LONDON
climate change
PARTNERSHIP

Your social housing in a changing climate

January 2013

About this document

This document was written by Sustainable Homes on behalf of the London Climate Change Partnership (LCCP). Sustainable Homes wishes to thank the following people for their help with the report:

- Ola Laniyan, Steve Loynes and Roy Carden of London Borough of Barking and Dagenham for their information on the planning side of the project
- Chris Ellis from United House Ltd for his information on the implementation of the project
- Ken Hughes of Sprunt architects, Steve Piltz of the Steve Piltz Consultancy Ltd, Colin Smith of CSA and Gavin Bayes of the Paul Owen Consultancy for additional project team considerations
- Brian Barrett of Savills for initial project considerations
- Mark Bennett of Tweeds for detailed project costings
- Amanda Gregor of Lund University, Sweden, for assistance with resident interviews and literature review

London Climate Change Partnership
January 2013

Published by
London Climate Change Partnership
City Hall
The Queen's Walk
More London
London SE1 2AA

www.climatelondon.org
enquiries 020 7983 4100
Cover photograph: United House
Copies of this report are available as an electronic download from **www.climatelondon.org**

Foreword

Social housing provides secure shelter for millions of people in the UK. The effects of climate change are impacting on that security. Residents are facing overheating, water shortages and flooding. These issues are set to increase. Preparation can help social housing providers reduce some of these effects. This report shows that with a little forethought, most of the adaptive works can be carried out as part of other refurbishment programmes that the social housing sector is already expert at. There is a significant policy drive to get the sector retrofitting existing homes to make them more energy efficient. Where organisations are able to incorporate these measures into retrofit works they will improve resilience and save money in the long term. Properties will not have to be visited twice. Residents will be disrupted less often.

I would urge all social housing providers to read this report and start incorporating the findings into their maintenance, responsive repairs and refurbishment programmes as soon as possible. Given the success of the sector to adapt to a changing world in the past, this is a great opportunity to continue to provide a secure environment for millions of people to live in.

Sir Gerald Acher CBE LVO
London Climate Change Partnership

Contents

Executive Summary

London is already impacted by events such as floods, heatwaves and droughts, and as our climate changes we expect to see an increase in the frequency and intensity of extreme weather events. Those vulnerable people living in social housing are likely to feel the effects the most and so it rests with social landlords to ensure that their stock is adapted for climate change.

Most of the social housing in London was not built with climate change in mind, which means that it will have to be adapted to suit our changing climate. Many adaptation techniques are available but have not been tested on a large scale on social housing before now.

This report explores the findings of such a large-scale test and examines the particular situation for social landlords. The report focuses on the Colne and Mersea blocks in the London Borough of Barking and Dagenham (LBBD). These two blocks, comprising 200 flats, were scheduled for Decent Homes works and the opportunity arose to adapt them to climate change at the same time.

The Your Home in a Changing Climate (YHCC)[1] report was used as a blueprint for adaptation features adopted in the Colne and Mersea tower blocks.

Adaptation Features Included in the Retrofit

Water scarcity: low flow kitchen and basin taps, small volume baths, new low flow showers, water meters

Overheating: external blinds incorporated in triple glazed windows, external cladding, light external colouring, extractor fans

Flood risk: flood barriers to ground floor flats, flood resilient external wall finish, non-return valves for soil pipes, existing drainage refurbishment

The project team found that acceptance of the works was gained by integrating the climate change adaptation and mitigation measures with planned Decent Homes works, which were more immediately desirable to the residents. The work was carried out using the installation contractors, United House, who were

1 Your Home in a Changing Climate, Three Regions Climate Change Group, February 2008

Executive Summary

experienced in working with social landlords. Most adaption works went smoothly but integrating the water meters with other heating and utility systems proved to be more problematic than anticipated at the beginning of the project.

Nevertheless the problems were overcome during the course of the project, and by and large, the residents reported being very happy with the works. The new showers were popular and virtually no overheating in the newly clad and triple glazed flats was reported.

There was evidence of awareness amongst residents on water scarcity and overheating, but limited awareness of flood risk. In particular, residents in the ground floor flats were not aware of the flood damage reduction measures installed.

In terms of social benefits, there is a strong case to carry out similar works throughout the sector. Key learning and recommendations are reported throughout the report but are summarised briefly here. Suggestions for appropriate additional funding are also made.

