Expansion of Anfield Stadium for Liverpool Football Club

Sustainability Appraisal

E1/1

Contents

This Sustainability Appraisal (SA) demonstrates how the proposed redevelopment of Anfield Football Stadium and adjacent public realm areas will deliver **sustainable development** in line with national and local policy and the objectives of the Spatial Regeneration Framework (SRF).

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Client
Liverpool Football Club

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Executive Summary

This Sustainability Appraisal (SA) demonstrates how the proposed redevelopment of the Anfield Football Stadium will deliver sustainable development in line with national and local policy.

Summary against SA Objectives

In 2012, Liverpool City Council (LCC), Liverpool Football Club and Athletics Ground Ltd (LFC) and Your Housing formed a partnership to deliver comprehensive regeneration in the Anfield area.

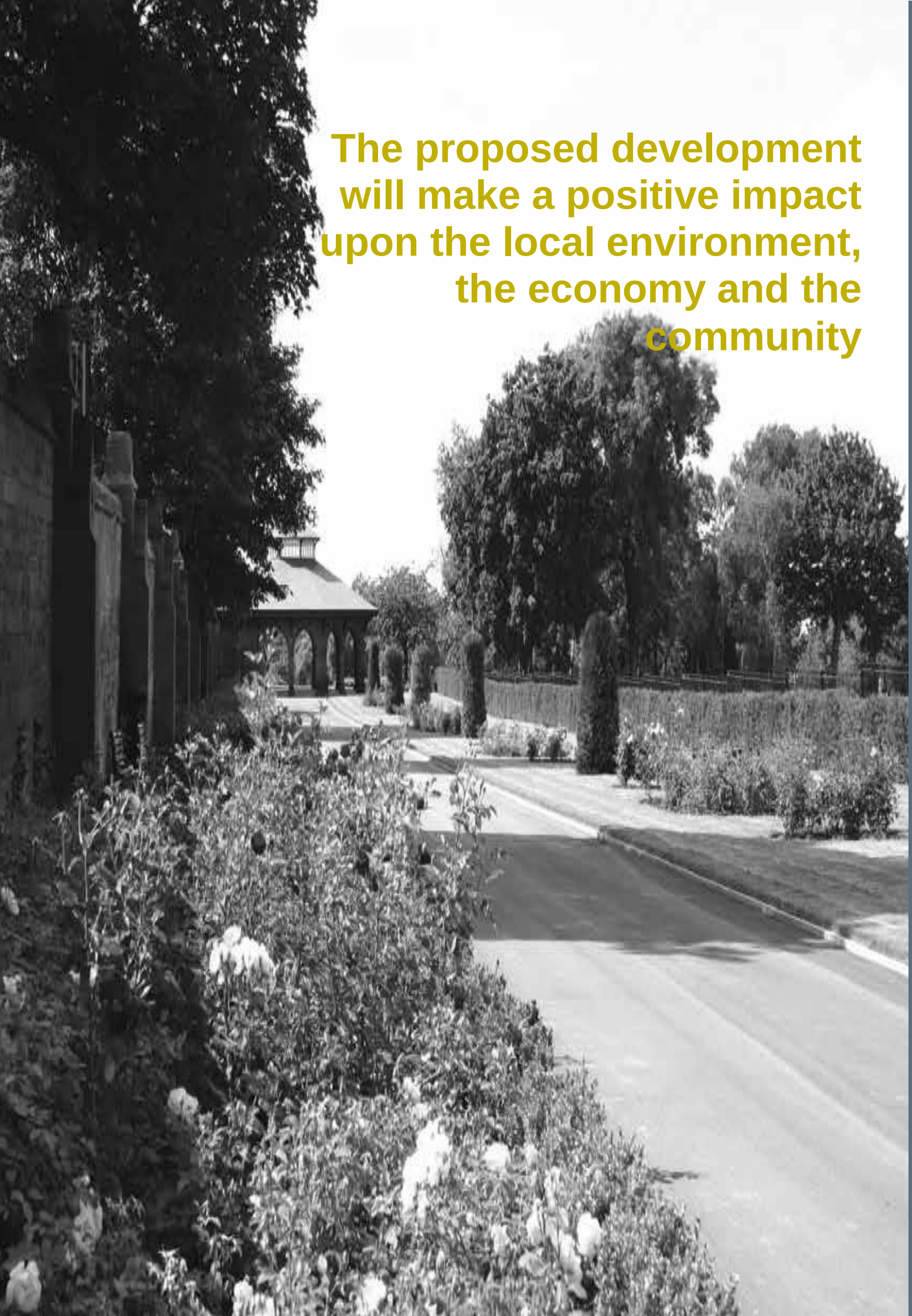
The Anfield Spatial Regeneration Framework (SRF) has subsequently been produced by Liverpool City Council to provide a co-ordinated approach to the regeneration of the area which includes the Anfield Football Stadium. As part of the SRF development process a Strategic Environmental Assessment/ Sustainability Appraisal was undertaken to ensure that the SRF promoted local and national sustainability objectives.

One of the recommendations of the SRF was that any future development projects arising from the SRF should demonstrate how it was incorporating the principles of sustainable development.

This Sustainability Appraisal assesses the proposed development of the Anfield Stadium against the sustainability objectives developed during the SEA process.

It demonstrates that the design proposals do make a significant positive contribution to the sustainability objectives of the City of Liverpool and the SRF.

Going forward, the application of internationally recognised sustainability standards such as BREEAM will ensure that sustainability is considered beyond the planning application process.



The proposed development will make a positive impact upon the local environment, the economy and the community

1. Introduction

This Sustainability Appraisal (SA) report has been produced in support of the planning application for the Expansion of the Anfield Football Stadium.

The report demonstrates how local and national sustainability policy and the sustainability objectives of the SRF have been integrated into the proposed development.

The Site and Surroundings

The Application Site is located at Anfield Football Stadium within the wards of Anfield and Breckfield, approximately 2 miles north-west of Liverpool City Centre.

The stadium is located between Walton Breck Road and Anfield Road and has been the home of Liverpool Football Club (LFC) since the Club was formed in 1892. The stadium is contained on three sides by walled and gated tarmacked areas to meet its current parking and servicing needs.

The wider surrounding area is characterised by neighbouring residential areas, Anfield Cemetery and Stanley Park.

There is free-flow of pedestrian movement around the stadium on match-days; however, the narrow external areas often become over-crowded and match goers spill out into the surrounding residential streets. On non-match days access to the stadium is more limited and the enclosed ground creates a barrier to movement between Walton Breck Road and Stanley Park.

History

There has been a football ground on the site of the current Anfield Stadium since circa 1883. The 1890-1893 Ordnance Survey Map shows the original ground as a rectangular pitch flanked by a small south stand and a larger north stand, with two pavilions to the east and west.

In the years since it was established, Liverpool Football Club (LFC) has grown and Anfield Stadium has been expanded to meet growing spectator numbers. The stadium currently attracts around 45,000 visitors each match day and is the second biggest tourist attraction in Liverpool, also being available for conferences, meetings and weddings.

LFC is as a result, one of the largest employers in the Anfield area with jobs ranging from management and administrative functions to catering and hospitality to grounds maintenance and stewarding.

Proposed Development

Liverpool Football Club and Athletics Grounds Ltd (LFC) are making a full planning application for the expansion of the Main Stand to accommodate approximately 8,300 additional spectators with associated hospitality and corporate facilities and new public realm.

Outline planning permission is also sought for the expansion of the Anfield Road stand to accommodate additional spectators circa 4,800.

The proposals form part of a wider initiative for regeneration of the Anfield area as set out in the Anfield Spatial Regeneration Framework (SRF).

Further details regarding the development proposals and application site are provided within the Design and Access and Planning Statements that accompany the application.

2. Background and Appraisal Methodology

In 2012, Liverpool City Council (LCC), Liverpool Football Club and Athletics Grounds Ltd (LFC) and Your Housing formed a partnership to deliver comprehensive regeneration in the Anfield area.

The Anfield Spatial Regeneration Framework (SRF) has subsequently been produced by Liverpool City Council to provide a co-ordinated approach to the regeneration of the area which includes the Anfield Football Stadium. Liverpool Football Club and Athletics Grounds Ltd (LFC) is now looking to expand their main stand in line with the objectives of the SRF in order to accommodate an increasing number of spectators and ensure an increasing economic contribution to the local area

As part of the SRF development process, a Sustainability Appraisal incorporating the requirements of the Strategic Environmental Assessment (SEA) Directive was carried in accordance with UK legislation and Government Guidance.

The key objectives of the SA/SEA process are to ensure that the relevant plan, policy or programme is promoting sustainable development by addressing all relevant social, economic and environmental factors,

The SEA/ SA process has assessed the emerging SRF in terms of;

1. Emerging development options which include the expansions of the football stadium

2. Identification of mitigation measures to reduce or improve the sustainability performance of each options

3. The preferred development option against the 'do nothing' scenario, i.e. no development within Anfield

The appraisal identified that, whilst there were some negative impacts associated with some of the development options, suitable mitigation measures will result in a SRF that ensures local and national sustainability objectives are translated into a more sustainable redevelopment of Anfield.

Of equal significance is the assessment of the potential impacts of the 'do nothing' scenario (i.e. no SRF) which identified a number of significant negative impacts on local sustainability objectives should no regeneration of Anfield occur.

Sustainability Appraisal Methodology.

In line with good practice and recommendations arising from the SA/SEA process, any projects within the SRF area should clearly demonstrate how it has incorporated the strategic objectives of the SRF into design features and application proposals

To facilitate this, the proposals have been assessed against the Sustainability Objectives and Appraisal Criteria developed as part of the SRF SEA/ SA process, outlined in Appendix 1.

Section 4 of this report assesses the proposed development of the stadium against each of the SEA/ SA objectives. A summary of the scoring against the objectives is included in Appendix 1.

To assess the proposed development against the SEA/ SA objectives, the proposed works are discussed in terms of the construction and operational phases. In all instances, expert judgement, and reference to the Policy Evidence Base has been used to determine the effects.

3. Policy Context

The following section sets out the national and local sustainability policies relevant to the proposed development.

UK Sustainable Development Strategy

The Government published a strategy for implementing sustainable development across the UK in 2005 which still acts as an overarching document from which a range of specific policies and legislation were derived.

