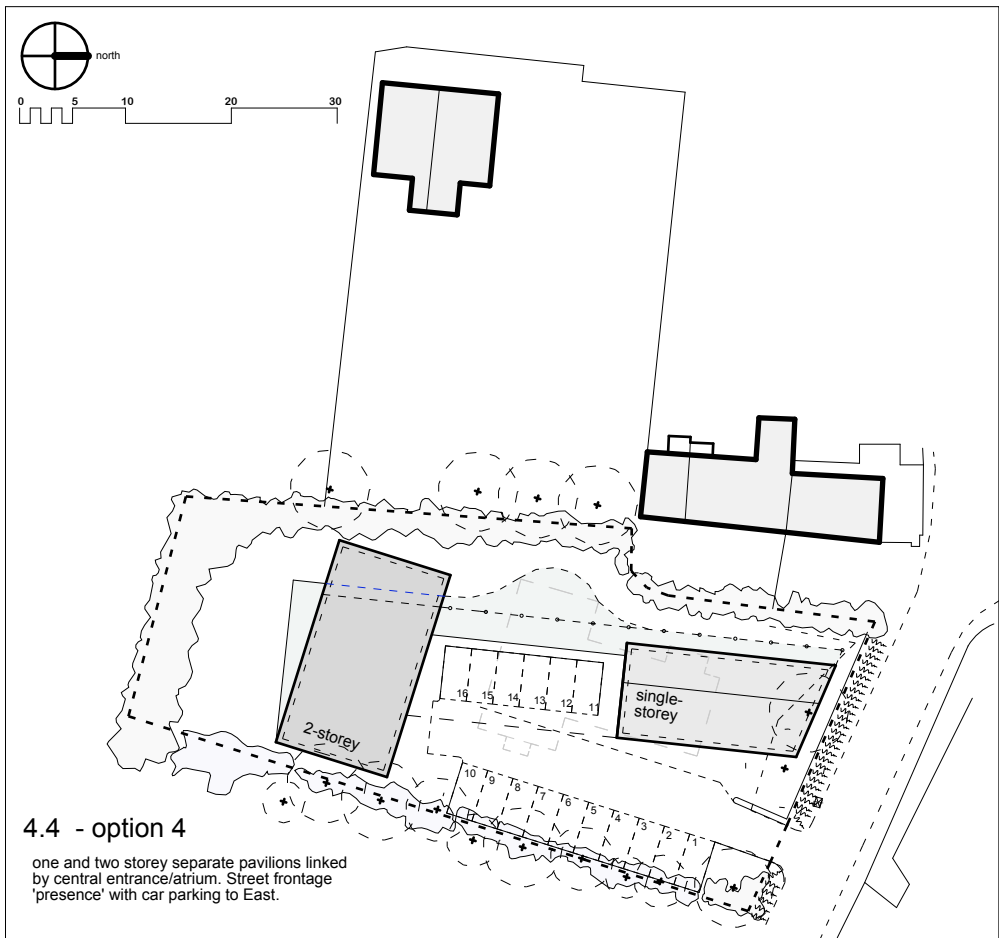
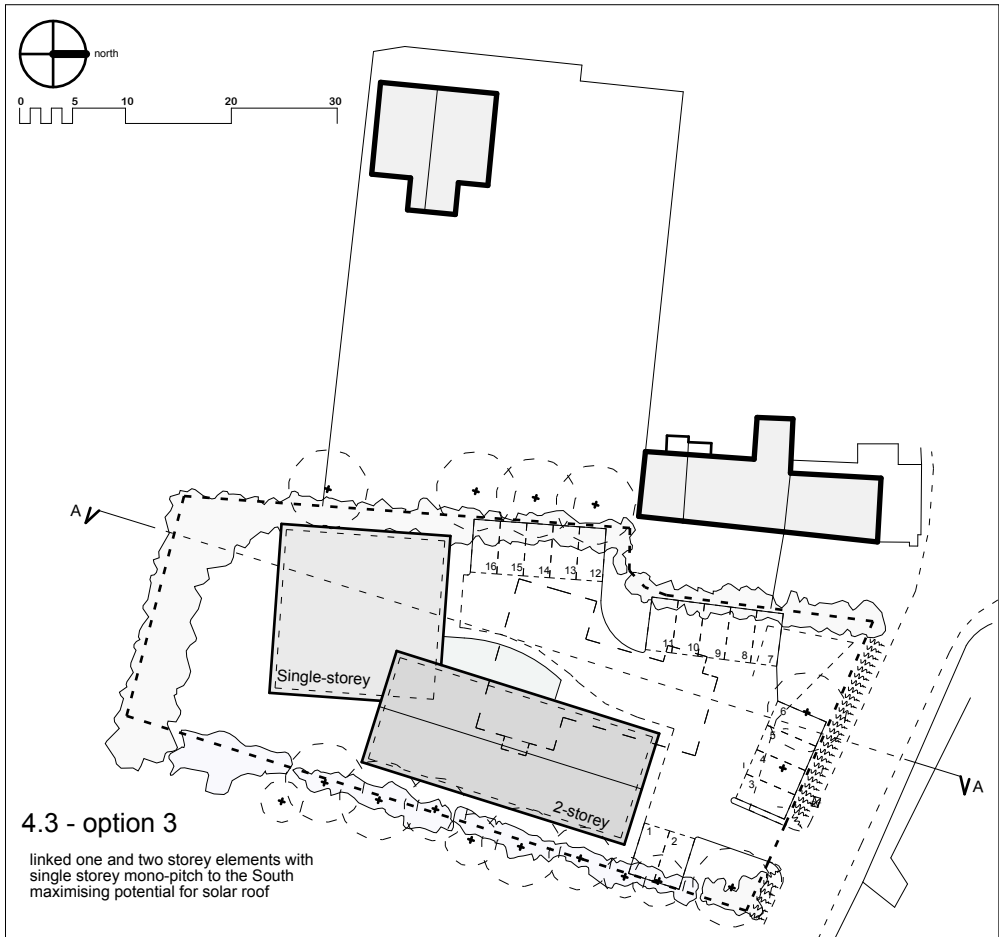
<b><u>Accommodation</u></b>		P/Person M <sup>2</sup>
Open plan office for 25 desk spaces*	125m <sup>2</sup>	5
‘Closed’ office space (also flexible) for 14 desk spaces	84m <sup>2</sup>	6
Productive work space for 6 people	48 m <sup>2</sup>	8
<b>Total Workspace for 45 people</b>	<b>257m<sup>2</sup></b>	
Centralised facilities & office storage (?)	15m <sup>2</sup>	
Kitchen & Informal Networking Space	22 m <sup>2</sup>	
2 meeting rooms for 8 people adjoined by movable partition ( to be used for training for 20 people) + chair store	44m <sup>2</sup>	
Exhibition space	25m <sup>2</sup>	2.5m <sup>2</sup>
<b>Total facilities accommodation</b>	<b>363m<sup>2</sup></b>	
Ancillary Accommodation	121m <sup>2</sup>	
<b>TOTAL</b>	<b>484m<sup>2</sup></b>	

Figures rounded up

+







## Section 5

### THE OUTLINE DESIGN

#### 5.1 Introduction

The production of an Outline Design for a building at feasibility study stage is also part of the design briefing process, i.e. the Outline Design can be examined and ‘interrogated’ by the architect and client together in order to establish the design brief for the next stage. The time constraints of this design feasibility study have not enabled this consultation process to be completed. The Design Brief has therefore been constructed in such a way that potential changes can be easily incorporated later, once decisions prompted by the Outline Design have been made.

The purpose of the outline design process is to examine, for the first time, how the complexity of variables implied by the site conditions and by the outline brief can be encapsulated in a proposal that is robust enough to enable a realistic construction budget to be obtained, a budget that can be used for the development of an actual future design proposal using a Design Brief that has been developed from the outline design process

The outcome of the outline design process is far from being a fully designed building. An outline design for a building at the design feasibility stage can be compared to a ‘first draft of the synopsis’ in a literary situation. It is not a concept for an actual proposed building that will definitely continue on to construction. It has the potential to be developed as such but it will be more than likely to be extensively changed or abandoned, the next design stage being informed by the information and insights that have been obtained and examined during the Design Feasibility Study itself.

#### 5.2 The Design Strategy

Within a design framework for a low carbon building and with the constraints identified, to strategy was to design a building to:

##### 5.2.1 In General

- Maximise solar gain, natural daylight and passive solar design principles
- Take advantage of the site slope in order to maintain privacy to adjoining owners, and increase site capacity potential
- Capture views if possible
- Design to a scale appropriate to the site and to the village of Creetown
- Consider replicability issues
- Consider construction costs

### 5.2.3 Workspace Design

To maximise:

- Flexibility of spatial arrangements
- Natural daylight
- Ease and efficiency of use

To consider:

- Audial privacy
- Informal meeting/networking arrangements
- Storage
- Security

### 5.2.4 Entrance Design

To maximise:

- Impact of arrival
- Image

To consider:

- Clarity of movement organisation
- Separation of building users and visitors
- Ease of movement through draught lobby
- Security

### 5.2.5 Exhibition Area

To Maximise:

- Dual use of facilities

To Consider:

- Separate viewing areas from the building users
- Security (for equipment and display items)

### 5.2.6 Construction: Structure and Building Materials.

#### 5.2.7 Main Design 'drivers'

- Site design responses
- Brief design responses- especially flexibility of open office space
- Image of building
- Low energy building envelope

#### 5.2.8 Consider

- Potential of on-site materials-earth/field stone
- Local building materials
- Possibilities for off- site production (Pre-fabrication)

### **5.3 The Development Potential Assessment (DPA)**

After an interim project meeting, at which the Development Assessment Potential Diagrams 4.2 received a favourable reception, the diagrams were examined further by the design team. Although conceptually diagram 4.2 was interesting, and possibly could be developed for another site, for the Creetown site this potential design solution did not offer adequate solar collection. Diagram 4.3 offered the most potential in this respect and was therefore chosen to be developed into the Outline Design. The DPA diagrams can be found at the end of this section

### **5.4 Design Decisions**

#### 5.4.1 The building form

The building form has emerged from responding to the constraints described in section 3.

It has been designed with a 2 storey element and a 1 storey element.

The ‘hinged’ building form developed from the necessity to optimise solar collection, comply with building lines and incorporate a single lift, necessary to comply with disability access legislation, to join all levels.

The roof form of the 2 storey element developed from the necessity to optimise solar collection and to increase daylight factor on the East side of the ground floor that is overshadowed by the boundary trees, especially in summer.

The roof of the 1 storey element is developed from the necessity to offer the optimum angle to the sun, whilst keeping the building profile as low as possible.

The 1 storey element is built into the slope to keep the building profile as low as possible, to reduce its impact on the neighbouring properties to the South and West boundaries.

The construction and appearance of these elements are described in the next chapter.

The underlying design principles of the Outline Design have been developed in order to examine how the replicability of the building, examined fully in Chapter 7, can be made feasible.