The costs of the adaptation works were £2.71 million over and above the Decent Homes works. The main savings for residents, projected to be a total of £75,000 per year, were lower space and water heating costs and reductions in metered water use.

With the exception of narrow baths, water saving measures such as low flow showers, low flow taps and small toilet cisterns were welcomed by residents as part of the Decent Homes package and transfer to metered water. The costs of installation of the measures are relatively low and it is recommended that all future installations of water fittings in social landlords' stock are water saving models and suggested specifications are given. Water saving devices could be fitted as part of Decent Homes, responsive repairs or refurbishments. As retrofit standards are developed, consideration could be given to incorporate these reflect these concerns.

< Flooding in Richmond, London - © Istock

There are a variety of solutions to reduce the risk of overheating and there is no single solution applicable to all social housing. It is therefore recommended that the risks of overheating are assessed, and solutions modelled, when major works are planned and when Decent Homes works are triggered. It is also suggested that the methodology used to generate Energy Performance Certificates is adapted to produce the overheating risk assessment at the same time. Including adequate ventilation can be integrated into general upgrading works and need not require additional funding. Where external shading is considered, external sources of funding may be required as these are potentially expensive and do not necessarily lead to high cost savings elsewhere.

The works also significantly reduced fuel poverty. This report focuses on the impact of those and other works on how the property was better able to deal with climate change. These issues relate to climate change adaptation rather than mitigation (reducing carbon emissions).

Executive Summary

It is suggested that health and wellbeing boards are approached to identify priority areas for investing in preventative measures. For example, prevention of overheating can lead to fewer hospital admissions. It is recommended that windows with integral shading are considered as a viable option for external shading. In this particular study, they were found to be more cost-effective than external shutters and awnings when maintenance was considered. Where external cladding is being installed the energy efficiency benefits may justify applying for funding under the forthcoming Energy Company Obligation mechanism.

Flood protection measures were a significant cost in this project and due to the low risk of flooding in this area, the landlord decided to accept some of the risk of flood damage. Again, it was recommended that a flood risk assessment for a landlord's stock be undertaken in order to prioritise which properties are at particularly high risk and to ensure that local drainage is fit for purpose in those areas.

When Decent Homes works are undertaken on properties that require rewiring, then ground floor wiring, electricity meters, sockets and switches can be brought down from the floor above so that the electrics are above flood level, taking care to ensure that they remain within the heights specified in Lifetime Homes requirements. Fitting bungs or covers to drains when there is a flood warning may be difficult to manage in a housing block where there is no clear responsibility for these actions. An active community flood plan could address this issue.

In all cases, it was recommended that information was passed on to residents, through a landlord's normal communication channels, that explain what they can do to reduce the water scarcity, flood damage and overheating.

This study shows that works to adapt homes to our changing climate can be incorporated into standard works to improve properties. Flooding, overheating and water shortages can cause real stress for communities, particularly vulnerable people. As a result of the works people in the Colne and Mersea blocks will be able to live more secure lives, regardless of the effects of climate change.

It is imperative that homes can withstand the impact that climate change may cause through flooding, water stress and overheating. Many of the suggestions here can easily be applied to maintenance, responsive repairs and refurbishment programmes. It is highly recommended that landlords take the lessons from this report, adopt adaptation measures to assist residents to live more comfortably and with less risk from our changing climate.

Introduction

London faces climate change. Extreme weather and the impacts of climate change are being experienced now and, according to projections, are set to increase.

Even if carbon emissions were drastically reduced in the next few years, historic emissions have impacted on our climate, which, in turn, is now affecting our weather. The impacts on London housing were reported in our earlier report **Your Home in a Changing Climate (YHCC) report**[2]. Furthermore, the UK Climate Impacts Programme (UKCIP) has modelled projections for the impacts given different emissions scenarios and risk for each type of impact. UKCIP produced the **UK Climate Projections (UKCP09)**[3] on behalf of the UK Government, which indicated that some of the impacts London face are:

- Water scarcity: the South East of England is already an area of serious water stress. London is one of the driest capital cities in the world, with available water per head of population similar to Israel.[4] Climate change is projected to increase the risk of drought in the UK, which, along with population growth, will increase the stress on our water supply. This will include water for crop irrigation and other industries as well as for domestic consumption. Ideally, domestic water usage should be reduced to 130 litres per person per day (lpd) by 2030.[5] Average water consumption for the UK is currently 160 lpd. Clearly this is not a sustainable level.
- Overheating: Prolonged periods of heat can result in respiratory problems, cardiovascular disease (CVD)[6], increased physiological risk, poor sleep quality and even death. Excess summer deaths are likely to increase from 800 to 2,800 by the 2050s across the UK. The most problematic factor is night-time temperature during heatwaves due to buildings overheating throughout the day and heat rising to higher bedroom levels.[7] An increase in the installation of domestic air conditioning will increase CO2 emissions, while also causing electrical cooling load, noise nuisance and the risk of power cuts.[8]
- Flooding: Increased summer and winter precipitation, combined with increased urbanisation, which reduces capacity for the surfaces to absorb water, increasing the risk of surface water run-off causing flood damage. Flooding damages property, displaces people and leads to increased insurance premiums for residents and repair bills for landlords or owners. For example, the floods in 2007 led to 65,000 claims and are estimated to have cost £3 billion.

In response to these changes several actions can be taken and these have been described in the YHCC report. The actions listed in the report were modelled to find how effective they were on a desk-based assessment. Following release of YHCC, the London Borough of Barking and Dagenham (LBBD) allowed these actions to be considered and tested for real in a social housing context.

This paper reports on the outcomes of the adaptation of the LBBD properties and the efficacy of the recommendations in YHCC.

The work of the London Borough of Barking and Dagenham and the report here focus on water efficiency, overheating and flooding. Other impacts London is likely to see, which are not tackled here in this report, include subsidence, sea level rises and windstorms. The **Environment Agency Climate Ready Service** has more information on these issues.

2 Your Home in a Changing Climate, Three Regions Climate Change Group, February 2008
3 UK Climate Projections 2009, UK Climate Impacts Programme, 2009
4 The Impacts of Climate Change on London – Summary Report, Greater London Authority, October 2002
5 Water for People and the Environment, Environment Agency, March 2009
6 Report of the workshop Blowing Hot and Cold at Home, Health Protection Agency, March 2011
7 Social & Community Housing in a Changing Climate, UK Climate Impacts Programme, 2011 Your Home in a Changing Climate, Three
8 Regions Climate Change Group, February 2008

Climate Change in London – An Overview

Our Changing Climate

It is recognised that our current climate is changing as a result of a dramatic increase in greenhouse gases (GHGs) through human activity. **The Intergovernmental Panel on Climate Change** (IPCC) is the leading international body that provides scientific assessment on the evaluation of climate change.[9] The Fifth Assessment Report, to be published in 2013/2014, will disclose further the scientific, technical and socio-economic effects of climate change.

Carbon dioxide (CO_2) concentration emissions, one of the main GHGs, have increased by a third since the Industrial Revolution.[10] Unfortunately, if our emissions completely stopped today there would still be a change to the climate for the next 30-40 years due to historic emissions.[11]

Research into future climate scenarios for the UK has been compiled by the **UK Climate Impacts Programme (UKCIP)**. They have calculated a range of emissions scenarios where higher emissions result in greater changes in the longer term.

Climate and Demographic Change

London has a total population of approximately 8.2 million, representing about 14.6 per cent of the total population of England and Wales.[12] London's population is expected to grow significantly. As a result of social change, it is projected that more people will choose to live alone.[13] The recent Powering the Nation report showed that the use of electrical equipment from a single occupancy household was as much as, and in some cases is more than family occupied homes.[14] If trends like this continue there will be increased pressure on housing in relation to volume and density with additional pressure to adapt to climate change from increasing use of energy.

The Urban Heat Island (UHI) is the effect of an urban microclimate that builds up over towns and cities due to the release and reflection of buildings (both domestic and industrial). UHI has significant consequences on the urban environment and causes increased distress in relation to overheating.

For an 18-month period leading up to March 2012, there was extremely low rainfall across most of England. This was the driest winter period across the region since 1976, resulting in water companies implementing temporary use bans (hosepipe bans) due to low groundwater and environmental stress.[15] With these recent water patterns, normal reservoir heights are lower, and with an increasing population, it adds to an already water stressed area.