One of the key aims of this strategy is to recognise the threats of climate change and ensure that the UK develops a strategy to mitigate and adapt to this phenomenon

Recently, the strategy has taken a renewed focus in light of the Government's definition of Sustainable Development in the National Planning Policy Framework (NPPF) as this document established five key principles to underpin the national sustainable development strategy:

1. **Living within Environmental Limits;**
2. **Ensuring a Strong, Healthy and Just Society;**
3. **Achieving a Sustainable Economy;**
4. **Promoting Good Governance; and**
5. **Using sound science responsibly.**

The strategy is implemented at a national level through the development of more specific strategies at a Government department or sector level.

With regards to planning and the built environment, this document set the basis for the development of plans and policies that promote development with climate change adaptation and mitigation.

Climate Change Act

The Climate Change Act (2008) set a legally binding target for reducing UK CO_2 emissions by least 80% on 1990 levels by 2050.

It established the Committee on Climate Change, responsible for setting binding interim carbon budgets for the Government over successive five year periods. The first three carbon budgets were announced in the Budget 2009, resulting in an interim target of a 34% reduction in CO2 equivalent emissions on 1990 levels by 2020.

EU directives set out the end results that must be achieved in every Member State. The UK has signed up to the EU Renewable Energy Directive, which includes a UK target of 15% of its energy consumption to be delivered from renewable sources by 2020, with interim targets of, 5.4% by 2013-14, 7.5% by 2015-16 and 10.2% by 2017-18.

UK Carbon Plan

In 2011, the Government published an updated plan setting out how the UK will achieve decarbonisation and make the transition to a low carbon economy. It outlines the strategy the Government will take to securing energy supply, improving energy efficiency and meeting the country's carbon emission reduction targets.

It sets this objective within a framework of mitigating and adapting to climate change and maintaining energy security in a way that minimises costs and maximises benefits to the economy.

With regards to development, the Carbon Plan presents the government's approach to promoting the delivery of low carbon, resilient and adaptive buildings and enabling sustainable transportation as positively contributing to these national carbon reduction targets.

Building Regulations

Whilst not planning policy, the Building Regulations have relevance, specifically *Part L: Conservation of Fuel and Power* as this document determines the energy efficiency and carbon emissions requirements for new buildings.

The primary vehicle for reducing carbon emissions in new development is through progressive changes to Part L and in 2006 the government established a policy whereby these regulations would be gradually improved in phases from 2006, 2010, 2013, 2016 and 2019. The 2006 revisions to Part L required a 23.5% saving over the 2002 standards for mechanically ventilated and cooled spaces.

Part L 2010 requires a further 25% average reduction in regulated carbon emissions over 2006 levels for non-domestic buildings. An 'aggregate' approach is adopted in recognition of the variation in energy demand profiles in different non-domestic building types and the resulting cost effectiveness of achieving carbon emission reductions.

National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG)

Following its publication in March 2012, national planning policy is now provided by the NPPF which sets out the government's planning policies for England and how these are expected to be applied. It also sets out the requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so.

The government has made clear its expectation that the planning system should positively embrace well-conceived development to deliver the economic growth necessary and the housing we need to create inclusive and mixed communities.

The presumption in favour of sustainable development is a key thread running through national policy for both plan making and decision taking.

The NPPF states that: '*The purpose of the planning system is to contribute to the achievement of sustainable development*'. It states clearly that in order to deliver sustainable development, the planning system must perform three distinct roles, aligned to the three pillars of sustainability, which must not be taken in isolation and should be pursued jointly:

An economic role – contributing to building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;

A social role – supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being; and

An environmental role – contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy.

Where a Local Plan is silent, absent or relevant policies are out-of-date then the 'Presumption in Favour of Sustainable Development' can apply.

This policy will ensure that development that meets the objectives of the NPPF is defined as sustainable and should be approved without delay.

Paragraph 6 of the NPPF states that:

"The purpose of the planning system is to contribute to the achievement of sustainable development. The policies in paragraphs 18 to 219, taken as a whole, constitute the Government's view of what sustainable development in England means in practice for the planning system".

The policies referred to in Paragraph 6 of the NPPF have been divided into 13 themes;

1. *Building a Strong Competitive Economy*
2. *Ensuring the Vitality of Town Centres*
3. *Supporting a prosperous rural economy*
4. *Promoting sustainable transport*
5. *Supporting high quality communications infrastructure*

6. *Delivering a wide choice of high quality homes*

7. *Requiring good design*

8. *Promoting healthy communities*

9. *Protecting Green Belt Land*

10. *Meeting the challenge of climate change, flooding and coastal change*

11. *Conserving and enhancing the natural environment*

12. *Conserving and enhancing the historic environment*

13. *Facilitating the sustainable use of minerals*

Should a proposed development demonstrate that it is supporting the relevant policies of the NPPF then it is deemed to be 'Sustainable Development'.

The recently revised National Planning Practice Guidance (NPPG) provides further advice on various planning issues associated with development, including those linked to sustainability and renewable energy and underpins the policies within the NPPF.

The Guidance can be a material consideration in planning decisions and should generally be followed unless there is clear reasoning for why it is inappropriate or not feasible.

The Development Plan

The adopted Development Plan for the area comprises:

- The saved policies of the Liverpool Unitary Development Plan (UDP);
- The Merseyside and Halton Waste Management Local Plan.

Liverpool Unitary Development Plan (UDP)

The current Liverpool UDP was adopted in November 2002. The UDP provides guidance on a wide range of land use issues which provide the basis upon which development planning decisions are made by Liverpool City Council.

At the time of compiling this report the current UDP is in the process of being replaced by the emerging Local Plan, not due to be adopted until late 2015/early 2016. The saved policies continue to provide the local planning framework within the city until they are replaced by the emerging local plan and as such must be given the most weight in the development of this Sustainability Strategy.

The UDP sets out a wide range of saved policies for new development and specifically with regard to sustainability including:

Policy HD21: Energy Conservation which expects developers to minimise the overall demand for energy arising from their development proposals by taking into account the need for energy, sensitive siting, orientation layout and design.

Policy OE11 which sets out a general presumption against development on green space unless the proposed development can be accommodated without material harm to the recreational function of the green space, its visual amenity, relationship to adjoining green spaces and any known nature conservation value.

Policy T6 which requires new development to give consideration to provision of safe cycling routes and provide secure cycle parking facilities.

Policy T7 which requires new development to give consideration to provision of safe and convenient walking routes.

The Merseyside and Halton Waste Management Local Plan

The Waste Management Local Plan was adopted in July 2013. It contains a number of general policies that are relevant to most forms of development including: ensuring that construction and demolition implements measures to achieve the efficient use of resources (Policy WM8); and development incorporates sustainable waste management principles into proposals (Policy WM9).

Draft Liverpool Core Strategy and the Emerging Local Plan

Given its emerging status this document is not part of the statutory development plan however, it does give a steer on the local authorities approach to development in the emerging Local Plan.

The weight to be given to the pre-submission draft of the Core Strategy is limited as it has not been tested at a Hearing. However, the application has been considered against the relevant strategic sustainability objectives and policies within the emerging Core Strategy/Local Plan to demonstrate support with these emerging policies where relevant.

Strategic Policy 1 Sustainable Development Principles aims to ensure that new development makes best use of resources, protects the environment, and addresses climate change and the needs to the local community. The City Council recognises the importance of weighing the benefits of new development proposals, particularly those of city-wide significance, against any potential policy conflicts.

Strategic Policy 23 Key Place-Making and Design Principles states that The City Council will secure innovative, high quality design to create well-integrated places that are usable, accessible, durable and adaptable. To ensure this, the City Council will seek to maintain and create places and spaces where people choose to live, work and visit. Development proposals will be required to demonstrate amongst other things:

- Sustainability as a key driver of the design process
- Support for increased permeability of the built environment, and strengthened linkages between places, by all sustainable modes of transport
- Compliance in appropriate developments with national and local agreed targets in BREEAM, Building for Life, Code for Sustainable Homes and Lifetime Homes.

Strategic Policy 31 Sustainable Growth states that to ensure the sustainable growth of the City development proposals should:

- Contribute to achieving the objectives of the City Council's Climate Change Strategic Framework.
- Make the most efficient use of land through the redevelopment of previously-developed sites and buildings ahead of greenfield sites, unless there are clear reasons why this is not feasible and other substantive regeneration objectives can be achieved.
- Ensure high levels of energy and water efficiency and a sustainable approach to construction and the use of materials. This should include meeting increasingly higher levels of the 'Code for Sustainable Homes' and BREEAM or any equivalent standard as appropriate through the lifetime of the Core Strategy.

Strategic Policy 32 Renewable Energy states that Development proposals should incorporate decentralised and renewable or low carbon energy production. Unless it can be demonstrated that it is not feasible or viable to do so development proposals should provide at least 10% of total predicted energy requirements from renewable or low carbon sources.

The Anfield Spatial Regeneration Framework (SRF)

The Anfield SRF is a Supplementary Planning Document (SPD) that has been prepared to inform the policies of the Liverpool UDP in advance of the adoption of a new local plan. The SRF contains a number of objectives to address key local and national sustainability policies.

SRF Objective 5 on Environment details that new development throughout the area includes expectations to:

- Protect natural resources, including air quality, ground and surface water, and soils.
- Improve existing open green space and, where possible, introduce new green infrastructure including the potential to retrofit green infrastructure.
- Provide sufficient facilities to dispose of waste sustainably, and in accordance with the waste hierarchy, through an appropriate refuse strategy and creation of a Waste Management Strategy where appropriate.

- Adhere to low carbon sustainable principles and be resilient to climate change by incorporating, for example, sustainable urban drainage systems (SUDs) and energy efficiency measures.

Additionally, the document sets out specific parameters for identified development projects, including the expansion to Anfield stadium. SRF objective 14 confirms 'in principle' support for the proposed expansion of the stadium subject to the following criteria:

- The impact on the amenities of residents living within the area;
- High quality design and distinctiveness;
- The creation of high quality public realm that links to adjacent land uses including housing to the West, Walton Breck Road High Street to the South and Stanley Park to the North;
- Maximising activity at street level and permeability through the area;
- The transport effects of the development;
- Impact on the special interest of Stanley Park and Anfield Cemetery.