5.4.2 The major design ‘drivers’ were:

- Responding to the site
- Responding to the accommodation schedule and the Outline Design Brief
- Developing an Exemplar Building
- The ‘replication’ of the building.
- Responding to construction cost potentials

## **5.5 Description of the Outline Design**

The following ‘walk through’ description of the Outline Design attempts to encapsulate its’ qualities.

### The Entrance

The building is approached through the car park which will be surfaced with a permeable surface and landscaped with climbing plants on the West boundary and a variety of flowering shrubs and ground cover adjacent to the building. New trees are in evidence, to substitute for the existing ones adjacent to Minnipool Place that are either dead or ailing. A circular bicycle rack is in evidence as one comes down the path to a fully glazed entrance lobby and enters the building.

### The interior

On coming through the entrance door, a glimpse can be obtained through the glazed wall at the far end of the entrance hall into the shared open office. The hall is well lit from the glazed entrance lobby and door and the light, and sun when it’s out, from the large south facing windows in the office area. The sun picks out the etched and stained glass screen between the hall and the open office, achieved through a grant for a local crafts person. (See Appendix F.)

On entering the open office, one’s eye is drawn to the staircase at the far end and a change of floor surface that leads one there. This is the main circulation space for the office and is free of desks. The light floods in from the roof windows above and the design of the mezzanine ensures that this light reaches the ground floor- necessary in this particular location as light from the East elevation is compromised by the trees around the site boundary, especially in summer. Reflectance factors throughout the building are affected by the final decoration scheme. In the open office a light colour would be the most appropriate option.

Upstairs there are a number of individual offices as well as a continuation of the open office space. There is a change of floor surface to sisal carpet which, apart from being cost effective and hard wearing, also helps the acoustic quality of the open space

Back in the entrance hall, a glazed door to your left will lead into a passage way that leads to the clean production spaces and other offices. Halfway down this passage way can be found a seat that is an informal meeting point.

The passage way is bounded on one side by an unfired earth brick wall. Not only is this a pleasing surface texture that improves the acoustic properties of the passage way, but it also

provides an acoustic buffer between the clean production spaces, where there may be machinery running, and the office space. It also provides thermal mass, which evens out temperatures by storing heat and is especially useful in summer time for cooling purposes. Another unfired brick wall is situated in the exhibition area.

Returning to the entrance hall again, this time as a visitor that is arriving for a training session: Take the stairs or the lift down to the lower ground floor, where you will find a small exhibition space in an area with a ceiling that follows the roof line, which gives it a sense of space beyond that of its limited floor area. On a very cold winter day you would also be cheered by the glow of the flame from the room heater that is positioned there. How could you possibly know that this domestic size room heater, the smallest on the market, is also heating the rest of the building unless you read the material in the exhibition? Its heat is distributed through a heating coil in the mechanical ventilation that excludes the need for under-floor heating or radiators.

Here the floor surface changes to ‘Marmoleum’, a breathable and hard wearing surface for the solid floor below, required here for construction efficiency purposes.

You would also pass the door to the common room where, depending on the time of day, there could be a buzz of conversation and laughter. On finally arriving in the training room, you take your seat as the trainer comes into the room, pulls back a folding partition to make the room twice the size, lowers a screen that had been invisible until then, and positions the projector.

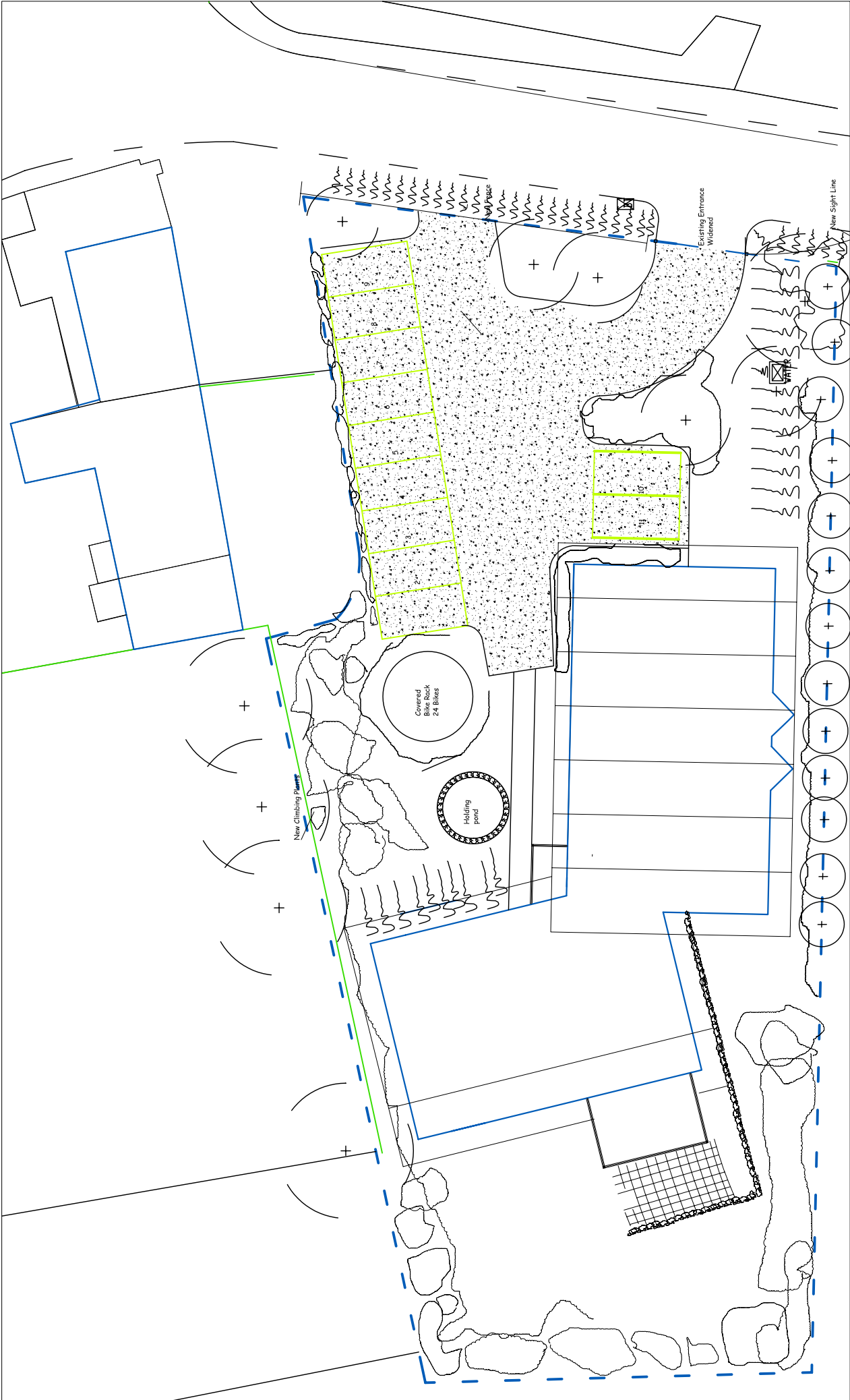
A welcome break into the common room when the residents have departed elsewhere. A room with a high ceiling again. Coffee and snacks in the sunspace and a splendid view out to the Cree estuary.

## **5.7 Viewing the drawings**

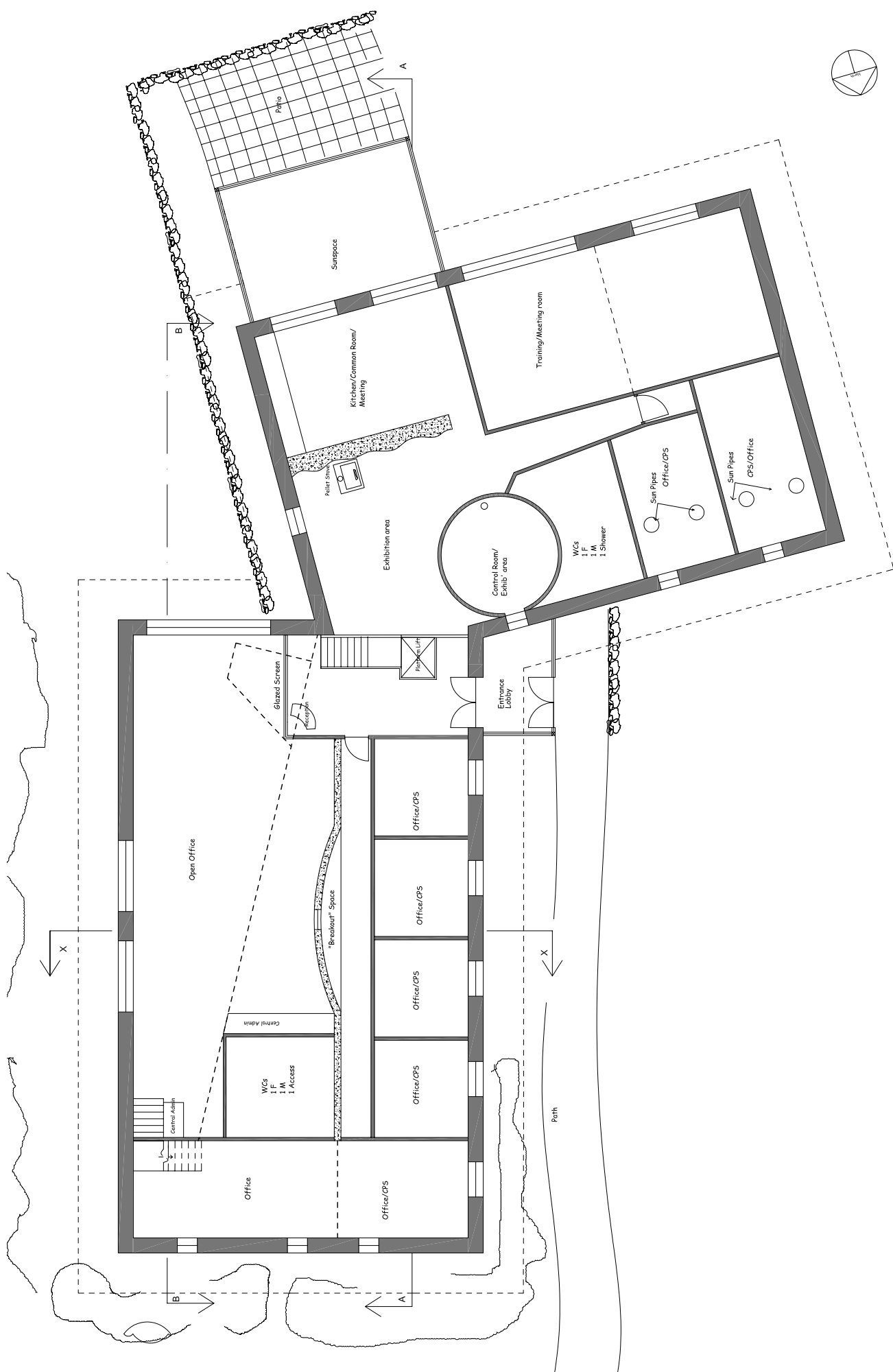
Section 5, with a description of the walling and roofing materials and the Outline Specification, also contains information that will assist an understanding of the Outline Design drawings found at the end of this section.