9 Intergovernmental Panel on Climate Change, 2012 http://ipcc.ch/
10 Global Climate Change – Causes, National Aeronautics and Space Administration, 2012
11 Adapting to Climate Change, Department for Environment, Food and Rural Affairs, May 2012
12 2011 Mid-Year Population Estimates, Greater London Authority, September 2012
13 Your Home in a Changing Climate, Three Regions Climate Change Group, February 2008
14 Powering the Nation – Household Electricity Using Habits Revealed, Energy Saving Trust, June 2012
15 Water Resources and Drought Prospects for summer/autumn 2012 and winter 2012/3, Environment Agency, June 2012

Climate Change in London – An Overview

Existing Housing Stock

Building stock is at significant risk of suffering from climate change impacts. It was estimated by the **Sustainable Development Commission** that around 70 per cent of the UK's housing stock that will be inhabited in 2050 has already been built.[16] A relationship between dwellings construction age and overheating has been established; dwellings built around the 1960s and smaller top-floor purpose-built flats are more likely to be at risk of overheating.[17]

London currently has about 3.2 million homes. The previous report *Your Home in a Changing Climate*[18] from the Three Regions Climate Change Group assesses the effective measures to retrofit existing homes to enable them to cope with the impacts of climate change. It is imperative that homes can withstand the impact that climate change may cause through flooding, water stress and overheating.

Adaptation for Social Housing

Your Home in a Changing Climate highlights the need to consider widespread adaptation of existing homes and this project will consider the importance of protecting social housing specifically. Points to note are:

- Many social housing customers will not have the means to adapt their homes themselves – this could increase vulnerability.
- Where social housing stock is impacted it could affect the ability of the entire community to be resilient to climate change affects, by overwhelming responsive capacity.
- One problem associated with damage to property is that often events like flooding (as experienced in 2003 and 2006)[19] are seen as one-off weather conditions rather than a result of the wider phenomenon of climate change.

Purpose of the Report

The purpose of this report is to:

- Evaluate the effectiveness of measures described in YHCC when applied to social housing –what are the hidden costs? Which measures work particularly well or are very cost-effective?
- Understand the ongoing resident engagement and monitoring needs
- Learn from the challenges overcome during the retrofitting work
- Establish the costs and benefits of the retrofitting measures proposed in YHCC guidance when applied to social housing on a large scale
- Provide recommendations to local decision-makers and policy-makers as to the scalability of climate change adaptation retrofitting in social housing of this type

For clarity, this report is based on information provided by the project team and residents and it has not been the purpose to carry out independent assessment of their findings and experiences.

16 Sustainable Development Commission, 2011
17 Investigation into Overheating in Homes, Department for Communities and Local Government, July 2012
18 Your Home in a Changing Climate, Three Regions Climate Change Group, February 2008
19 Your Home in a Changing Climate, Three Regions Climate Change Group, February 2008

Report Methodology

An important point to note about the Colne and Mersea homes refurbishment is that it was not just a climate change adaptation project. The driver for refurbishment was to bring the blocks in line with Decent Homes requirements and other interventions for overall improvement such as a new door entry system for security and significant energy efficiency improvements. Climate change measures were included because an opportunity arose to do so.

The approach for this report was therefore to separate out key information about climate change adaptations from the project as a whole. In some cases this was straightforward; in others there was some overlap. This is explored in full in this report.

The research included interviews of key stakeholders in the project and a close review of subsequent documentation resulting from the interviews. The stakeholders were broadly separated into two groups, namely the project team and the residents.

Key personnel from the project team were interviewed and their comments to climate change adaptations were included in the report. The organisations interviewed were

- The London Borough of Barking and Dagenham (the client),
- WYG (who were asked by LBBD to put a project team together),
- United House (the main contractor),
- Sprunt (architects),
- CSA (mechanical and electrical advice),
- Paul Owen Associates (flood risk assessors),
- Steve Piltz (environmental consultant) and
- Tweeds (quantity surveyor and employers agent).

Interviews were structured around the recommendations for climate change adaptation reported in Your Home in a Changing Climate.

Residents from both blocks were approached by means of a notice in the blocks giving details of interview dates and times and also by direct contact from the United House's resident liaison officers (RLOs). In all, 18 different residents were interviewed for their views.

The information gained was used for this report and is split into overall learning for the project and more specific learning for the individual climate change adaptations. A cost benefit analysis was also performed as well as comments on the social benefits of the project.