The process of development of the Local Plan will respond to and build upon the adopted version of the Anfield SRF SPD . The SPD is a material consideration in the determination of the planning application for the stadium expansion and must be reasonably attributed with a significant degree of weight.

Other Relevant Documents

The 'Liverpool City Region Sustainable Energy Action Plan' (2012) states that Council's intention to 'meet and exceed the European Union 20% carbon reduction objective by 2020 and provide local access to European funding for future development'.

The 'City of Liverpool Climate Change Strategic Framework' (2009) is also in place to ensure that all the Council's policies and programmes are aligned to its 2009 carbon reduction target of 35% carbon emissions reduction by 2024 and that the city is well adapted for the future climate.

Summary of Policy Implications

Central to the government's and Liverpool's vision for 'Sustainable Development' is the approval of development that jointly promotes economic, social and environmental benefits.

The NPPF states that these principles should be promoted jointly and simultaneously through the planning system to achieve sustainable development.

The NPPF also sets clear expectations with regard to the metrics of assessing sustainable development including; job creation, reduction of carbon emissions, sustainable transportation and good design and is supported by further guidance within the NPPG.

At a local level the Liverpool Unitary Development Plan promotes well designed and accessible development that protects and enhances the local environment and supports a healthy and diverse economy.

The adopted Anfield Spatial Regeneration Framework (SRF) SPD details policy which sets out guidance and proposals for the comprehensive, coordinated and planned approach to secure sustainable regeneration of the Anfield area in advance of the adoption of the emerging Local Plan.

The Emerging Local Plan to be adopted in 2015/2016, sets a vision of Liverpool as a sustainable, vibrant and distinctive global city at the heart of the Region supporting sustainable growth that delivers high quality design, accessibility, deployment of renewable energy and resilience to future climate change.

The following section of this Sustainability Strategy demonstrates how the proposed development at Anfield Stadium is in accordance with national and local policy and the objectives of the Strategic Regeneration Framework.

“The initiative is really about improving people's lives in the area. It's about creating a better place to live, it's about creating better facilities in and around the area and we are just one part of that.”

- LFC

4. Appraisal of the Development Proposals

The SA framework developed to assess the Anfield SRF provides the sustainability objectives and appraisal criteria against which the development proposals have been assessed.

The following section outlines how the proposed development promotes national and local planning policy by assessing its performance against the SEA/ SA objectives.

1) Biodiversity, Flora, Fauna and Geo-diversity

Ecological surveys have identified that the habitats found on site are of poor quality and low ecological interest. However, a number of mature trees including Ash and Horse-Chestnut are present immediately adjacent to the site within Stanley Park.

The site and surrounding area was found to be unsuitable for a range of protected and important species including badgers, birds, great crested newts, reptiles and uncommon invertebrates.

It is also noted within the Environmental Statement (ES) that the stadium as a whole offers very little suitability for roosting bats and that all trees within and immediately adjacent to the site have been classified as Category 3 trees (no potential to support bats).

To improve the biodiversity performance of the proposals, an updated tree survey has been used to identify opportunities for routes between the site and Stanley Park that allow existing quality trees to be retained where possible. Bat boxes are also proposed for inclusion within existing mature trees to provide additional bat roosting habitat.

A landscaping strategy is proposed for the development which includes additional planting of grassed areas and native and ornamental shrubs.

Given the low ecological value of the existing site, there will be no negative impact on biodiversity from the proposed development. With mitigation measures proposed there is likely to be a neutral impact on biodiversity, flora, fauna and geo-diversity.

2) Water Quality

The nearest body of water to the site is the pond located in Stanley Park, approximately 600m from the development site.

The site currently sits above a Principal Aquifer and is such there is considered to be a high sensitivity to pollution incidents.

The implementation of best practice policies with regards to minimising surface and groundwater pollution will form part of the requirements upon the main contractor as a result of assessment under BREEAM (discussed objective 6). These requirements will also be enforced through a Construction and Environmental Management Plan (CEMP).

In order to mitigate the pollution risk to surface water, sewer water and groundwater during construction the CEMP and BREEAM requirements will include the following;

- Storage of hazardous substances in accordance with relevant legislation;
- Emergency procedures in place in case of accidental spills;
- Procedures put in place should contaminated land be encountered- all works to cease until an assessment has been carried out; and
- Piling works to be carried out in accordance with EA guidance.

As a result of the mitigation, the development proposals will have a neutral impact on water quality.

3) Flood Risk

The principal surface water body in the vicinity of the proposed development is the River Mersey which flows some 3km to the east of the site and is considered to be of low risk for fluvial or tidal flooding.

The site is not within any source protection zones and no sensitive groundwater abstractions are located within 1km of the site. The site itself is not in a 'Known Flooding Area' and the Environment Agency has confirmed no records of flooding at the site.

It is noted however that there may be a risk of increased surface water run off as a result of the development on a temporary and/or permanent basis due to an increase in the area of impermeable surfaces and the new roof on the Main Stand. The site drainage strategy has been drafted to accommodate this additional run-off. Sustainable Urban Drainage systems (SUDs) have been considered but the low permeability of the ground at the site means that these measures are not technically feasible. As a result, extensive consultation has been undertaken with United Utilities and it has been determined that the existing drainage infrastructure has capacity for the proposed discharge rates to the combined sewer located on Back Rockfield Road via an underground drainage network.

The surface water drainage design also accounts for additional capacity for future climate change rainfall increase. There is no requirement to attenuate surface water on the site.

As a result of the mitigation, all surface water is to be managed and controlled on site and will not increase flooding elsewhere. As such, the development proposals will have a neutral impact on flood risk.

4) Air Quality

Current air quality at the site is in line with air quality objectives though it is noted by the council that congested junctions across the city exceed levels for NO_2 as a result of road traffic emissions.

In the short term, construction activities associated with the expansion of the stadium will have a temporary negative impact upon local air quality through the use of a range of site plant that will result in direct emissions to air from exhausts. The implementation of best practice policies with regards to minimising air (dust) pollution in line with the relevant guidance will form part of the requirements upon the main contractor as a result of assessment under BREEAM and separately through the CEMP.

Other examples of mitigation measures proposed for the construction stage include:

- No idling vehicles.
- Imposing and signposting a maximum speed limit.
- Use of soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Avoiding scabbling (roughening of concrete surfaces) if possible.
- Ensuring sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensuring bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- Use of water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Locating access gates at least 10m from receptors where possible.

The increase to traffic emissions as a result of the proposed phased development is considered to be minor given that measures are already in place to promote sustainable transportation. Assessment predicts pollutant levels (including NO_2) significantly lower than the relevant objectives following development and mitigation through the Access and Transport Strategy which aims to offer reliable and efficient alternatives to travelling by car and continue to promote the use of existing restrictions/ provision of alternatives to car use on match days despite the increased capacity of the stadium.

No further mitigation is required for the operational stage on the basis that the effects are negligible.

As a result of the construction stage mitigation and negligible effects once operational, the development proposals will have a neutral impact on local air quality.

5) Climate Change Adaptation

Climate change will cause the UK to become warmer, winters will become wetter, and summers will become drier. Adapting to this changing climate is an important part of future proofing our new buildings through location, design, construction and operation.

One of the most effective climate change adaptation and mitigation measures available to new development is to ensure that these issues are considered from the outset of the design and independently assessed.

To that end, Liverpool Football Club have committed to assessing the sustainability performance of the redevelopment under the BREEAM Bespoke methodology with a target of a Very Good rating.

The new stands and associated facilities will be in compliance with Building Regulations 2010 and will as such have an inherent enhanced resilience to climate change through improved materials and design to cope with predicted changes in our weather.

Additionally, mechanical ventilation has been incorporated into the design and allows resilience to higher air temperatures in the future which may otherwise have adverse effects on human comfort where relying solely on naturally ventilated spaces (through openable windows).

The site drainage strategy also makes an allowance for climate change to ensure that additional surface water runoff and/or a higher frequency of extreme storm events can be accommodated within the drainage systems.

The potential for solar gain to enter the spaces has been limited through review of glazing proportion and by either a reduction in the amount of glazing for the space, consideration of the use of passive shading / brise soleil and the use of solar-controlled glazing as standard where appropriate.

As a result of the design measures taken, the development proposals will have a moderate positive impact on the stadium and surrounding area's ability to adapt to climate change.

6) Climate Change Mitigation

One of the most effective climate change mitigation measures is to minimise a buildings consumption of energy, thereby reducing carbon emissions.

The expansion of the stadium and increase in hospitality areas will have an impact with regards to increased energy and water use however as per the SRF objectives, the design has adopted measures to reduce resource consumption where possible given that this is an extension to an existing building as opposed to a new stadium.

An energy strategy has been developed for the Stadium and is included within Appendix 2. This strategy identifies the most commercially and technically viable design measures for reducing the carbon footprint of the stadium. The main conclusions from this report are outlined below.

LED lighting will be incorporated into the design of the stadium expansion to ensure lighting energy use is minimised.

In addition to the Building Regulations, the BREEAM assessment will award credits based on performance above Part L compliance as well as for other elements of sustainable design and construction.

Sub-metering of energy will be utilised to monitor usage of occupancy areas and the sub-metering of major energy consuming items is required both as part of Building Regulations and as a mandatory requirement under BREEAM for ratings of 'Very Good' and above.

Heating Ventilation & Air Conditioning constitutes a major site energy load which will be carefully considered throughout the design process. Energy efficient plant will be utilised in order to meet Building Regulations requirements. Mechanical Ventilation Heat recovery is included within the current proposals to maximise energy efficiency by extracting all available heat from outside air.

A renewable energy technology in the form of Air to Water Heat Pumps has been proposed in order to provide a source of renewable heat to boost hot water supply.

With the proposed renewable energy technologies (reversible air source heat pumps) incorporated into the scheme for heating and /or cooling, the proposed development will exceed

the requirements of Approved Document L2A(2010).

As a result of the development proposals there will be a neutral impact from the perspective of climate change mitigation.

7) Cultural Heritage

From the outset of the design process, the potential impact on the heritage setting of the nearby Grade II* registered Stanley Park and nearby listed buildings has been a key consideration.