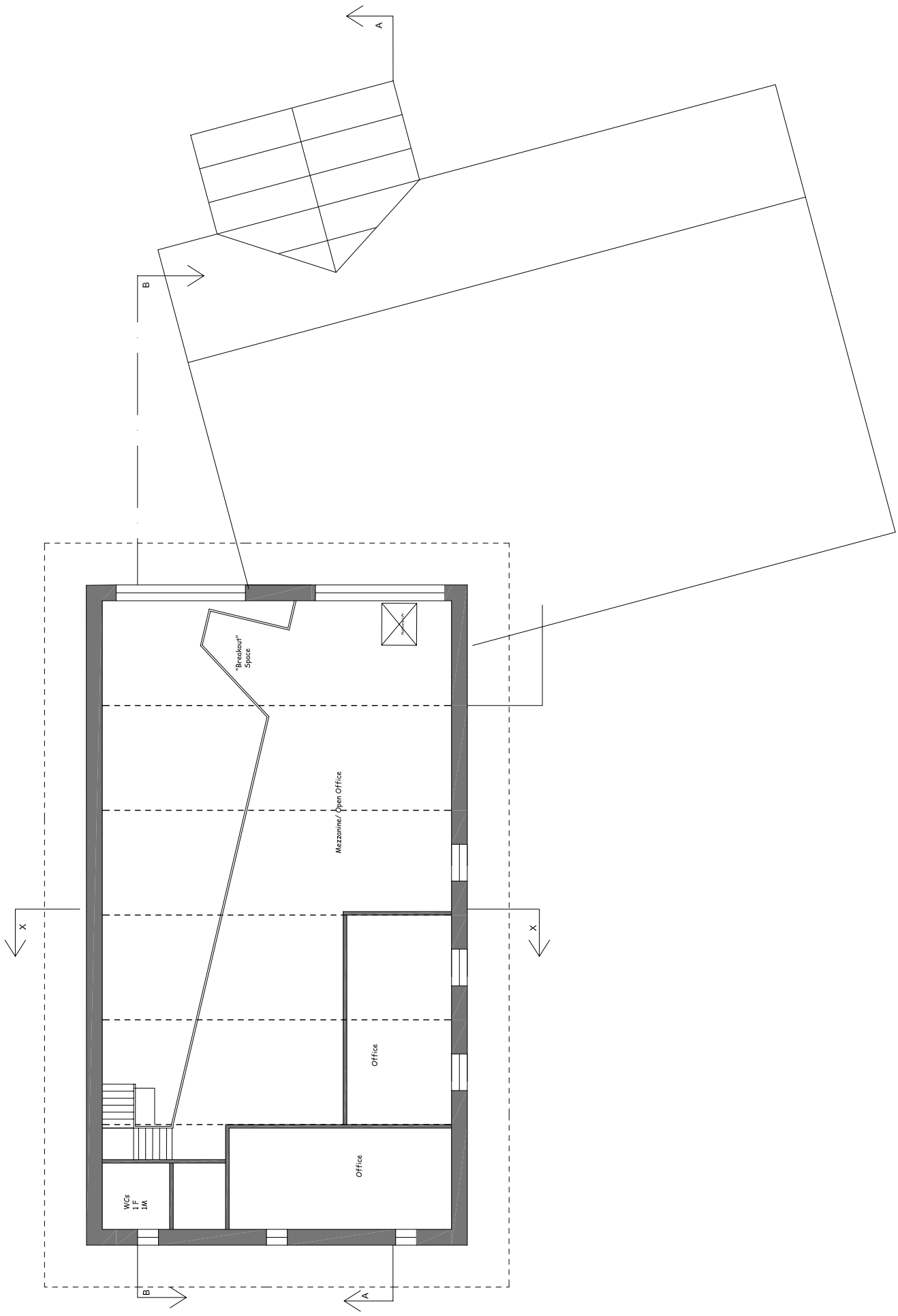




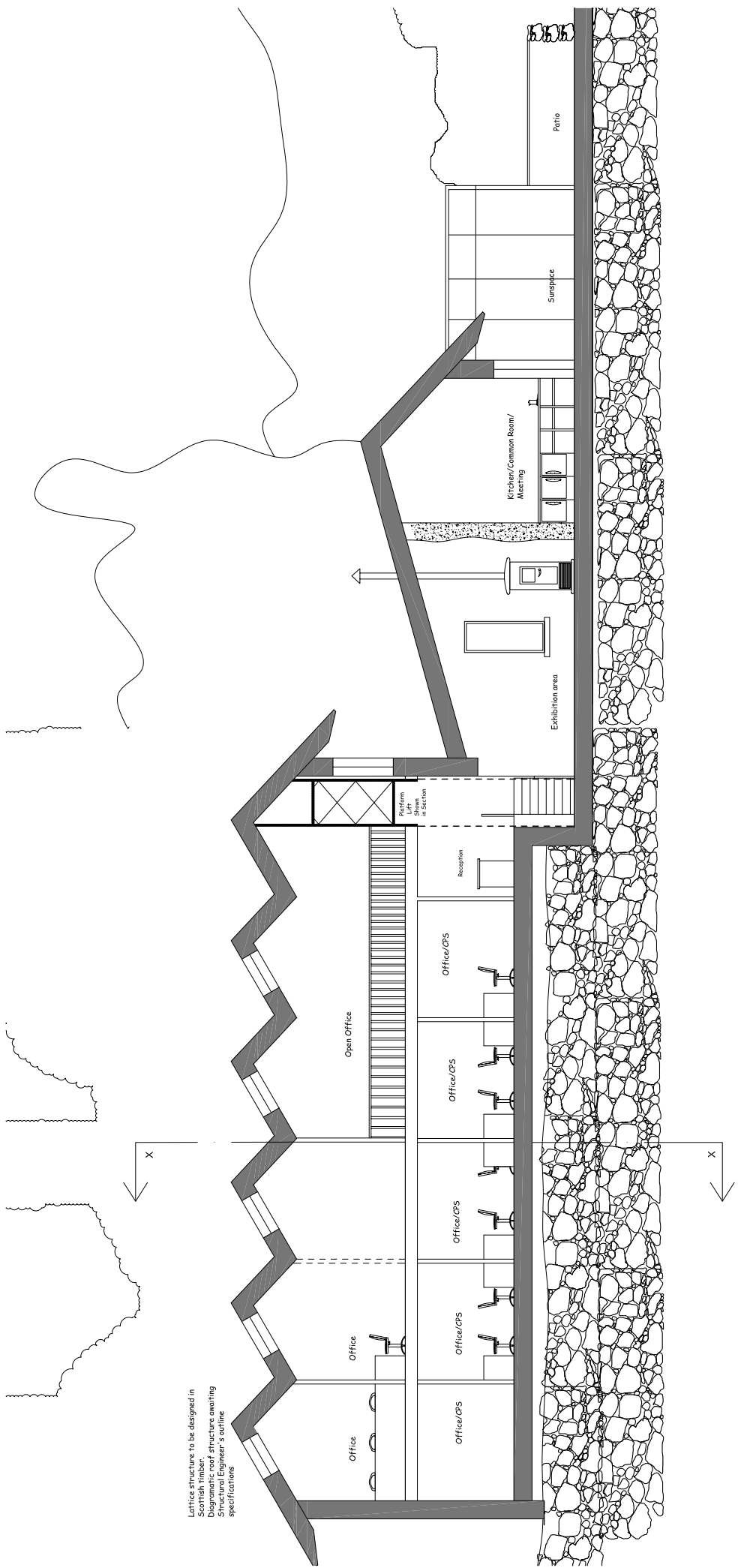
5.1 Site Plan



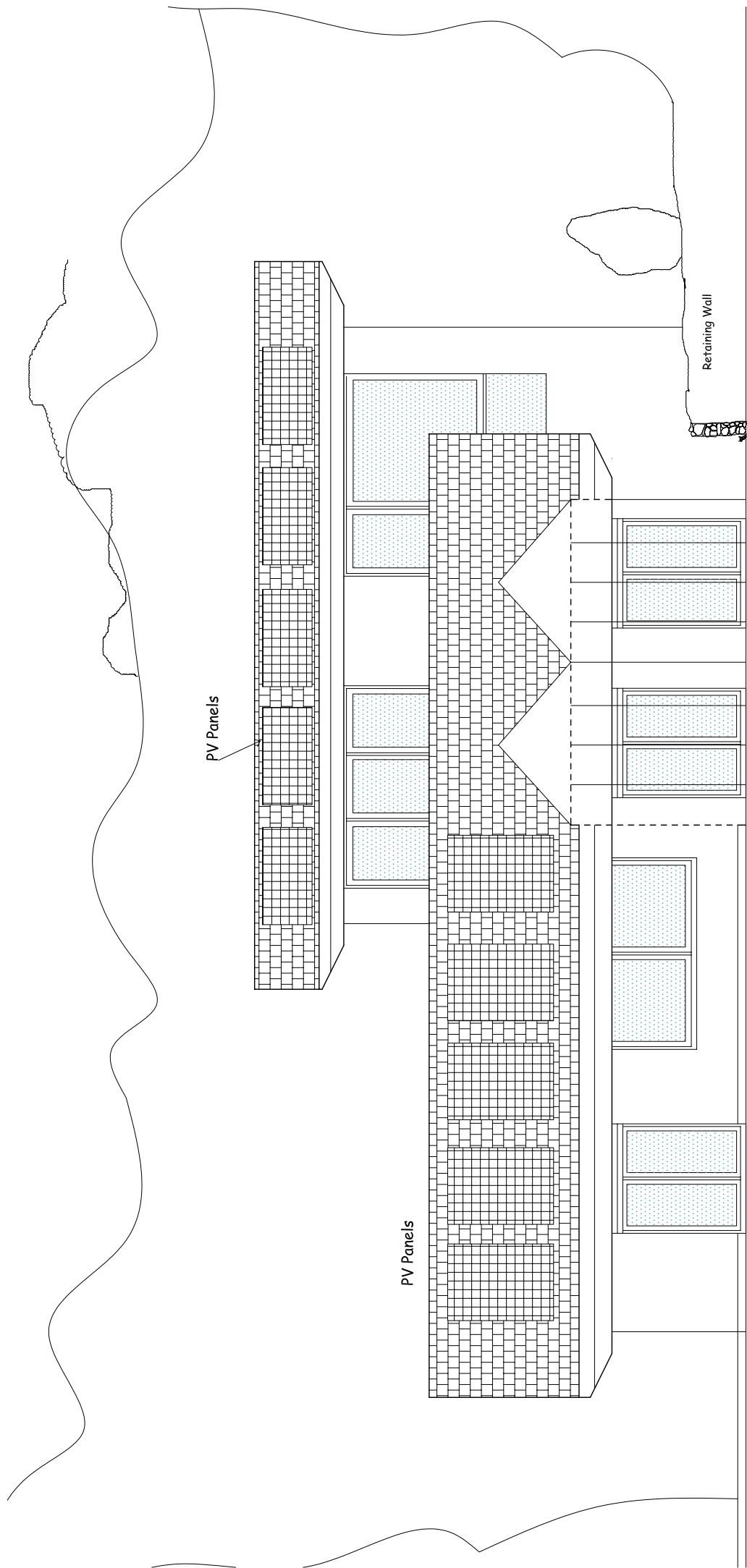
5.2 Ground / Lower Ground Floor Plan



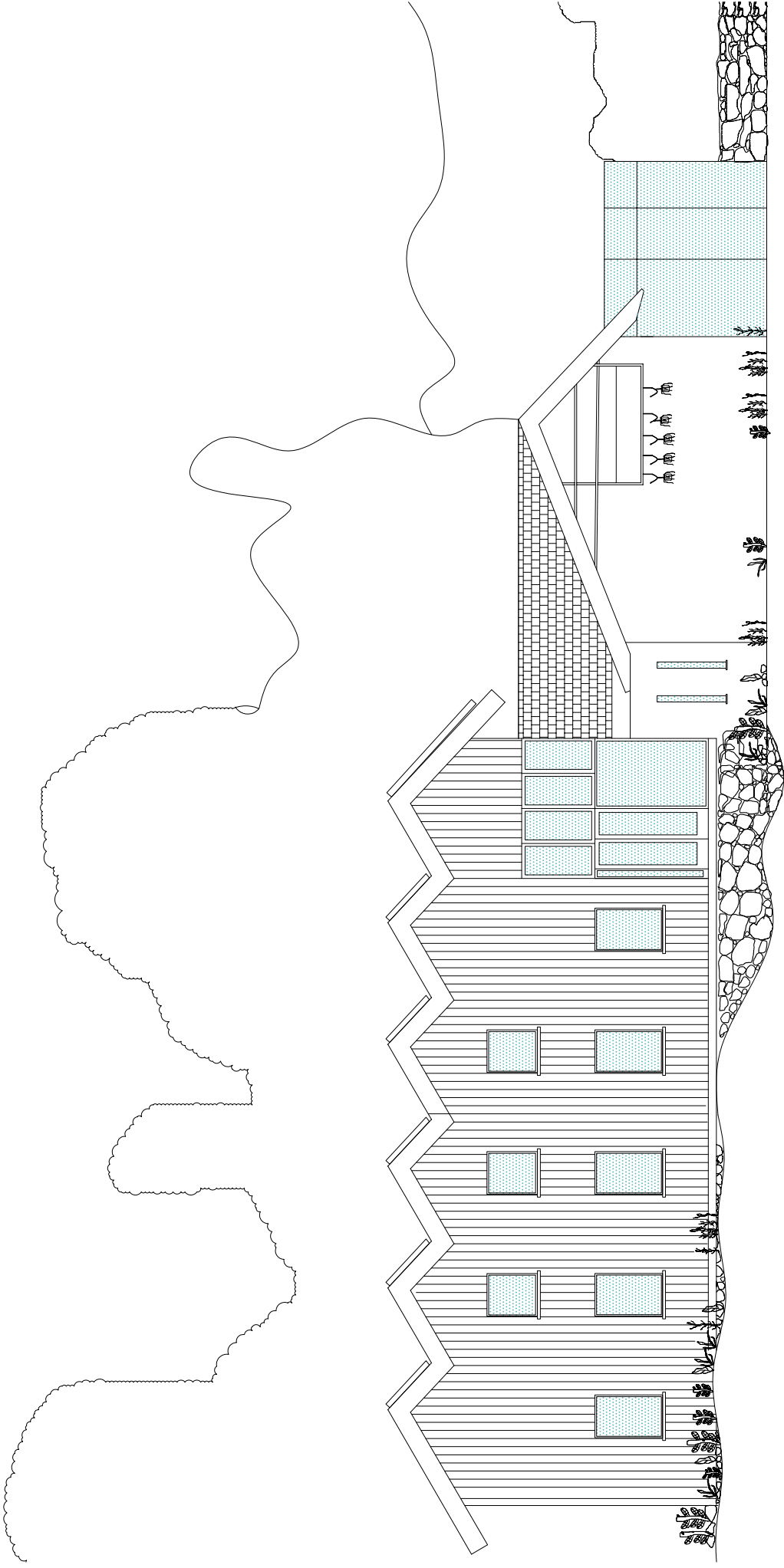
5.3 Mezzanine Level Plan



Lattice structure to be designed in Scottish timber.  
 Diagrammatic roof structure awaiting Structural Engineer's outline specifications



5.5 South Elevation



5.6 West Elevation



## Section 6

# CONSTRUCTION, RENEWABLE TECHNOLOGY AND THE EXEMPLAR BUILDING

### PART A.

#### 6.1 Developing an Exemplar Building: Construction and Building Materials

The design and construction of a Low Carbon (LC) building differs substantially from a building built to current building regulations. Building materials that have been produced using fossil fuels and highly processed (e.g. building boards that have insulation ‘bonded’ to them) are not specified in LC buildings.

Travel distances to site of materials and components are a major consideration. It will be seen from the Outline Specifications (OS) that there are dilemmas here that could be addressed by SUP in the process of developing an LC building. (See section 10).

In the OS, local materials and local skills have been considered. However, some of the materials in the OS are not local but have the potential of being local. Air permeable wall boards are an example of this. They are produced in Germany from forest waste products. Similar boards are not yet available in the UK. Timber shingles, which have been specified as a roof covering, have been included in the ICB, despite the fact that Spanish slate could be substituted at a cost saving of £30,000.

#### 6.2 The differences between a Low Carbon Building (LCB) and a Building Standards Building (BSB)

Please note that the building standards referred to in this report are current standards and incorporate Renewable Energy (RE) technology required for demonstration purposes - see Table 6.2.

An LCB differs from a BSB in the following respects. It:

- Enables and anticipates changing social behaviour through ergonomic design
- Provides the optimum context for the use of renewable technologies
- Contains thermal mass
- Is built with ‘breathing’ walls
- Considers the energy demand of the production of materials and transport (low embodied energy)
- Is built to airtight standards
- Moves beyond reducing carbon emissions and potentially sequesters carbon
- Harvests rainwater
- Incorporates a grey water system
- Uses natural sewage techniques



- Is designed for De-Construction (for future recycling and disposal)
- Is designed with low toxicity in construction and use.

The other principles have been addressed in the Outline Design (OD) and the Outline Specification (OS) for the Creetown site.

### **6.3 The Outline Design:**

Refer to the Outline Specification in Appendix B for more detail.

A summary of the OS is as follows:

#### Structure

The structure is an engineered timber frame made from locally sourced Douglas Fir and prefabricated within SUP's Region

#### Walls

- Boarded timber rain screen (Local timber)
- Lime harling on reed lath (Reed lath comes 'pre-fabricated')
- Hemcrete floor and walls\*

#### Breathing Walls (BW), Floors and Roof containing

- A mixture of 'Warmcel' and Hemp Batts insulation
- Breathable wall boards and membranes

#### Roof

- Oak or Larch timber shingles

#### Windows and External Doors

- Triple glazed and argon filled

#### Internal finishes:

- Clay plaster on thermal and internal quality board throughout, finished with eco-paint.
- Reclaimed hardwood floor
- Jute/Sisal contract carpeting on Scottish softwood flooring
- Contract 'Marmoleum' on the solid floor area

#### Other Items:

- Electrics- non PVC cables
- Gutters and downpipes - non PVC

#### Hemcrete\*

Hemcrete is a mixture of hemp and lime - recently introduced to the UK, from Europe, by Tradical. Trained, licensed operators spray the material onto either permanent or temporary shuttering pinned between the timber frame. Once dry, Hemcrete is permeable, has a high thermal value and is cost effective. The material also comes in the form of blocks.