While the stand will be visible from Stanley Park, English Heritage has confirmed that based on the proposed design and materials for the expansion of the Main Stand that they consider the impact on setting and significance acceptable.

The detailed design of Phase 2 of the proposed development is not known at this stage. Through agreement with English Heritage the character of materials proposed in the construction of that stand will be generally non-reflective and 'muted' to minimise the impact on Stanley Park and Anfield Cemetery and the listed buildings contained within them. The development proposals will improve connectivity between Stanley Park and Walton Breck Road, and residential areas; it will help to reinforce the space as a Public Open Space for the Anfield community.

The Heritage Statement and Built Heritage Chapter of the Environmental Statement conclude that there will be a 'low adverse' impact upon the built heritage although this supports the overall conclusion of 'less than substantial harm'.

Overall therefore, the development proposals will have a minor negative impact on the built heritage.

8) Townscape and Landscape

Though the stadium dominates the landscape in the Anfield area, the surrounding streets are characterised by dense two and three storey terraced housing and business properties forming a tight urban grain, with many of these vacant and/or boarded up.

The existing stadium forms the tallest structure within the locality. However, there is a lack of sufficient space around the perimeter due to the close proximity of the surrounding housing.

Stanley Park Grade II* Registered Park and Garden is found adjacent to the stadium, and presents as an important feature within the local townscape.

The site itself generally comprises hard standing with some landscaped areas. Land to the south-west of the Main Stand, and within the application site boundary, is currently laid out as open space having previously been occupied by terraced dwellings. The application site also includes residential dwellings in three terraces east and west of Lothair Road, and east side of Alroy Road which are due for demolition.

New public realm and open spaces will be created as a result of the development proposals, alongside the new stands. The current plans demonstrate that these spaces will be in keeping with the wider Anfield SRF and will provide a buffer between the residential neighbourhoods and the stadium.

A new avenue ('the grove' will facilitate movement of large numbers of visitors around the stadium on match days while providing a n attractive link for the community between Stanley Park and Walton Breck Road on non-match days.

The area of green infrastructure will also be increased as a result of the development proposals and planting of native and ornamental shrubs is also included to enhance the areas of Public Open Space.

Overall, the development proposals will have a moderate positive impact on townscape and visual character within the area.

9) Economy

The current stadium directly supports 1,790 jobs or 271 full-time equivalent (FTE) jobs. It is one of the largest employers in this area of north Liverpool and the City and also feeds a number of different businesses. Stadium related employment currently supports £5.1m of employment income per annum; £4.7m per annum within the city region and £4.0m per annum within Liverpool.

The stadium itself is the second largest tourist attraction in Liverpool. Stadium-related expenditure in the city-region is of the order of £5m per annum.

The expansion of Anfield Football Stadium will provide the catalyst for regeneration of the surrounding area with direct in the form of net additional construction and operational jobs as well as additional jobs indirectly as a result of the wider regeneration and investment in the area.

New premium hospitality facilities will act as prime match day and non-match day revenue generators, and help meet LFC's aspiration to be at the forefront of quality in the Premier League.

The expansion will allow increased visitor numbers and match day capacity which will make a positive contribution to the economy, particularly in the immediate locality of Anfield. This is more likely to result in further investment in the area from the commercial sector.

As a result of the development proposals there will be a significant positive impact on the local economy with the redevelopment of the club ground being the catalyst for further regeneration of the Anfield area of the city.

10) Employment, Skills and Training

Despite overall employment growth in the local impact area since 2009, negative growth in the Anfield Ward highlights a need for increased job opportunities to support local, district and wider city region jobs growth.

As a direct result of the expansion jobs will be created both during the construction phases and long term once the facilities are operational.

The project aims to encourage the use of local labour and suppliers during the construction phases.

It is estimated that across both Phases 1 and 2 that 1,640 person years of employment across the UK, or the equivalent of just under 990 temporary FTE construction jobs per annum (based on 20 month construction timelines for each phase) will be created.

Other forthcoming proposals within the Anfield area such as those proposed by Your Housing Group and University Technical College will work in synergy with LFC to further promote skills and training in Anfield and offer additional employment for local residents.

As a result of the development proposals there will be a moderate positive impact on employment, skills and training in the local area.

11) Resource Use and Waste Management

The expansion will require material resource as part of the construction activities. However, improved fabric efficiency as a result of construction to meet Building Regulations Part L 2010 will mean that the completed building will be less maintenance intensive.

Additionally, through assessment under BREEAM within the Materials and Waste sections, the development proposals will promote sustainable use of resources and the use of materials with recycled content where they can be proven to meet quality requirements.

A Construction Resource Management Plan (formerly Site Waste Management Plan) will be developed as part of the main contractor requirements under BREEAM. This will need a commitment to minimise construction waste in line with best practice benchmarks and divert waste from landfill.

On an operational level BREEAM requires a dedicated storage area to be set aside for the storage of recyclable waste with suitable access to facilitate collections. The club also operate waste management and recycling procedures to ensure that waste associated with the running of the club such as glass, packing and plastic are segregated and recycled.

Overall, the development proposals will have a neutral impact on resource use and waste management.

12) Housing

There is currently a mix of housing stock adjacent to the stadium though it predominantly consists of terraces with some properties run-down, vacant or derelict.

A number of properties in the Rockfield area will be demolished to accommodate the extended Main Stand and provide an extensive area of open space as an interface between the stadium and retained adjacent dwellings in Alroy Road.

Improvements will also be made to adjacent retained housing, including provision of street planting and parking bays.

Overshadowing to the retained adjacent residential properties on Alroy Road will be considered further during detailed design to minimise any potential impacts to local residents.

Overall, there will be a minor positive impact upon the area as well as synergy with the wider housing regeneration proposals.

13) Accessibility and Sustainable Transport

There is no direct national rail access to the local area and persons arriving into Liverpool Lime St Station are faced with a further 40 minute walk to the stadium. However, the Merseyrail Northern Line rail service has three stations within 1.4 miles of the stadium, the closest of which, Sandhills, is served by a special Soccer Bus service to and from the stadium on match days, though these are all within walking distance of the stadium.

Existing bus services are supplemented by a dedicated match day service (the City Centre Express) to Walton Breck Road and there are high levels of taxi provision between the city centre and the stadium. The levels of post-match congestion currently cause delay to bus services, particularly along Walton Breck Road; the Transport Strategy aims to address this through local diversions on match days.

All major car parks within close proximity of the ground will be managed by LFC to ensure that only those with pre-booked parking passes approach the stadium in a vehicle. However large numbers of spectators arrive by car and the area on match days is heavily congested.

There is currently limited cycling provision at the stadium and in the surrounding area. Facilities are available however, in the food village, located in the family park off Anfield Road and the South West corner of Stanley Park at the Isla Gladstone Conservatory.

The small areas of circulation space around the stadium and barriers to access and movement through to Stanley Park currently also result in an unfavourable situation for local residents.

The development proposals aim to reduce the use of private car by the uptake of more sustainable forms of transport.

The sustainable transportation measures are organised over a series of five sub-strategies:

- Traffic Management
    - Improved taxi drop off/pick up areas;
    - Improved disabled parking and drop off/pick up areas;
    - Walton Breck Road closure.
- Public Transport
    - Improved soccer bus service;
    - Improved city centre express services before and after matches
    - Extension to coach parking facilities.
- Parking
    - Extension to existing parking restrictions on Walton Breck and Anfield Road;

- Additional cycle parking facilities.

- Pedestrians
  - Pedestrian access improvements;
  - Walk routes (signage) to City Centre, Sandhills, Kirkdale and public transport (bus and taxi) hubs around the stadium.
  - Wayfaring around the stadium and identifying links between Walton Breck Road and Stanley Park

- Marketing and Promotion
  - Integrated match day ticketing and public transport;
  - Dwell time initiatives;
  - Staff Travel Plan.

These measures provide mitigation for the development proposals and improve upon the existing baseline to promote the use of more sustainable forms of transport and encourage spectators to arrive on foot to the stadium.

As a result of the mitigation proposed as part of the development there will be a neutral impact on accessibility and sustainable transport.

13) Health and Wellbeing

The enhancement of the surrounding public realm and open spaces will allow better movement of people on match days to and from the stadium without filtering into the nearby neighbourhood areas.

Increased surveillance around the stadium and Stanley Park is likely to have a positive effect on the area by discouraging crime and antisocial behaviour. In addition to this, away team fans will be relocated following Phase 2 to the east end of the Anfield Road Stand closer to where the majority of them arrive at the stadium by coach to enable them to be easily and safely directed to the appropriate entrances.

Noise levels on match days are unlikely to dramatically increase as a result of the expansion though the design has been careful to mitigate and attenuate crowd noise where possible. New noise sources from additional services plant will be mitigated within the design so as not to exceed set limits.

The additional provision for wheelchair viewing on the middle and upper tiers will promote and improve social inclusion for those spectators with disability.

As a result of the mitigation, the development proposals will have a minor positive impact on the health and wellbeing of the local community.

Sustainability Appraisal Conclusions

Appendix 1 contains a summary of the sustainability performance of the proposed development compared to the strategic assessment undertaken on the SRF options (which included expansion of the Anfield Stadium) as part of the SEA process.

The scoring clearly demonstrates that as a result of project level mitigation and further assessment, the sustainability performance of the proposed development has improved its sustainability performance across a range of issues which in many cases has resulted in a neutral impact compared to a negative impact predicted during the SA.

5. Conclusions

This report demonstrates that the consideration of sustainable design and construction processes will ensure that the regeneration of the wider Anfield Football Stadium and wider area will make a positive contribution to the sustainability objectives of Liverpool and the SRF.

Sustainability Appraisal Conclusions

Appendix 1 contains a summary of the sustainability performance of the proposed development compared to the strategic assessment undertaken on the SRF options as part of the SEA process.

The scoring clearly demonstrates that as a result of project level mitigation and further assessment, the sustainability performance of the proposed development has improved its performance from the initial scoring in the SA in the following areas;

- Biodiversity, Flora and Fauna and Geodiversity
- Flood Risk
- Air Quality
- Cultural Heritage.
- Climate Change Mitigation; and
- Resource use and Waste Management.

The development also continues to make a number of positive contributions to the sustainability objectives associated with;

- Climate Change Adaptation
- Townscape and Landscape
- Economy
- Employment Skills and training
- Health and Wellbeing
- Housing

The application of the BREEAM Bespoke assessment methodology with a target of Very Good will ensure that sustainable design and construction measures will continue to be promoted during the future, design construction and operational stages of the proposed development.

Appendix 1 -Summary Appraisal Matrix

Sustainability Appraisal Themes.	RESOURCES & WASTE	CLIMATE CHANGE & CO2			HERITAGE, LANDSCAPE & TOWNSCAPE			POLLUTION		ECONOMIC GROWTH		COMMUNITIES, HEALTHY LIFESTYLES & EQUALITY		HOUSING
Sustainability Appraisal Objectives	11. Resource Use and Waste Management	6. Climate Change Mitigation	5. Climate Change Adaptation	3. Flood Risk	1. Biodiversity, Flora and Fauna and Geodiversity	7. Cultural Heritage	8. Townscape and Landscape	4. Air Quality	2. Water Quality	9. Economy	10. Employment, Skills and Training	13. Accessibility and Sustainable Transport	14. Health and Wellbeing	12. Housing
Anfield Football Stadium - Expand the Main Stand and the Anfield Road Stand - Strategic SA	-	-	+	-	-	--	++	-	0	++	++	0	+	+
Anfield Football Stadium - Expand the Main Stand and the Anfield Road Stand -Turley Sustainability Appraisal based on current design and proposed mitigation.	0	0	++	0	0	-	++	0	0	+++	++	0	+	+
Commentary on achieving Environmental, Economic and Social Objectives	Following project specific mitigation and assessment, the proposed development has improved its scoring across a number of objectives particularly in respect of negative impacts. In addition, the proposed development continues to make a number of moderate and significant postive contributions to the the sustainability objectives of Anfield and the SRF.													

+++	Significant positive effect upon the SA Objective
++	Moderate positive effect upon the SA Objective
+	Minor positive effect upon the SA Objective
?	Uncertain impacts on the SA Objective/ Multiple effects which are both positive and negative
0	Neutral / No effect/ Negligible effect on the SA objective
-	Minor negative effect upon the SA Objective
--	Moderate negative effect upon the SA Objective
---	Signifcant negative effect upon the SA Objective
D	Effect depends upon implementation

Appendix 2 – Energy Statement – SKM Associates.

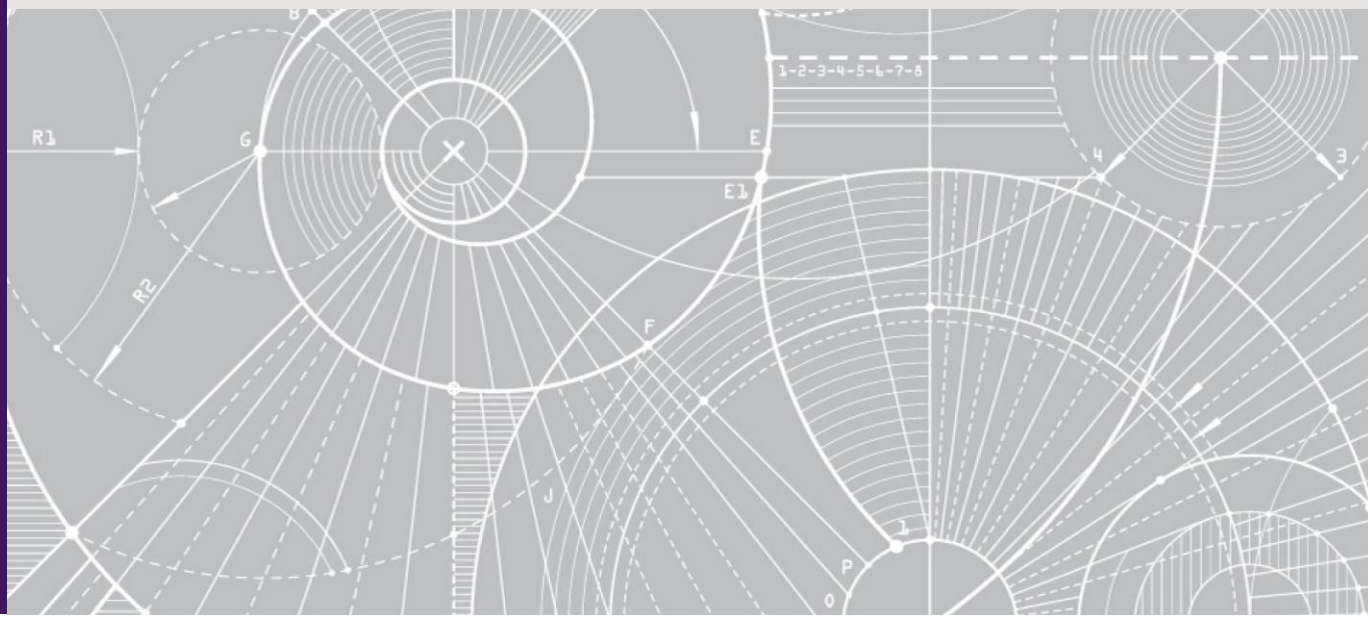
Anfield Main Stand

LIVERPOOL FOOTBALL CLUB

Energy Statement

UN12545-EMM-RP-002 | C

9 May 2014



Anfield Main Stand

Project no:	UN12545
Document title:	Energy Statement
Document no:	UN12545-EMM-RP-002
Revision:	C
Date:	9 May 2014
Client name:	Liverpool Football Club
Client no:	N/A
Project manager:	Craig K Wilson
Author:	Steve Mills
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Document history and status

Revision	Date	Description	By	Review	Approved
A	21 Mar 14	First issue for internal review	SLM	CKW	CKW
B	4 Apr 14	Issued for Planning Purposes	SLM	CKW	CKW
C	9 May 2014	Draft Stage D Issue – updated model output using Revit model dated 11 March 2014 (Frozen Stage D model)	SLM	CKW	CKW

Contents

Executive summary

This energy strategy has been developed to demonstrate that this development will seek to integrate national and local sustainability policies whilst satisfying the client brief and the constraints associated with the operational nature of the building. The stadium is an iconic building, and therefore the aesthetics were also borne in mind as a key consideration throughout the development of the strategy.

A review was undertaken of national, regional and local Planning policies, which established that Liverpool City Council do not currently, have any adopted policies requiring on-site renewable energy generation or carbon emission reductions. However, the emerging core strategy does have a 10% renewable energy requirement, and although this carries little weight, has been considered in the context of this strategy.

In addition the Anfield Strategic regeneration Framework (SRF) has an objective for all new development to consider its carbon emissions and seek to minimise these in the context of climate change mitigation..

Therefore, the energy strategy has considered these drivers, in addition to the fact that the project commences with the replacement of an existing building, and includes the remodelling of existing areas.

The strategy has been formulated by consideration of the energy hierarchy, beginning with a 'lean and mean' approach – concentrating on the attainment of an energy efficient building and associated systems, prior to considering the use of 'green' approaches – low-to-zero carbon and / or renewable technologies.

Passive engineering has been employed to minimise internal gains as far as possible, followed by the review of modern technologies including the use of low-energy LED lighting throughout, and the potential for solar gain to enter the spaces has been limited by the use of solar-controlled glazing where required.

The types of systems within the development have been selected so as to be high efficiency, to minimise energy consumption – including the use of ventilation plant with low energy motors, high thermal energy recovery and demand-led controls. Such approaches will minimise energy when areas are partly occupied, and isolate areas when unoccupied.

A comprehensive controls system will be incorporated which will not only control the systems, but provide energy metering and monitoring, which will help the Client to achieve the forecasted carbon performance.

Options for renewable technologies have been explored in order to consider technical and practical feasibility for the scheme – in addition to their financial viability. The most appropriate technology was deemed to be Reversible Air Source Heat pumps.

The proposed building services solution exceeds the requirement of Approved Document L2A(2010).

1. Introduction

The energy strategy for this project has been developed hand-in-hand with the design team for the new main stand. The strategy has been to address national, regional and local policies, in striving to achieve low energy usage and therefore low carbon emissions for the development.

This report describes the approach taken by the design team to reduce energy use and carbon emissions within the proposed development and quantifies the building performance with respect to the Local Authority targets, including the Building Regulations Approved Document L2A (2010).

2. Policy Review

2.1 National and Regional Policies

The Spatial Regeneration Framework (SRF) promotes at a strategic level sustainable design features within the SRF area which will 'where possible seek to reduce the energy and carbon emissions of new development'. The design of the new stand and its servicing solution has been developed with consideration to selection of materials and systems which have low embodied carbon, in addition to striving to avoid, or to reduce greenhouse gas emissions.

The National Planning Policy has also been borne in mind in the context of the current National Planning Policy Framework (2012) and its basis in 'Delivering UK Sustainable Development' (2005) and the 'Climate Change Act' (2008) - the latter of which set a legally binding target for reducing UK CO2 emissions by least 80% on 1990 levels by 2050. The Act also introduced a system of carbon budgets including a target that the annual equivalent of the carbon budget for the period including 2020 is at least 26% lower than 1990. The building services systems have been designed to minimise emissions as far as possible, which will therefore contribute towards these targets.

The government strategy to achieve the UK's greenhouse gas emission reduction target is outlined in more detail in 'Reducing the UK's Greenhouse Gas Emissions by 80% by 2050' (2013). The Building Regulation reductions in targeted building emission rates (BERs) are helping to drive emissions downwards – and the building services strategies employed on this project have been developed in order to support the reduction in CO_2 emissions to achieve compliance with the Building Regulations target.

A formal submission has been made to, and has been accepted by Liverpool City Council Building Control (before 6 April 2014), and there is a commitment by the club and the project team for a meaningful start on site to be made before 6 April 2015. As a result, the project was registered under ADL2A (2010) as opposed to the forthcoming 2013 edition, and the project has been designed to comply with ADL2A (2010).