The use of Hemcrete walling arose in the OD process because a solid floor, required for construction efficiency purposes in the single storey section of the building, introduced this material into the construction process

Hemp production is underway in the UK, mainly in the South West, where the farmers have recognized its' value as a commercial enterprise.

### Scottish Timber

Imported timber is currently used in the construction industry in preference to Scottish timber, because of perceived constructional disadvantages of using home grown material. This perception has been challenged<sup>1</sup> but a building built with Scottish timber will have slightly larger structural sections to compensate for its lower stress grading.

## **B.**

### **6.4 Developing an Exemplar Building: Renewable Energy Technologies (RET)**

#### The Exemplar Building

The high specification of the building envelope of the outline design has established that a conventional heating system is unnecessary, even on moderately cold days in winter. Thus there is little renewable energy demonstration potential from technologies that use water as a distribution system - ie biomass central heating. Passive solar panels can be used for the hot water supply and this technology will be available for demonstration purposes. However this technology has been in use for some time and an exemplar could be expected to develop further the educational and training aspects inherent in an LC building.

It has also been noted that the difference between solar panels that produce hot water, PV cells and wind generation is not well understood by the general public. As wind generation is not available on the Creetown site, the inclusion of PV cells demonstrates how direct electrical power, via the installation of suitable batteries, can be obtained from daylight, for lighting and other appliances.

These considerations led to the inclusion of PV technology in the Outline Specification, despite the capital expense. The technology and an explanation would be on display in the exhibition area. The building is not an 'autonomous' building and will be connected to mains electricity as a back-up.

The absence of a conventional heating system, as the OD at Creetown demonstrates, is a much needed demonstration model that could stand alone, without the PV technology, using mains electricity from a green tariff for the lighting and power required.

After an examination of the OS by the Renewable Energy Engineer it became clear that the specification of the OD would allow the building to be considered as a zero carbon building (ZCB) on another site where wind or hydro generation was available.

The development of an Exemplar on another possible future site is described in section 9.

## **6.5 The Outline Design: Renewable technologies**

### **6.5.1 The OD at Creetown**

The principle of providing the optimum context for the use of renewable technologies has been met by the construction specification.

Further to this the OS also contains thermal mass in the form of two unfired earth brick walls. A rammed earth wall was considered and can be seen in this form on the OD drawings. (See section 8).

#### The Outline Specification (OS): Renewable technology specification

The following issues were addressed during the preparation of the OS:

- Energy demand and supply
- Both winter and summer conditions

The specification of the building ‘envelope’ reduces the energy demand of the building.

The following specifications were examined for the Renewable Energy Technology specification:

- Heating and Hot Water
- Backing up both systems in unfavourable solar condition
- Ventilation
- Daylighting standards

It became clear that the OD would not require a conventional heating system and that the reduced heating demands, for pre-heating and cold snaps could be met by an automated wood pellet domestic room heater, with a back boiler, to boost the internal temperature to above comfort standards. The heat would be distributed via a heating coil in the ventilation system.

The room heater is placed in the exhibition area where not only can it be a demonstration piece of equipment for visiting groups, but it can be glimpsed from the entrance, giving cheer from the flame on severely cold days. A small box of wood pellets would be stored in a kitchen cupboard for manual stoking.