2.2 Liverpool City Council Policies

2.2.1 Reduction in Emissions and Conservation of Energy

At regional and local level, the Liverpool Unitary Development Plan (UDP) is a 'saved plan' (sitting within the Local Plan framework) and will gradually be replaced by the new Local Plan. The outdated EP16 policy on renewable energy will be replaced with Strategic Policy 32 presented in the Core Strategy document when it is adopted as part of the Local Plan. This means that the policy on renewable energy will not become enforceable until the draft version of the Core Strategy is adopted by Liverpool City Council. Policy 32 (Renewable Energy) states that:

Development proposals should incorporate decentralised and renewable or low carbon' energy production. Unless it can be demonstrated that it is not feasible or viable to do so development proposals should provide at least 10% of total predicted energy requirements from renewable or low carbon sources, in Non-residential development over 1000m² gross floor space.

The strategic policy also refers to pollution from light and noise, and cites external lighting as being important in relation to public safety and enhancing the appearance of buildings. This must be achieved without causing intrusion or overspill into neighbouring residential areas – whilst minimising the associated energy consumption.

In addition, the 'Liverpool City Region Sustainable Energy Action Plan' (2012) also states that the Council aims to 'meet and exceed the European Union 20% carbon reduction objective by 2020 and provide local access to European funding for future development'. The 'City of Liverpool Climate Change Strategic Framework' (2009) is also in place to ensure that all the Council's policies and programmes are aligned to its 2009 carbon reduction target of 35% carbon emissions reduction by 2024 and that the city is well adapted for the future climate.

The design of the new stand has been approached in such a way as to keep these drivers in mind throughout the design process. The design team have strived to address each of these points by firstly aiming to minimise the energy consumption required by the serviced spaces within the stand (by ensuring the building form and fabric is as efficient as possible) and thereby minimising the associated CO_2 emissions. Then, the building services systems that serve those areas have been designed to achieve highly efficient performance targets. Lastly, the use of renewable energy has been considered and selected on the basis of the optimum solution to satisfy the Client brief, whilst achieving the requirements of the Building Regulations and the emerging energy policy. The low carbon and renewable energy technologies on site will generate in excess of 10% of the annual energy requirements of the new stand.

Therefore , the proposals are in line with the emerging policy that will form part of the new Local Plan, (calling for 10% of energy requirements from renewable or low carbon sources on relevant non-domestic developments) the Energy Strategy should focus on measures to meet or where possible surpass the requirements of Building Regulations Part L 2010, with a view to providing a renewables/LZC contribution and/or a reduction in CO_2 emissions to contribute to achieving the UK's climate change commitments.

2.2.2 Air Quality

Sustainability Objective 4 within the SRF is to 'maintain or improve local air quality'. The whole of the city was declared an Air Quality Management Area in May 2008, so this has been considered with respect to the potential solutions available to contribute to carbon reductions – to ensure that the proposals achieve those air quality-related objectives.

3. Approach to Minimisation of Energy Consumption

3.1 Lean and Mean Approach: Passive & Energy-Efficient Design

The new stand has been assessed to determine which areas would come under the requirements of the Building Regulations ADL2A (2010). Those areas have been designed so as to be constructed to include the measures defined herein - which are to ensure that the design achieves compliance with the Building Emission Rate (BER) as stipulated within ADL2A (2010).

It is noted that there the POTS area beneath the existing podium is being remodelled, and it is proposed that these are included in a single Part L assessment for the purposes of demonstrating Compliance to the Local Authority.

In particular, the following parameters were used in the model:

- U-values to be 20% better than Approved Document ADL2A (2010):

Element	Element Properties
Walls / boundary to unheated space adjacent	U-value = 0.26 W/m^{2}K
Floors / boundary to unheated space below	U-value = 0.21 W/m^{2}K
Roofs / boundary to unheated space above	U-value = 0.18 W/m^{2}K
Windows	U-value = 1.52 W/m^{2}K / g-value = 0.50 (selected areas: g = 0.4)

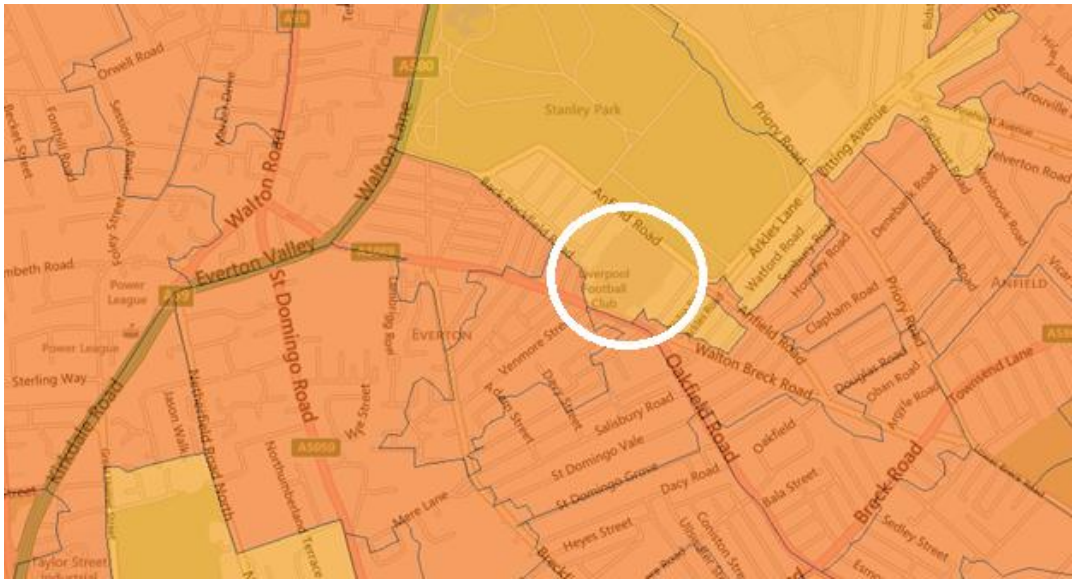
- Air permeability proposed as a maximum of 5m^3/hr/m^2 at 50Pa.
- Glazing proportion has been reviewed in detail with respect to solar gains entering each space, to passively limit the quantity of associated cooling required.
- In areas of high solar gains due to extensive glazing, the use of passive shading / bris-soleil has been considered, and / or a reduction of the glazing area.
- High-performing ventilation systems to be used, including high-efficiency heat recovery.
- Avoidance of mechanical cooling where possible, and high performance cooling systems (chillers including a 'free-cooling' feature) where cooling is deemed necessary.
- Zoned heating and cooling with local control functions.
- Variable speed drives on ventilation systems to reduce flow rates in periods of reduced occupancy, and zoned isolation when unoccupied.
- Design of all pumping and air distribution networks specifically arranged for differing occupation times on each zone, to provide flexibility in terms of use of sub-divided spaces.
- Zoned lighting controls system including daylight compensation and absence detection, also allowing the perimeter to be separately controlled. Low Energy LED lighting throughout with high efficiency fittings and carefully selected light fittings.
- Use of a BMS with support from a specific Energy Metering Analysis system.
- Full sub-metering will be provided in line with the requirements of Building Regulations ADL2A (2010).

Simplified Building Energy Model (SBEM) calculations have been undertaken based on the frozen Stage D general arrangement layouts and sections (by importing the architectural Revit model into the Compliance assessment software), to provide an updated assessment of the building performance.

3.2 Green Approach: Application Of Combined Heat & Power (CHP) and District Heating

The potential for use of CHP has been reviewed in line with the Liverpool City Council energy policies, with respect to its potential to supply this project, although it is noted that there is a high probabillity that occupancy will be extremely peaky – with large periods of no (or low) occupancy. This will be reviewed as the scheme continues to be developed. The consideration of CHP and district heating took into account the following points:

- Energy efficiency: Usually, district heating is more energy efficient than decentralised equivalents due to simultaneous production of heat and electricity in combined heat and power generation plants. Also, a larger central plant can be more efficient than many small plants, and would reduce overall energy consumption, and hence have a lower carbon emission factor.
- Carbon Emissions: A district heating network will reduce CO_2 emissions through optimisation of heat supply. Central plants also employ stringent emission controls in comparison to individual buildings which will provide air quality benefits. The DECC heat map was reviewed for the immediate area surrounding the site, and this showed that there is a relatively low potential for heat demand - principlally because there is parkland to one side, and low-density residential housing to the remainder.



- Fuel Cost Savings: Savings from bulk fuel purchasing and higher efficient plants of district heating networks could be passed onto the community through lower fuel charges.
- Future flexibility of fuel source: Ability to change fuels in future, if and when fuel economics change.
- Increased lettable / usable areas in the individual buildings: As a result of the centralised plant solution (and therefore reduced plant space in the individual buildings).

The usage profile of the stadium does not currently support the use of CHP, as there are long periods of no (or very low) heat demand, and during occupancy (very high density), the space loads will be predominantly cooling-led. However, CHP and sources of district heating external to the stadium have been considered.

As a result of the above considerations, we have not included CHP within the design, nor the provision at this stage for connection to a future district heating network.

3.3 Green Approach: Renewable Energy

A number of potential low carbon renewable energy sources have been considered, to show how the CO_2 emissions of the development can be reduced, to establish what the building emission rate (BER) is forecast to be, and what percentage improvement the BER could achieve below the target emission rate (TER) as stipulated in ADL2A (2010).

The feasibility of each of the energy sources below has been assessed with regards to the potential contribution each could make to supply a proportion of the development's energy requirement, whilst also considering technical, planning and financial issues.

3.4 BE GREEN: Renewable Energy Considerations

As part of the energy strategy, a number of potential low carbon renewable energy technologies have been assessed and summarised below. Whilst the policy is not currently adopted, each technology has been considered in terms of its ability to meet the emerging policy requirement.

The feasibility of each of the energy sources below has been assessed with regards to the potential contribution each could make to supply a proportion of the development's energy requirement, whilst considering the technical, planning and financial issues.

A number of potential renewable energy sources have been considered. These are considered to be the most likely options:

- Air Source Heat Pumps
- Photovoltaics
- Wind turbines
- Solar Thermal
- Ground Source Heat Pumps – Closed Loop & Open Loop

The feasibility of each of the energy sources listed has been assessed with regards to the potential contribution each could make to supply a proportion of the development's delivered energy requirement, whilst considering the technical, planning and financial issues.

3.4.1 Air Source Heat Pumps

This technology uses a heat pump as a heat exchanger to provide either heating and / or cooling to serviced internal spaces. Heating is provided by removing heat from the ambient air, whereas cooling is provided by reversing the refrigerant cycle to reject heat to the ambient air. The heat pump units are designed to have a high Coefficient of Performance (CoP). Air source heat pumps are defined as a 'renewable' energy source and CoP's in the order of 4:1 are regularly achieved by manufacturers – meaning that for one unit of electrical energy (kWh electricity), the heat pump outputs in excess of 4 units of thermal energy (kWh heat).