The daylighting standards are higher than average, reducing the need for artificial lighting during daylight hours. Roof windows give the interior a high daylight factor.

	Types	Energy source	Location
Winter space heating	Not required		
Winter ventilation	MV +windows	Daylight/Photovoltaic (PV) Mains	
Back up heating	Hot water coil in MV system	Automated biomass room heater	Exhibition area
Winter hot water	Room heater	Room heater	Exhibition area
SUMMER			
Summer ventilation	Windows +MV	Daylight/Photovoltaic (PV)	Roof
Summer hot water	Solar panels	Sun	Roof
Boost/Back up hot water	Immerser(?)	Daylight/Photovoltaic/Mains	

Table 6.1 ENERGY SOURCES TABLE (LCB)

- PVs produce electricity in daylight. However calculations are arrived at as kW<sub>p</sub>, the 'p' being peak. Peak PV production requires a bright sky thus an orientation towards the South is preferable.
- PV panels have a life expectancy of 25 years and require very little, if any, maintenance\*.

The details of the calculations made for this specification can be found in Appendix E

### 6.5.2 The OD as a Building Standards Building

The same issues of demand and supply in both winter and summer as the LCB were addressed

A biomass boiler for central heating and solar panels for hot water have been specified in the Outline Specification. In addition there is a small heat pump for demonstration purposes. The report findings have reservations about this specification on the Creetown site. See Appendix E.

	Types	Energy source	Location
Winter space heating	Underfloor heating	Biomass Boiler	Boiler room
Winter ventilation	MVHR +windows		
Back up heating	Heat pump		
Winter hot water	From storage	Biomass boiler	Boiler room
SUMMER			
Summer ventilation	Windows +MV		
Summer hot water	Solar panels		Roof
Boost/Back up hot water	Heat pump		

Table 6.2 ENERGY SOURCES TABLE Building Standards Building

MVHR: Mechanical Ventilation with Heat Recovery

MV: Mechanical Ventilation

The details of the calculations made for both specifications can be found in Appendix E

## **6.7 The Outline Specifications and the Outline Drawings**

\* denotes where this can be seen on a drawing

The West and East elevation of the 2 storey element is clad in timber boarding\*. The North elevation is finished with lime based harling.

The roof is made up of a series East/West pitched roofs to give good solar access.

The windows on the West elevation\*, together with the windows on the South elevation\* and the roof windows, satisfy the high day lighting requirement.

The 1 storey element is constructed in a different manner from that of the 2 storey element for site specific reasons and is clad entirely in lime based harling to suit that construction. \*

The roof here is an asymmetric duo pitch, optimally pitched on the south side for solar panels. Also on the south side, a glazed sunspace which opens out onto a patio and inwards to the kitchen/common room is in evidence. \*

The Outline Design process then proceeds to the preparation of the Initial Construction Budget found in section 8.



## Section 7

# REPLICABILITY

### 7.1 Introduction

7.1.1 Some of the design decisions in the Outline Design were made as a direct response to site specific requirements. These decisions are explained in Sections 4 and 5. However, the principles which governed the Outline Design have the potential of being replicated for different future locations in the Southern Uplands Region. This chapter is intended to examine this potential in the context of current construction industry practices. How SUP incorporates the principles examined in the Outline Design or other future agreed principles into the Design Brief for the next stage will, it is to be hoped, be assisted by this understanding.

7.1.2 The replication of buildings is usually considered because of perceived advantages in cost, both in the building fabric and in design fees, or construction time, or both. The issues are complex, and a full discussion of them is beyond the remit of this report. Nevertheless, a number of issues can be raised that may be helpful.

### 7.2 The Outline Design

7.2.1 The Outline Design demonstrates the way in which a building can have a detailed response to the site in order to meet the construction client's briefing requirements in spite of a variety of design constraints.

In the context of designing for a Low Carbon building, the two principles of using locally produced standard construction components and standard specifications have been examined together. A degree of prefabrication is possible, if the building contractor chose, with some elements being constructed on site. It is likely that the services would not be pre-fabricated and the building would be finished with clay plasters and lime renders.

#### 7.2.2 The potential for pre-fabrication

The Generic Plan diagrams (Diagram 7.0) indicate the potential for building replication, giving different orientations for different site conditions.

7.2.3 The outline Design has been designed to a structural grid of 10 metres x 3 metres. The breadth (10 metres) of the building envelope was determined by site constraints at Creetown. Designing to a grid enables a simple system of dimensional co-ordination to be set up for potential pre- fabrication purposes.

7.2.4 The roof trusses would be prefabricated at a timber engineering facility, in the local area. The pre-fabrication of floor, wall and roof panels would be within the scope of local building contractors.

7.2.5 A pre-fabrication system for the internal partitions would be designed at the next stage of design.



7.2.6 Where a building goes ‘off the grid’ as in diagram 7.6, the site conditions found at Creetown are replicated. Manipulating standard components in a non- standard manner implies a higher construction cost which compromises construction cost savings that are inherent in pre-fabricated system

### **7.3 Replication and Professional Fees**

In practice, no project is 100% repetitive to the degree that there is zero architectural and other technical and professional work. When a building has originally been designed with replication in mind, it should be noted that:

- Another site will be different, making necessary a re-evaluation of the suitability of original design. Amendments will follow.
- Improvements to the original ‘prototype’ will most likely be necessary as building user evaluation will have been received and SUP’s requirements may have changed for other reasons.
- Local site and ground conditions will require, at least, re-evaluation of the original structural design.
- Different services and site access will certainly require a fresh site layout.
- Client cost constraints and quality of specification will require verification and, most likely, adjustments to the design.
- A new planning application will be required, and a Building Warrant. The latter is subject to changes in Building Standards legislation
- All the tender and contract administration procedures will still be required.

In circumstances where there is no change to the original design and all parties have gained from previous experience and are working from essentially the same brief, it is reasonable to conclude that time and cost savings should be available and that this will be reflected in the price of professional services. The normal procedure is to negotiate fee levels at the time of commissioning when guidance on copyright issues would also be available.

### **7.4 Acting Locally and Replication**

- Local contractors, and ‘self- build’ and volunteer assistance
- The Outline Design

#### **7.4.1 Local Building Contractors**

Perceived cost benefits of standardisation should be compared to addressing the tendering process with local building contractors. Building contractors are resistant to change and high tenders associated with low carbon building are related to this fact. Familiarisation with the

techniques and materials of low carbon construction is necessary and this, together with the introduction of improved management practices, has the potential to pass economies through to the construction client.

7.4.2 The construction industry throughout the UK is hampered by the following:

- Lack of local skills
- Instability of supply lines
- Inclement weather

Construction processes and management practices on small projects can be improved with training and the Construction Training Board can be approached for assistance. Training workshops for low carbon construction throughout SUP's region would enable low carbon construction capacity to be established.

7.4.3 Supply lines for LCB can only improve with use. The business opportunities for such a scenario are growing fast but are outside the remit of this report.

7.4.4 The issue of inclement weather and the provision of improved working conditions is not confined to low carbon buildings. It can be addressed by temporary construction enclosures which are already in evidence amongst the better organised building contractors.

## **7.5 'Self-Build' and the Volunteer Assistance**

The use of low carbon building materials is in evidence amongst self help and volunteer groups. Incorporating self build and volunteer processes alongside professional construction would require a form of building contract that would manage enthusiasts, including health and safety requirements, and this could be examined at the next design stage if it were considered appropriate. However, issues of liability would need to be addressed.

## **7.6 Replication and Low carbon Building**

7.6.1 Low Carbon Buildings (LCB) perform differently from buildings built with current UK construction practice, due to the presence of materials that are chosen for their low embodied energy content, breathability and waste management. These qualities are not present in the majority of construction components on the market. The LCB supply line is growing fast, however, but, apart from prefabricated elements such as windows and doors, there are few prefabricated components on the market. The exception to this are the Tradis insulated structural panel system and a prefabricated straw bale system that is currently under construction in a new office building for York City Council. If these systems are of interest to SUP, further research would be required to assess their suitability.

7.6.2 However, perhaps more importantly, one of the principles of Low Carbon (LC) building is low embodied energy in construction. Some pre-fabricated construction components use highly capitalized manufacturing procedures and have to travel considerable distances to the point of assembly. The use of local building materials is paramount in LC construction, and these can be pre-fabricated by local contractor as required.

## **7.7 The Site and Standardisation**

Finding land for development at an affordable price is one of the most difficult aspects in building procurement. There is no such thing as a standard site and the site specific conditions are always present. From a rural regeneration perspective the use of infill sites in villages is an appropriate way for SUP to intervene and these are usual quite limited in size and with non- standard geometries. The renovation of disused buildings with or without an extension is also the most ecologically sound way of building. If SUP goes forward with the development of some of the forms of standardisation addressed in the following paragraphs, opportunities for development may be missed.

## **7.8 Replication Issues**

A building can be replicated by:

- The use of standardization and/or pre-fabrication in design and construction
- Working closely with Local Building contractors

The Outline Design has been developed with both of these considerations in mind, examining methods that are relevant to SUP's needs.

## **7.9 The Use of Standardisation:**

In order to place the LC building option in the context of current construction industry practices it is necessary to examine some of the principles of standardisation and pre-fabrication.

There is a variety of methods by which standardisation can be approached. Making use of existing standard building companies is one approach, for a building that is:

- Designed specifically for SUP, as a standard building
- Designed using standard construction components
- Designed using standard specifications

This begs the question of what are the benefits of standardisation? Will there be cost and time advantages for SUP?

## **7.10 Modern Methods of Construction**

Modern Methods of Construction (MMC) have not been included in this feasibility study but the reasons for its exclusion needs to be made clear, which are as follows:

MMC are based on the requirements of the UK mass construction market, particularly with reference to housing provision. Although MMC address some of the issues in the construction industry with regards to the potential quality of the end product and with providing better working conditions, the prime driver of MMC is the shortage of suitably trained construction workers in places of high construction pressure, with particular reference to London and the South East.

MMC requires financial investment for the gearing up of technical capacity to suit the mass scale of operation. This sort of investment has not arrived yet in Scotland. Any building carried out in the SUP region of operation would be subject to considerable distances.

Although European grant funding is available in some circumstances, it is understood that it applies to larger organisations than SUP

MMC increase the prefabricated element in construction that has been present and growing in the construction industry since the late 1940's. In that sense it is not modern. The concept of MMC has been used before, in the establishment of heavy concrete system building in the 1960s. In that sense the 'method' in MMC can be, with reason and in spite of extensive technical advances, questioned. Other processes of prefabrication and construction are more appropriate to SUPs requirements.

Prefabrication can take place at any scale from whole buildings to building components. But at some stage the prefabricated elements arrive on site, where they are subjected to inclement weather. Prefabricated construction elements require vigilance in storage and have been known to fail because of the lack of it.

The point of failure in building construction is nearly always at a joint. And joining construction elements that have been produced by MMC requires a high degree of precision. This requires a trained workforce, many of whom are recruited from overseas.

For all these reasons, the size and technical requirements of projects that use MMC as a prime method of construction are large and complex- much larger than that envisaged by SUP. This together with the lack of investment in Scotland have led to the exclusion of MMC in this Design Feasibility Study.

## **7.11 Methods of Standardisation**

### **a) Making use of existing standard building companies**

Although not considered in the Design Feasibility Study, SUP may wish to investigate the use of standard building companies. It should be pointed out that although it may appear at the outset that there are time and cost savings in this form of procurement, if there is any change at all to the standard, this benefit is eliminated. The upgrading of specification to include more insulation would be costly. As yet, a standard building company that offers a low carbon solution is unknown to the author of this report.

#### b) A standard building designed specifically for SUP

SUP's intention, as documented in the ODB, is to develop 3 sites in the region. Unless a standard building that had been designed specifically for SUP was procured with the intention of it being the subject of a rolling programme of construction, it would not be an economically viable option.

#### c) Design using standard construction components

The use of standard construction components is in common usage throughout the construction industry and been in a gradual process of development since the post-war years. These components sometimes travel great distances to the point of assembly but if they are project specific they can be pre-fabricated locally.

#### d) Design using standard specifications

The use of standard specifications is also common practice in the construction industry. A palette of building materials specification that is chosen in consultation with the construction client at the design stage can be replicated in more than one project.

### **7.12 Pros and Cons of Standardization/Pre-Fabrication**

The design judgments about project specific use of pre-fabrication have to be made in the light of potential benefits in:

- Cost advantage
- Quality control
- Construction time

#### 7.12.1 Cost

The potential of these benefits will differ with each building project depending on its location and purpose.

The cost benefits of pre-fabrication are relevant only on large production runs.

#### 7.12.2 Quality

The potential for quality control at the point of workshop/factory production is increased and construction waste can also be minimised and easily recycled. However, the performance of the finished product depends on site management, workforce skill, and supervision at the final assembly point.

#### 7.12.3 Time

A high degree of prefabrication is required in order to incorporate services. If this cannot be obtained then pre-fabrication opportunities are limited. The incorporation of services saves on-site construction time considerably.

7.12.4 Construction time benefits depend on the type of construction. In the case of timber frame construction, prefabrication can range from the timber frame only to the prefabrication

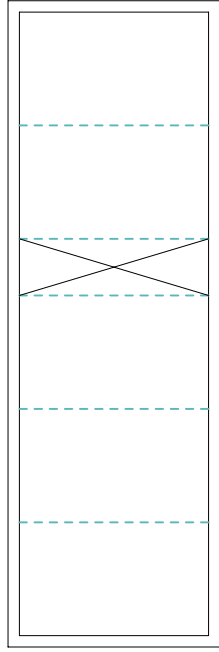
of complete panels, including insulation, for walls and roofs. The latter are entirely dependent on excellent quality control at site level. Such panels have been known to fail because of poor site storage or construction management during inclement weather. Prefabrication is relevant to construction work above the wall plate level - the position where the damp proof course goes in. The site works below that level are the same whether the superstructure is pre-fabricated or not. The time spent on site works depends on the type of soil, levels of ground and the weather. Prefabrication statistics relating to time benefits do not take site access, foundation and drainage construction into account.

### **7.13 The Way Forward**

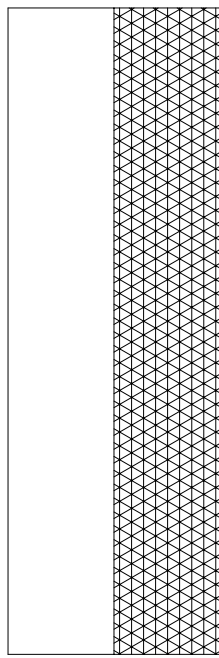
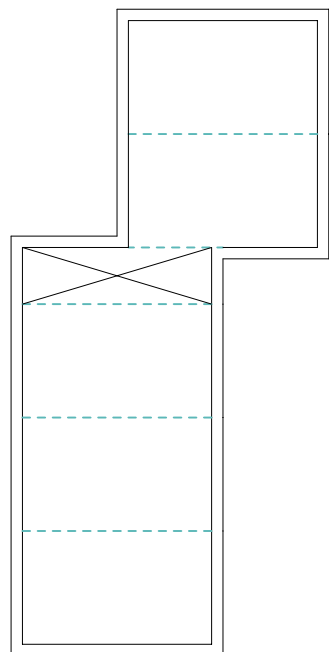
As can be seen from this chapter there is a considerable variety of approach. The SUP may wish to carry out further research on this matter before a Design Brief for the next stage of design is finalized. (See Section 12)

# NORTH / SOUTH ORIENTATION

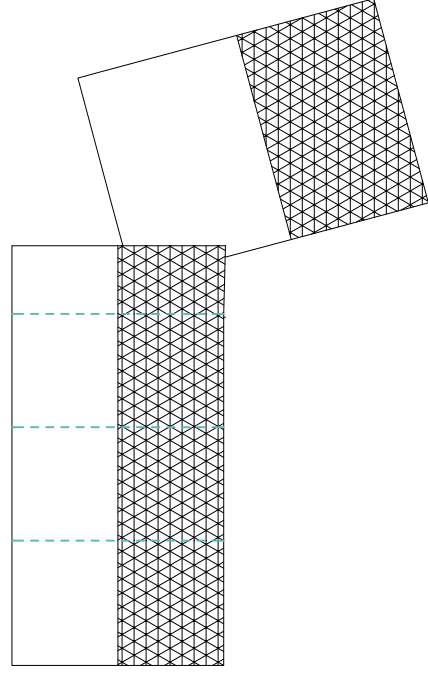
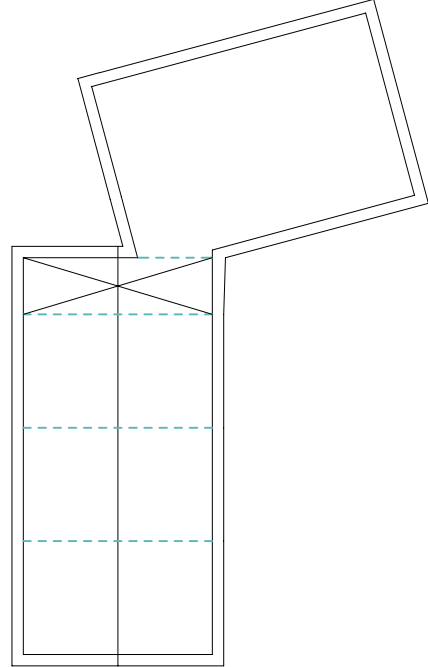
1. Standard



2. Adjustable to site Geometry

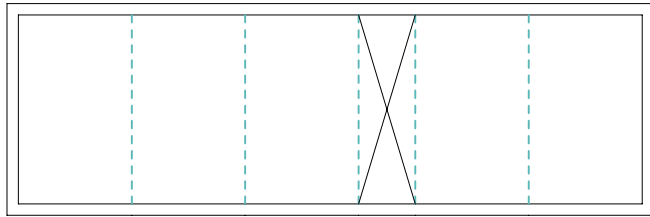


3. Tailored to site conditions. Introduction of non-standard construction elements at the 'hinge'

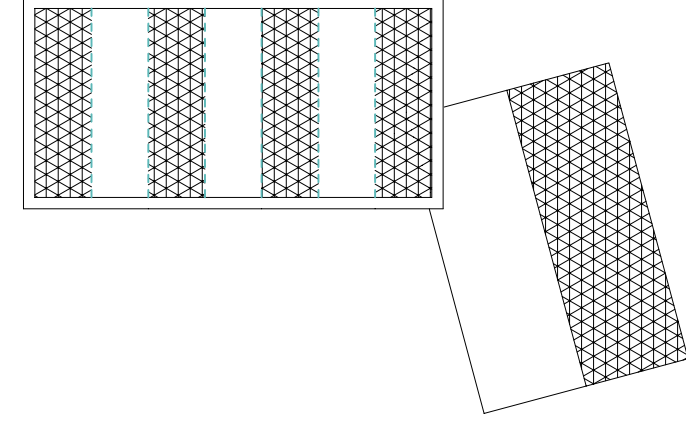
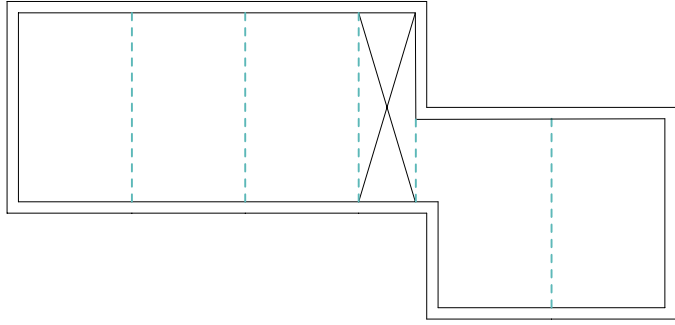
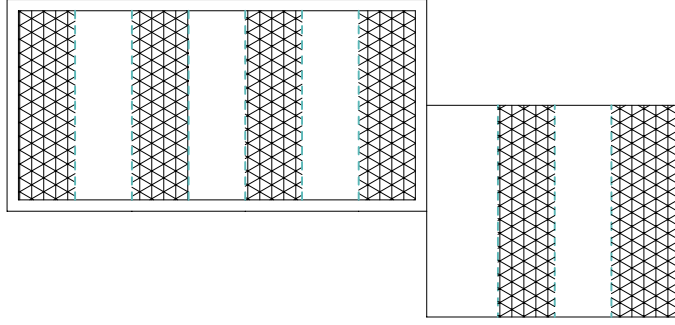


# EAST / WEST ORIENTATION

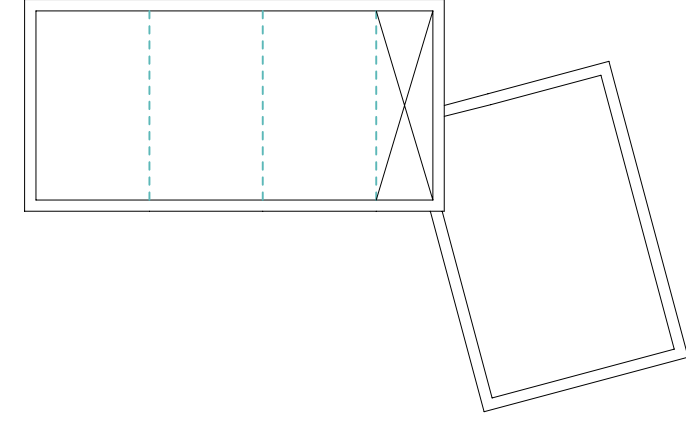
4. Standard



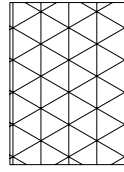
5. Adjustable to site Geometry



6. Tailored to site conditions. Introduction of non-standard elements at the 'hinge'

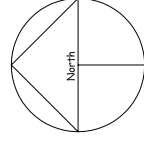


All types can be 1 or 2 storeys and extendable indicated by the area



This Red Hatching indicates the Solar Collection area of the roof

# 7.0 Generic Plans







## Section 8

### THE INDICATIVE CONSTRUCTION BUDGET

8.1 An Indicative Construction Budget (ICB) for the Outline Design has been created by interpreting the drawings and specifications with current quantity surveying methods and practice at the feasibility stage.