These units are available in a 'heating only' / 'cooling only' mode (predominantly 2-pipe systems) in addition to reversible mode (3-pipe systems), the latter being able to provide the flexibility to be able to simultaneously heat some areas whilst cooling others.

Air source heat pumps can only be considered as a renewable technology when used in heating mode as defined in Annex VI of Directive 2009/28/E) although by using reversible heat pumps, the cooling demand is satisfied by the same equipment.

Air Source Heat Pump		Anfield Main Stand
Heating output	kW	50
Cooling output	kW	50
Heating run hours	hours	1,300
Cooling run hours	hours	600
Annual heating output	kWh pa	65,000
Annual cooling output	kWh pa	30,000
Heating COP	COP	4.5
Cooling SEER	SEER	5.5
Heating electricity demand	kWh pa	14,444
Cooling electricity demand	kWh pa	5,455
Efficiency of Boiler	%	86%
Efficiency of air chiller	COP	5.5
Gas Savings	kWh pa	75,581
Electricity chiller savings	kWh pa	5,455
Gas cost savings	£ pa	2,645
Electricity costs savings	£ pa	655
RHI Savings	£	3,055
GSHP Electricity consumption	kWh pa	19,899
GSHP electricity costs	kWh pa	2,388
Total cost saving	£ pa	3,967
Capital cost	£	30,000
Payback	years	8

To generate sufficient energy to achieve the 10% target, it would be necessary to generate (and use on site) around 91,000kWh. The above calculation summary shows that, considering the heating and cooling output only (for the purposes of this calculation), a plant of 50kW heating output would need to operate for a total of 1,900 hours (heating, cooling and DHW outputs would collectively be in excess of this figure). The associated capital cost is in the order of £30k – with a payback of around 8 years.

The heat pumps would be situated on the external plant deck on the uppermost storey of the new stand. Therefore, the use of reversible air source heat pumps will not have a visual impact on the scheme, and will not materially affect Planning Permission. The noise output of the units would need to be issued to the Planners for review, to ensure that the overall noise emissions did not contravene any Planning Conditions, but the equipment would be selected with these limits in mind. The acoustician report for the project has set targets as follows:

- Based on BS4142 guidance for 'complaints are unlikely':
  - Plant noise limit of L_{Aeq} of 34dB at 1m from window of all affected residential premises;
  - Plant noise limit of L_{Aeq} of 55dB at 1m from the stadium façade for publicly-accessible walkways.

The equipment selections will meet these targets.

3.4.2 Photovoltaics

Photovoltaic cells are used to convert solar radiation into Direct Current (DC) electricity. The DC electricity is then inverted to AC electricity for use in buildings or for export to the grid.

Monocrystalline silicon cells are made using cells cut from a single silicon crystal. This is the most efficient of the technologies (around 15%). The downside of this type of cell is its high cost due to more complicated manufacturing processes. Polycrystalline silicon cells are made from cells from an ingot of melted and recrystallised silicon. These are cheaper to produce than monocrystalline cells but have a reduced efficiency at about 8 - 12%. Amorphous silicon cells are composed of silicon atoms in a thin layer. This is a "thin film" technology. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, making it ideal for curved surfaces. The main disadvantage with amorphous silicon is its low efficiencies, between 4 and 8%. However, they are cheap to produce compared to other types of PV cell. Many cells are joined to form PV modules. These are then connected together to form PV arrays.

Solar Photovoltaic (PV) technology is not directly related to any specific building fabric element or service. They therefore allow for reasonable flexibility in their sizing subject to certain constraints, the most important being surface area (roof or facade). Similar to Solar Thermal technology, PV is constrained by the orientation of the roof or facade and also the amount of surface area available. PV requires a significant amount of roof area to achieve any real carbon reduction.

The roof could be on an adjacent building – it would not have to be on the stadium roof.

In terms of operation once installed, PV arrays require minimal maintenance over their operational life and have no primary fuel requirements.

The table below outlines a feasibility assessment for PVs on this project, for each of the two target carbon reductions, each based upon an array laid at around 10 degrees from horizontal, facing due south with no overshadowing:

PV		**Anfield Main Stand**
Roof area required for yield	m2	900
Size	kW	117
Annual output	kWh	93,435
Electricity used on site	%	70%
Assumed export	%	0%
Savings from Supply	£	11,212
Savings with used elec FIT	£	9,941
Savings from export FIT	£	-
Capital cost	£	140,153
Operational Costs	£	1,402
Total Savings	£	19,752
Payback on Capital	yrs	7

A PV area of 900m^2 would be required to generate energy equivalent to 10% of the annual energy consumption of the new stand. The associated capital cost would be around £140k and have a simple payback of around 7 years.

The PV array could be situated on the main roof, to the outer (north western) edge.

3.4.3 Wind Turbines

The performance of a wind turbine depends largely on the available wind resource in terms of wind speed and occurrence. It is essential that turbines should be sited away from obstructions, with a clear exposure or fetch for the prevailing wind.

3.4.3.1 Large standalone wind turbines

Located in an urban environment with buildings within close proximity a turbine would need to be taller than the surrounding buildings, trees or other obstructions to access sufficiently high wind speeds, to be viable. Standalone wind turbines also need to have sufficient topple distance from buildings and local infrastructure (e.g. housing, roads, electricity transmission cables) to reduce the risk from any accidents.

For these reasons it is not considered that a large standalone wind turbine would be viable for this site.

3.4.3.2 Small building integrated wind turbines

It is not recommended to install small scale building integrated renewable technologies within the urban environment. Average annual wind speeds for the square kilometre containing this development site have been obtained from the Business, Enterprise & Regulatory Reform (BERR)'s wind speed database are as follows:

Height above Ground (m)	Wind Speed (m/s)
10	5.6
25	6.3
45	6.8

However, due to the impact of the urban environment, the outputs of building integrated turbines are low. A study undertaken in Warwick University[1] covering 168,950 hours of operation of 26 building mounted wind turbines (at a level of 45m above ground level) from five manufacturers across the UK during 2007-2008 found a capacity factor (i.e. time when the turbine as at maximum operation) was 0.85% when you would expect closer to 20-25%.

Due to the complexity of the stadium roof structure, it is not recommended to apply building-integrated wind technology to this project.

3.4.4 Solar Thermal

Solar thermal collectors are modular and either 'building integrated', i.e. forming part of a cladding system, or 'bolt on'. Arrays are typically pitched at about 30° and orientated between southeast and southwest and it is important that overshadowing is avoided. The two main types of solar collector are flat plate and evacuated tubes, with evacuated tubes being slightly more efficient but also more expensive.

Determining the size and timing of the annual hot water demand is a key issue in assessing the viability for solar thermal. Further technical considerations include having a suitable orientation of collector panels on the roofs (ideally south facing) and connection to the specified hot water system.

[1] www.warwickwindtrials.org.uk/resources/Warwick+Wind+Trials+Final+Report+.pdf

The table below outlines a feasibility assessment for solar thermal technology on this project:

Solar thermal		Anfield Main Stand
Annual hot water demand	kWh pa of Fuel	185,000
Half hot water gas	kWh pa of Fuel	92,500
Matching half hot water	m2	231
Matching half hot water	kW	162
Fuel used (pump) Used Energy	kWh pa of electricity	925
Operating costs	£	500
Gas savings	£	3,765
RHI Savings	£	8,233
Total savings	£	10,572
Capital cost	£	173,438
Payback	Years	16

A solar thermal collector area of around 230m2 would be required to generate energy equivalent to 10% of the annual energy consumption of the new stand. The associated capital cost would be around £175k and have a simple payback of around 16 years.

The collector array could be situated on the main roof, to the outer (north western) edge. This technology would be viable, although there are others which would be more cost effective. In addition, since hot water usage is anticipated to be fairly sporadic, this technology is not recommended for this project.

3.4.5 Biomass Heating

The term “biomass” refers to any material derived directly or indirectly from plant or animal matter. Therefore, biomass fuels can be derived from a number of sources such as wood from forestry, urban tree pruning, agricultural residues and specially grown crops for energy (energy crops). Biomass fuel has low carbon content as it is considered a renewable fuel; however it has some related emissions due to processing and transport of the fuel.

Current biomass systems are fully controllable using programmable timers, room or zone thermostats and can be incorporated into building management systems (BMS). However, there are a number of features and attributes of biomass heating that are different from either gas or oil which needs to be considered such as fuel storage, accessibility, and increased size, cost, and loading efficiency.

- Building space and organisation to accommodate and operate the plant.
  - Sufficient space needs to be provided to accommodate fuel storage. It is also important to ensure there is outside access to the fuel storage area and plant room, to facilitate biomass deliveries.
- Fuel Supply
  - Regular fuel deliveries would be required to operate the plant. The impact on the local road networks and possible congestion associated with the delivery of the biomass fuels needs to be assessed.
- Noise
  - For ventilation reasons, larger fans are installed on biomass boilers, which may result in increased noise levels.

- Air Quality
  - Biomass exhausts can have an impact on local air quality and require significant treatment to avoid degrading local air quality. When considering Sustainability Objective 4 within the SRF (reference section 2.2.2 above), the potential to negatively affect the local air quality is a significant drawback to this technology.
- Heat Demand
  - Biomass as an energy source is not suitable where there are large fluctuations in thermal loads. Biomass boilers operate most efficiently when run at a constant rate with no or little throttling down of the output,

To generate sufficient energy to achieve the 10% target, this would equate to a boiler of output 75kW operating for around 1,200 hours per year. The heat demand in the stadium will not provide a steady load (which is important for biomass plant) - the demand will be sporadic.

Although the payback on this technology is relatively short (around years), it is not recommended for this project on the basis that its use would potentially conflict with Objective 4 of the SRF, and the main stand requires a predominantly cooling-led solution (and therefore has a lack of constant base load).