8.2 The ICB is presented in elemental form, accompanied by a short report, in Appendix D.

8.3 The ICB for an Outline Design to current Building Standards (BS), which includes renewable energy technology (detailed in Table 6.2 in Section 6), is obtained from a database of precedent costs, as detailed in the report from the Quantity surveyor in Appendix D.

8.4 The Outline Design and Outline Specification have been costed as a traditionally constructed building. Some items in the specification can be re-interpreted for pre-fabrication at the next design stage if required.

8.5 The following table, indicates a realistic Indicative Construction Budget for the proposed Eco-office, built to either specification, on the site at Creetown.

	<b>Creetown</b>	<b>Creetown</b>
	Low Carbon Building	Building Standards Building
Indicative Construction Budget	£1,065,500.00	£765,000.00

Table 8.1

Both construction budgets include preliminaries at 11% and a contingency sum of 5% in addition.

For example, in the ICB for the low carbon building at Creetown, the preliminaries are:

£100,562.00 with a contingency sum of £50,738.00

Both Construction Budgets are exclusive of VAT and professional fees.

8.6 The low carbon building at Creetown includes a figure of £41,000 for photo voltaic cells. The reason for this specification is given in Section 6. Wind or hydro energy is not available on the Creetown site. The calculations made in the Renewable Energy Engineer's report refer to an array of 142m<sup>2</sup> of photo voltaic cells, but the cost of these, at £125,000, was considered to be excessive for budgetary purposes, and a reduction was made in order to be able make a more reasonable comparison with the option of a building built to current Building Standards. (See Section 9)

### **8.7 VAT**

Depending on SUP's VAT status, one of the following regimes would be applicable to a building project:

- Paying it in advance
- Paying it and reclaiming it later
- Being zero rated

VAT would be payable at the current 17.5% rate if SUP is not eligible for zero rating.

VAT is normally payable on professional fees

Specialised VAT advice is recommended.

8.8 Professional fees are required for the following construction consultants for the next design stage:

Architect  
Landscape architect  
Access consultant  
Quantity Surveyor  
Planning Supervisor (CDM)  
Structural /Civil Engineer  
Renewable Energy Engineer

Fees can be negotiated or based on the estimated construction cost. If the latter method of calculation is employed 15% - 18% can be expected

## 8.9 Background

It is known that the specifications for a low carbon building are more expensive.

The reasons for this are as follows:

- The building materials and techniques are not yet widely used and are therefore in a minority market.
- Materials currently in production in Europe cannot be sourced in the UK
- The construction skills required have not been widely developed.
- There is a scarcity of labour for techniques required for LC buildings
- Building Contractors 'price high' for items that are not within their experience

## **8.10 Matters arising from the ICB**

The Indicative Construction Budget continues to be explored in the next chapter where it is presented together with other considerations.

During the next design stage it is expected that design, construction and technology changes will be made within the space allocation and construction budget/s set in this feasibility study.

## **8.11 Using the ICB in this report**

The budgetary information in the report is project specific and should not be used out of context with this report.



## Section 9

### ALTERNATIVE SCENARIOS

9.1 The four scenarios that have been considered are:

a) **Proceeding with the development of the Creetown site** with either:

1. A Low Carbon Building (LCB)  
or
2. A building built to current building standards (BSB) that would also demonstrate renewable technologies. See Table 6.2 , Section 6.

b) **Developing another site** with either:

3. A Zero Carbon Building (ZCB)  
or
4. A building built to current building standards that would also demonstrate renewable technologies.(BSB) See Table 6.2, Section 6.

9.2 The data available for the production of the elemental Indicative Construction Budget (ICB) enabled the site specific costs at Creetown to be identified. Even though site specific costs can be expected in any building project, the ICB for the Creetown site could be reduced on other sites.

9.3 In addition, the Creetown site is not suitable for wind generation. Disregarding cost, PV cells do not have the capacity at Creetown to supply the entire energy demands of the building.

9.4 On another site, if wind generation were available, the outline design developed for Creetown would have the potential of becoming a zero carbon building.

9.5 This table indicates the potential difference in the ICB if another site or sites were developed.

	<b>Creetown</b>	<b>Creetown</b>	<b>Other Sites</b>	<b>Other Sites</b>
	<u>Low Carbon Building</u>	Building Standards Building	<u>Zero Carbon Building</u>	Building Standards Building
Indicative Construction Budget	£1,065,500.00	£765,000.00	£990,000.00	£720,000.00

Table 9.1 Comparative Initial Construction Budgets (ICBs)

9.6 In a cost/benefit analysis of low and zero carbon buildings, their development costs are offset against their life cycle costs. The following table makes a comparison between the scenarios studied.

	<b>Creetown</b>	<b>Creetown</b>	<b>Other Sites</b>	<b>Other Sites</b>
	<u>Low Carbon Building</u>	Building Standards Building	<u>Zero Carbon Building</u>	Building Standards Building
Indicative Construction Budget	£1,065,500.00	£765,000.00	£990,000.00	£720,000.00
Average Annual Energy Costs	£1,484.00	£3,462.00	Maintenance only	£3,462
Average Potential Annual Income			£1,320.00*	

Table 9.2 Comparative ICBs with Average Annual Energy Costs

**NB**

All construction budgets include preliminaries at 11% and a contingency sum of 5% in addition.

All Construction Budgets are exclusive of VAT and professional fees.

\* This sum assumes selling excess electricity to a supplier for 3p/kWh. With Renewable Obligation Certificates (ROCs) and other benefits this would increase to 6p/kWh. Figures for wind turbine output are based on a wind speed of 5 metres/second which is low for Scotland.

The PV cells in the ICB for the Creetown site supply a reduced amount of electricity from that stated in the RE Engineer's report (Appendix E) and the annual energy running costs have been recalculated accordingly.

## Section 10

### **TOWARDS A ZERO CARBON BUILDING - THE CASE FOR DEVELOPMENT**

An argument for a low-zero carbon building cannot be made on cost grounds alone. At present, the price of energy does not reflect its true value and low carbon building materials and techniques are relatively expensive compared to those being currently conventionally used. Payback periods for renewable energy systems are often in excess of 10 years. This cost/benefit balance will, almost without doubt, change. As the methods of low carbon construction improve and are utilised by all developers, they will become the norm rather than the exception by cost conscious consumers. The speed of change seems to be already increasing, though no definite time period can be estimated.

Making a case for the development of a low-zero carbon building would be facilitated by comparative carbon emissions data for the building options. However, as The Carbon Lite (sic) programme (presently being promoted by the Building Research Establishment) states, 'there is currently no tool to aid in producing a fully comprehensive low carbon design', and data for the embodied energy of the materials and emissions due to the construction process are the subject of ongoing research worldwide. Reliable figures are not yet available.

This report includes estimates of energy use for the building, which may be regarded as a first approximation to carbon emissions. More accurate data can be obtained from software simulations, but this was not considered appropriate for this stage of the study, because they require details of the building construction and services which have not yet been agreed. The calculations and information required for the application for a Building Warrant, namely the Target Emissions Rate (TER) and Building Emissions Rate (BER), will be determined when these further details are established.

Therefore, at this early stage of feasibility testing, the recommendations in this report have been based on professional knowledge and experience, accepted practice in calculation, and peer-reviewed research.

#### **10.1 The Case for Development**

The case for the development of a low- zero carbon building that would also meet SUP's social objectives is therefore made on the basis of this being an exemplar in the field of carbon foot-printing, both in the construction of the building itself and by the way it has the potential to assist changing patterns of user behaviour through aware ergonomic design.

The reduction of carbon emissions is the issue. The feasibility of developing methods by which that can be achieved through construction has been one of the major objectives of this study.

## **10.2 Buildings and carbon emissions**

The construction of buildings, and the energy required to heat and provide power for them, account for just over 50% of carbon emissions in the UK. An involvement with building processes which can reduce this level of emissions is therefore to be recommended. If not for any other reason than responding to existing legislation on climate change, and anticipating future legislation.

For example, the Government's Climate Change Bill is already progressing through Parliament. It aims to reduce carbon emissions by 60% by the year 2050, with the interim aim of a 30% reduction by 2020. The current Climate Commitment legislation which is targeted on large organisations may very well come SUP's way in the near future.

### **10.3 What benefits can be gained from SUP's involvement in this project?**

Whilst this is difficult to predict in detail, such involvement with a low carbon construction and having the foresight to address issues which have become important in developing the theory and practice of environmentally aware developments identifies SUP as a responsible organisation that is willing to embrace change. Therefore there is the potential to be seen as proactive to these issues:

- As an organisation
- As a construction client
- As a building owner
- As a landlord

## 10.4 AS AN ORGANISATION

### **Benefits of being at the leading edge**

- Attracting grant and research funding
- Attracting interest from beyond SUP's designated region
- High degree of motivation of staff
- Potential of satisfying results for the general public in SUP's region
- Additional benefits to be gained by the Region
- Enhanced profile in terms of anticipating and responding to likely environmental issues

Any or all of the above could enhance SUP's public profile especially in terms of its ability to lead, to enable business activity, and commission and engage in environmentally important research.

### **Developing a Low – Zero Carbon Office Facility**



The type of construction technology that is evidenced in this report has been in the development stage for the last 20 years. There are a growing number of examples of such construction throughout Europe. In Scotland there are many projects that take one or more of the LC construction principles described in this report forward. However a concept of an Eco-Office with a comprehensive low-zero carbon specification has not yet been developed.

As a consequence, this will be the subject of attention from an educational and training perspective. There is likely also to be interest from the general public.

### **The Development of Local Businesses, Training and Education**

With particular reference to the Outline Design and the work involved in its preparation , some potential training and business opportunities connected with the construction process, became apparent, as follows:

Working with the local communities to enhance:

- Training and new business opportunities
- Engaging with local building contractors to create partnerships between clients and contractors and develop improved standards and practices

#### Training Opportunities

Construction training in the use of LCB materials and techniques has the potential to provide an improved climate for future building contract tenders. Building contractors submit high tenders for work with which they are not familiar. Some of the training opportunities that arise from the OD are:

- Working with Scottish timber (Perceived as unusable by the majority of building contractors in Scotland )
- Constructing breathing walls
- Designing out toxicity
- Working with clay and lime plasters
- The installation of solar technical systems
- Building with earth and field stone
- Managing Construction Waste (The largest waste stream in the UK)

#### Business opportunities

There may be benefits to the local economy by sourcing materials, both for construction and in use, as locally as possible as follows:

- The production of hemp\* for construction purposes
- Training licences for hemp/lime construction
- Training licences for ‘Warmcel’ insulation
- The production of sheep’s wool insulation
- The production of non toxic building boards
- The production of Oak or Larch timber shingles
- Building materials reclamation

## Hemp in Construction

See Section 6

## The Low Carbon building as an Educational Resource

Because of its' capacity as an educational and training resource an LC building will have a higher than usual public profile. This may also benefit business due to the advertising potential and for contact opportunities due to visitors.