3.4.6 Ground Source Heat Pumps

Ground source heat pumps utilise either water extracted from an aquifer (open loop) or water circulated within underground pipe work (closed loop) as the heat source in a refrigeration process enabling them to produce hot water, typically at around 45°C, that can be used as a heating medium in buildings. The technology relies on the stable temperature of the ground of between 10-14^{o}C.

Ground or water based cooling exploits the thermal energy held within the ground and the improved thermal transfer properties of water to provide a more efficient heat pump than using the medium of air.

Maximising efficiency of the GSHP system is achieved by correctly sizing the unit and any ground or water coupled component of the system. It is the high Coefficient of Performance (COP) of a Heat Pump that offers a saving in operational costs.

3.4.6.1 Open Loop Ground Source Heating

In open-loop systems, groundwater is abstracted at ambient temperature from one or more abstraction boreholes, passed through heat exchangers and / or heat pumps before being discharged back into the aquifer through one or more injection boreholes. The water will have undergone a temperature change via the heat exchangers and the discharged water will be cooler (if used for heating of the building) or warmer (if used for cooling of the building), within agreed limits.

The availability and potential sustainable abstraction rate from below-ground aquifers is not currently known for this site (and would require a geological survey to be undertaken). If there was availability, a risk exists that the Environment Agency may not provide a licence for abstraction of groundwater due to the potential for the abstraction of the water to influence the migration of elevated concentrations of contaminants (if present) in groundwater beneath the site. In addition, abstraction of significant volumes of water from the gravels could potentially lead to localised settlement.

The lack of knowledge of availability of aquifers is a high risk. A further risk with open loop heating and cooling systems is that without significant preliminary assessment, the output of the boreholes is unknown.

This risk is exasperated for open loop systems as the ground water may well vary throughout the year and into the future with predicted warmer and drier summers – which could alter the water table level, and require deeper borehole installations. For these reasons, open source ground source heating and cooling appears unlikely to be viable for this site.

It is not recommended that this technology is considered further for this scheme.

3.4.6.2 Closed Loop Ground Source Heating

A closed loop system comprises a sealed pipe network buried within the ground through which water is continuously circulated. Loops can either be placed in purpose drilled boreholes, which are usually around 100m in depth or within the building piles.

A closed loop ground source system does not impact the groundwater resource itself, as it does not change natural sub-surface water flow and as such is not directly regulated by the environment agencies. However pollution caused directly or indirectly by a closed loop scheme would still come within the remit of the environment regulators e.g. pollution caused by a leaking system or the cross-connection of two aquifer units.

The viability of closed loop heat pumps systems dependent on a number of issues:

- Demand for heating/cooling
- Cost/carbon emissions of gas/electricity being offset
- Ground area available for boreholes/horizontal loops

The assessment for this project has shown the potential costs for installing 20 closed loops each to a depth of 100m boreholes to the rear of the new main stand beneath the hard standing.

Closed-Loop GSHP		Anfield Main Stand
Number of Boreholes		10
Lenght of Boreholes	m	100
Heating output	kW	50
Cooling output	kW	50
Heating run hours	hours	1,500
Cooling run hours	hours	350
Annual heating output	kWh pa	75,000
Annual cooling output	kWh pa	17,500
Heating COP	COP	4.5
Cooling SEER	SEER	5.5
Heating electricity demand	kWh pa	16,667
Cooling electricity demand	kWh pa	3,182
Efficiency of Boiler	%	86%
Efficiency of air chiller	COP	5.5
Gas Savings	kWh pa	87,209
Electricity chiller savings	kWh pa	3,182
Gas cost savings	£ pa	3,052
Electricity costs savings	£ pa	382
RHI Savings	£	3,525
GSHP Electricity consumption	kWh pa	19,848
GSHP electricity costs	kWh pa	2,382
Total cost saving	£ pa	4,577
Capital cost	£	80,000
Payback	years	17

This shows that to generate sufficient energy to achieve the 10% target, a plant of 50kW heating and cooling output would need to operate for a total of 1,850 hours (heating, cooling and DHW outputs would collectively be in excess of this figure), using 10 boreholes each of depth 100m. This option would occupy an external area in the region of 20 x 5m on plan (for the borehole array – which ideally would never be built on, to facilitate future access and maintenance). The associated capital cost is in the order of £80k – with a long payback - around 17 years.

The development will not incorporate building piles, and therefore the use of 'thermal piles' would not be possible, and is therefore discounted.

Due to the long payback period and the logistics of implementing this solution, it is not recommended for this project.

3.4.7 Renewable Feasibility Assessment Summary

The Table below highlights and overview of the feasibility assessment of the key technologies considered suitable for development.

Technology Summary	Comments
Air Source Heat Pumps (Recommended)	The BRUKL report already produced achieving Building Regulations compliance allows for the inclusion of air source heat pumps for heating/cooling and hot water provision, to be supplied by grid electricity. This is the most capital cost-effective method of securing carbon and energy reductions through the use of renewable energy technologies.
Solar PV (Not recommended)	Solar Photovoltaic (PV) technology is not directly related to any specific building fabric element or service. They therefore allow for reasonable flexibility in their sizing subject to certain constraints, the most important being available surface area (roof or facade) and also orientation of the roof or façade, requiring a significant amount of roof area to achieve any real carbon reduction. The required area is available at the rear of the roof of the new stand. Reductions in cost and current FiT levels allow a payback of around 7 years after which the panels would provide a source of income for the club. Maintenance would be minimal with a visual inspection recommended and possibly cleaning annually. Therefore, they are feasible, although as a result of the relatively high capital cost, they are not recommended for this project.
Wind Power (Not recommended)	The use of local wind turbines is not favoured due to the built up nature of the local area, and the associated turbulence this terrain will cause. In addition they are likely to be visibly intrusive and require a significant drop zone which will not be available.
Biomass Heating (Not recommended)	Compliance with Sustainability Objective 4 within the SRF will be a significant issue. The extremely sporadic requirement for hot water and low levels of heating required are minimal, so a purely thermal solution such as biomass is not ideal. In addition, the high cost and on-going complication of fuel sourcing, deliveries and maintenance will result in long paybacks.
Solar Thermal (Not recommended)	As above for biomass a thermal solution is not ideal to the demand profile of the building. In addition (when comparing with other renewable solutions such as PV) the collectors would compete for roof space with a solar PV array, and are less feasible than PV. The RHI would be available (system under 200kW), although maintenance will also be more onerous than an electrically-driven solution.
Ground Source Heating / Cooling (Not recommended)	There would be significant technical and logistical risks to implement a large scale borehole array and ground investigations would be needed to validate the solution – including test boreholes. Lengthy payback due to sporadic demand for heating and hot water, even with the RHI.

3.5 Feasibility of Heat Import / Export

The most capital cost-effective solution has been identified as heat pumps, which are a refrigerant-based system. This provides heating and / or cooling throughout the year as required, to all serviced areas of the new main stand.

With respect to the heating solution, the new main stand will be highly insulated and have low air permeability – and therefore the heating loads will be predominantly 'pre-heat' for occupied areas, and then 'tempering' of mechanical ventilation supply air to maintain the maximum quantity of 'free cooling' to offset the high heat gains which will occur as a result of high occupancy. As a result, the chosen solution is a cooling-led solution – which has led to the identification of heat pumps as the most appropriate system.

Since there will not be a large or continuous base heat load, and because the heating system is refrigerant-based, there has been no allowance made to be able to connect to future district heating networks.

3.6 Grants

There are currently no grants available for use in funding the renewable content of the scheme.

3.7 Predicted Energy Consumption

Based on the BRUKL calculation, for the development, the following energy and emissions predictions have been calculated:

Energy & CO_2 Emissions Summary		
	Main Stand	Notional Building
Heating + Cooling demand [MJ/m^2]	54.61	58.1
Primary Energy [kWh/m^2]	155.78	157.63
Total CO_2 emissions [$kgCO_2/m^2$]	27.6 BER	28.2 TER

Key: BER – Building Emission rate TER – Target Emission Rate

These results are based on ADL2A (2010). As noted above, the 2010 Regulations will apply since the project was submitted to Building Control before the 5th April 2014 and a meaningful start on site will be commenced prior to 6th April 2015.

3.8 Compliance with ADL2A (2010)

The solution proposed at this stage to achieve the Target Emission Rate (TER) of ADL2A (2010), is a highly energy efficient building envelope, the use of low energy systems (including AHUs and extract fans with low SFPs and optimised heat recovery), LED lighting throughout (excluding floodlights which are classed as 'process load' and external lighting – neither of which are assessed within SBEM under ADL2A), and the incorporation of renewable technology in the form of highly efficient reversible air source heat pumps as the heating / cooling sources.

With the proposed renewable energy technologies incorporated into the scheme, the proposed development will exceed the requirements of Approved Document L2A(2010).

4. Conclusion

The energy strategy has been developed to achieve the Client brief, whilst taking into account the ongoing operational nature of the stadium and the constraints applicable to the existing building and site boundary. The stadium is an iconic building, and therefore the aesthetics were also key consideration throughout the development of the strategy.

The consideration of energy usage and carbon emissions as described herein, has led to a solution that achieves the Client brief and the objectives of the Anfield Strategic Regeneration Framework (SRF) for new development to reduce carbon emissions in so far as is practical.

The energy demands of the proposed development are led significantly by the cooling requirements associated with high density occupied spaces. The elements that affect the cooling duty have been reviewed to minimise internal gains as far as possible, including the use of LED lighting throughout, and the potential for solar gain to enter the spaces has been limited by the inclusion of solar-controlled glazing where appropriate.

As the potential sources of cooling were to be electrically driven which would significantly increase the carbon footprint of the stadium, their efficiency was reviewed to attain a system with as high a Seasonal energy efficiency rating as possible. The proposed cooling and heating system is served by reversible air source heat pumps which are capable of delivering heating or cooling to each zoned area, and capable of providing each zone with independent temperature control.

The ventilation philosophy is to use low energy motors on air handling units and fans (to minimise specific fan powers as far as possible), high thermal energy recovery (using thermal wheel technology) and demand controls - to minimise energy when areas are partly occupied, and isolate areas when unoccupied.

A BMS will be incorporated which will not only control the systems, but provide energy metering and monitoring, with systems that will generate alarms for ‘out of limits’ consumption – which will help the Client to achieve the forecasted carbon performance.

The proposed building services solution exceeds the requirements of Approved Document L2A(2010).

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