## The absence of a conventional heating system in an LC building is a much needed demonstration model.

'Seeing is believing' tours funded by Forward Scotland, can support confidence building, required before moves towards this standard can be considered by the general public

An exemplar model, in the OD, has been achieved by the specification of the building envelope. These specifications and techniques would also be available to the general public, and for training purposes by:

- Visiting and experiencing the building itself
- Small scale construction mock-ups and models in the exhibition
- Viewing videos of the construction process\*
- Producing software for an inter active computer model

These three latter inclusions would require grant funding separate from the construction budget.

## A video\*

Made by a professional film maker, the production of a film of the entire construction process could be considered for educational and training purposes. A film such as this would have the potential of demonstrating construction techniques in detail, which has also potential for commercial sale. In the Outline Design the video would be viewed by the general public in the training room next to the exhibition space on the ground floor.

The video could also include material that was relevant to 'retro-fitting', renovation and repair using the principles and techniques explained in the video.

In addition, an interactive computer programme would enable the general public to obtain answers from a journey of questions based on their own personal requirements and experience.

The management of these visits could provide employment for a local person or organisation and there maybe other opportunities for the local community to participate in the facility of an Eco-Office

The management of a low carbon building has business benefits for the users in sourcing appropriate business supplies

#### 10.5 AS A CONSTRUCTION CLIENT

It can be seen from the business opportunities that may arise from developing a low-zero carbon Emissions building that by becoming a construction client SUP would have the potential to develop a significant leadership role in this field. Links into some of SUP's existing interest areas may also be significant.

#### 10.6 AS A BUILDING OWNER

A low- zero carbon building will be protected as an asset through its' high rating with Energy Performance Certification.

#### 10.7 AS A LANDLORD

The potentially low running costs of a low-zero carbon building will be reflected in the rental charges.

#### Maintenance and repair

Low Carbon buildings are beginning to be designed to be easily taken apart for disposal purposes and potential re-use (De-Construction). They are therefore potentially more easily repaired and maintained than conventional buildings.

#### Research

There is potential in the construction of the Low Carbon building model for action research projects which may attract funding.

### **10.8 In Conclusion**

There has been little mention in this report of the impact of low-zero carbon construction on health. Pilot projects are required where this impact can be assessed by agreed research methods. Anecdotal evidence suggests that the benefits of such construction methods are significant both for the users of an LC building and the workforce that constructs it. With health and safety legislation increasing in all fields of endeavour it suggests that it will soon catch up with the built environment. It appears that sick building syndrome is not a health hazard in low carbon buildings and can be positively beneficial to those with allergies and asthma. The Scottish Ecological Design Association (SEDA) will publish a report, partly funded by the Scottish Executive, on this subject in the near future

Advances in the construction industry toward the low-zero carbon building techniques itemised in this report would, as the sector that is responsible for the largest percentage of carbon emissions in the UK, have significant impact on their reduction. Construction clients have an important role to play. By anticipating future concerns and requesting a response to their constructional requirements for a low-zero carbon development, SUP is in a position, as an organisation of considerable repute in the region, to act as a catalyst in this field of endeavour. For their own benefit and the benefit of many others.

For all the reasons laid out in this Section, and for others detailed elsewhere in this Design Feasibility Report, the progression towards the development of a Low-Zero Carbon option for the Eco-Office project will be addressed in the conclusions to this report in Section 11.



## Section 11

### CONCLUSIONS AND RECOMMENDATIONS

#### 11.1 Findings

##### Specifically for the site at Creetown

The findings of the Outline Design process have established that:

1. A Low Carbon building, at the Initial Construction Budget stage, is 30% higher than a building built to current building standards.
2. A case for a Low Carbon building at Creetown cannot be made on the grounds of capital cost alone.
3. The Outline Design and Specifications contained in this report would enable a building of this type to perform in winter without heating, apart from very cold snaps, allowing renewable energy technologies to operate efficiently.
4. That the combination of design constraints presented by the Creetown site, whilst being advantageous in other respects, involves significant cost penalties for a low carbon building on this site.
5. The site area at Creetown is insufficient to allow the inclusion of rain harvesting, a grey water and natural sewage system, that could be reasonably expected in an exemplar low carbon building.
6. That the Outline Design presented in this report, if built on another site where wind energy generation was available, would have the status of an exemplar as a potential Zero Carbon Building.
7. Sufficient information for the Outline Design specified to current building standards to progress to funding application if so desired, is available.

##### In addition an analysis of the Outline Design process has:

8. Established that the accommodation functions and standards for a shared workspace facility can be sized to any site, or resized for the existing one.
9. Established design principles in the field of low carbon building that could be transferable to other sites as required, with further professional consultation, and that have informed the design brief for the next stage.
10. Indicated the potential for construction training and promoting new business activity in the field of low carbon building.

11. Explained the reasons for increased construction capital costs in building with low carbon materials.

12. Established that the specification of some of the building materials required for the performance of a super-insulated building need, at the present time, to be sourced at a distance because of the lack of a local supply. Hence the phrase ‘towards a low carbon building’ is more accurate, and includes the possibility of developing business to fill the gap.

13. Established that pre-fabrication with low carbon materials is at an innovative stage and is dependent on high quality construction management , supervised site storage conditions and precision on-site construction skills.

14. Indicated the potential for the SUP to become leaders, as construction clients , in the field of low carbon building and be participants in funded action research.

## **11.2 Conclusions**

In the light of the foregoing, the following conclusions are drawn:

1. The progress of a proposal for Low Carbon building, such as that investigated in the Outline Design process, through to the next stages of design, to realisation, is dependent on a robust case being made for grant funding, on the basis of acting as an exemplar of carbon emission reduction in building construction. Additional grant funding to that required for an equivalent proposal constructed to current building standard levels is required.
2. There are specific site attributes that must be addressed when considering future sites for the development of a low/zero carbon building.
3. There is no cost advantage to be gained by high levels of prefabrication in SUP’s region, unless a ‘rolling’ programme for building replication can be established at the outset.
4. The Outline Design Brief, the principles of construction used in the Outline Design and Outline Specifications and guidance from the Initial Construction Budget found in this report could all be transferred to other sites. Additional input from construction professionals will be required, to address other site specific issues and, in consultation with SUP, decisions arising from the findings of this report.

### 11.3 Recommendations

These conclusions have enabled the following design and technical recommendations to be made:

#### The Development of the Creetown Site:

1. The Outline Design can be progressed with the Outline Specification and Initial Construction Budget in this report to the next stage of design, as set out in Section 12, if additional funding for a Low Carbon exemplar building can be made available.
2. The Outline Design in this report can progress with specifications to current building standards levels that are available as current design practice if grant funding is successful.

#### Other Sites

3. In order that other sites can be assessed for development potential, that a set of technical criteria are drawn up that meet the requirements for an exemplar building.
4. If the Low Carbon building case for development is successful, that the Design Brief for the next stage should be for a zero carbon building.
5. That a decision is taken, informed by information contained in this report and further research by SUP, whether:
  - A future site or sites should be developed as a series of one off projects that employ the same principles of building construction and specifications that have been developed in the Outline Design process for the site at Creetown, with professional fees for the second and subsequent projects negotiated accordingly.

Or

- The Design Brief for the next phase of design is predicated upon substantial pre-fabrication methods that will be required to be adapted to more than one site, without substantial design changes. This approach is considered to be feasible only if a 'rolling' programme of construction can be initiated.

If the latter decision is made, the number of future sites should be established before the further commissioning of design consultants takes place.

6. That a meeting takes place between SUP and a representative of the local Construction Training Board to establish a way forward to initiate and support local building contractors engagement with low carbon building techniques and practices . and thus provide the potential for favourable construction tenders and negotiations for both SUP, other construction clients in the area and the general public.
7. That a meeting takes place between SUP and the Carbon Centre at the Crichton Campus (Glasgow University) in Dumfries to establish the potential for funded action research in the field of Low-Zero Carbon building, related to the findings of this report.







## Section 12

### THE DESIGN BRIEF

#### 12.1 Decisions Required

It is proposed that the existing Outline Design Brief and Outline Specifications will be the basis of a Design Brief (DB) for the next stage of design, with a few additions, (as in paragraph 12.2 & 12.3) if the proposed building goes forward as a Low-Zero Carbon design, at Creetown or any other site.

However, the Design Brief for the next stage will be dependent on the decisions made by the Southern Uplands Partnership, from the findings and recommendations in this report and other considerations that are outwith it.

For a design perspective, these decisions will be made as a result of SUP moving forward by considering these alternative choices, as follows:

- The development of a Zero Carbon (ZC) building
- The development of a building to current building standards
- Developing pre-fabrication for the purpose of replication

#### 12.2 The Creetown Site

Aware ergonomic design specifically for:

- Waste management and recycling by the building users,
- Drying space for drying clothes, boots and shoes,
- Electric charging facility for electric vehicles in the car park

The Design Brief should be finalised by SUP, in consultation with the future design team, and include feedback from the Outline Design and Specification process at feasibility stage. Changes can be made within the Initial Construction Budget in this report.

The following items should be included:

- Consultants. These are detailed in Section 8
- Commissioning a Landscape Architect at the same time as the Architect and the rest of the design team
- A laser measured and levels site survey
- A soil survey and boreholes
- Environmental Impact Assessment

### **12.3 The Development of a Zero Carbon building**

The following considerations should be added to the Design Brief for a Zero-Carbon Building:

Aware ergonomic consideration as in paragraph 12.2

- A Grey Water system
- Rainwater harvesting
- A Natural Sewage system

### **12.4 The Development of a Building to Current Building Standards (BSB)**

The Outline Design and the Initial Construction Budget (Section 8) can be followed for a development constructed by conventional means to current Building Standards. However, the Outline Specification in this report would be irrelevant for such a building. Working with Building Standards legislation is current architectural practice, and conventional materials, products and techniques would be employed, in consultation with SUP.

### **12.5 Developing Pre-Fabrication for the Purpose of Replication**

It can be seen from Chapter 7 that standard pre-fabricated buildings and components are currently available specified to current Building Standards. The assumption is made, therefore, that in considering the decision regarding pre-fabrication that SUP would anticipate a higher standard, approaching the Low Carbon - Zero Carbon level.

As stated in Chapter 7, building systems that employ a high degree of pre-fabrication with LC materials is at the innovative stage. Furthermore, cost advantages can only be gained on long runs and one building is insufficient for these methods to be cost effective. Further research would be required by SUP if this approach were adopted and the Design Brief would require significant additional briefing instructions in the construction and technology sections to those contained in the Outline Design Brief.

However, discussions could go forward with local contractors to enable them to incorporate a familiar level of pre-fabrication, which is standard practice in the construction industry, with higher levels of specification to meet the LC standard.