Colne and Mersea Refurbishment

Background

The LBBD properties were the Colne and Mersea Tower blocks. They are 17-storey residential tower blocks built in the late 1960s to early 1970s for social housing. There are 100 flats in each block. Most of the flats are social housing properties. Of these, 22 are leaseholder properties.

The land surrounding the two tower blocks is known to be contaminated, as this was originally the site of the old Cape Asbestos factory.

^ *Outer finish of blocks before refurbishment (Permission of LBBD).*

^ *Inside of a typical flat prior to refurbishment (Permission of LBBD)*

The method of construction of the internal frame is in-situ concrete with concrete floors spanning onto cross walls and spine walls with concrete lift shafts and stair cores. The external envelope of the building is cavity constructions consisting of a fair-faced brickwork outer skin with either a concrete or hollow clay block inner skin.

Adaptive Measures

Detailed descriptions of the adaptation measures, together with considerations of the recommendations of Your Home in a Changing Climate are explored later in the pages below, but in summary the measures installed were:

- Low flow kitchen and basin taps, small volume baths, new low flow showers and water meters, to address **water scarcity**
- External blinds incorporated in triple glazed windows, external cladding, light external colouring and extractor fans, to address **overheating**
- Flood barriers to ground floor flats, flood resilient external wall finish, non-return valves for soil pipes and existing drainage refurbishment, to address **flood risk**

Non-adaptive Measures

The other measures installed were to achieve Decent Homes requirements and other issues to meet residents' needs. These will not be described in any great detail except where there is some overlap with or impact on climate change adaptation works.

- For Decent Homes: new kitchens, new bathrooms and new centralised gas heating system to replace existing storage heaters
- Others: new door entry system, new lift system (so that now two lifts operate on each floor) and solar photovoltaic system

Overall Project Management

Costs

The overall tendered cost of the project, including Decent Homes works, was £10.7 million. This was after value engineering savings had been deducted. The split in costs was as follows:

General items (including scaffolding, design work and survey work)
£2.71 million

Water stress measures
£0.14 million

Overheating measures
£1.90 million

Flood risk reduction
£0.03 million

All other works
£5.92 million

Total
£10.70 million

LBBD received a grant from the London Development Agency (LDA) Innovation and Opportunity Fund for climate change and mitigation works. The total received was £3.6 million. This was used to fund the actual adaptation measures, as well as some mitigation works and the extra survey and design effort for the works. In addition it was used to part-fund the scaffolding and access required for the whole project. Match funding was to come out of LBBD reserves.

LBBD also set up an energy service company (ESCO). The aim was that residents would only be charged for what they consumed. The ESCO would collect charges on behalf of LBBD. LBBD would, in turn bulk buy fuel and recoup costs. This was a change from the previous situation where water and heating were included as part of the rent as a flat rate and not dependent on quantities consumed.

Detailed costs for individual measures are given in subsequent sections in this report.

Overall Project Management

Timings

The timings for the project were driven by a completion date for the Decent Homes works and a requirement from GLA funding to have spent £7 million by the end of the first financial year of the project. At the outset of the project the timings were as follows:

Milestone	Timing
Detailed specification developed with framework architects and consultants	August 2009-June 2010
Planning permission application and receipt	Submitted March 2010, received July 2010
Tender for contractor from framework contractors	Issued February 2010, returned April 2010
Contractor appointed	August 2010
Start on site	July (site handed to contractor), works commenced August 2010
GLA funding received	March 2011
Anticipated works completion	August 2011

In reality the programme was delayed – cladding works took longer than expected due to satellite dishes, and there were complications in integrating the various heat, water and power metering and monitoring systems. There were also several issues with access and disputes from some residents concerning the scope of works within flats, although these were eventually all resolved. Works were actually completed in February 2012.

What Worked Well

There was a great deal to achieve on this project. Three key factors helped achieve a successful project.

- Building resident support
- Running the project effectively
- Good practise on site

Building resident support

One of the major concerns from LBBD was that of gaining resident support for the project. It was felt that residents would be concerned because historically all heating and water bills were included in the overall rent for the properties. In addition, new water saving devices would need to be fitted and it was unclear how residents would react. Another major concern was the disruption that was likely to be caused by the works overall – Decent Homes, energy efficiency as well as climate change adaptation works.

Starting early: Resident consultation for the project began at the same time as the development of the project brief. Anecdotal information on overheating and cold was gained which informed the brief. It was found that it was better to invite written information from residents, rather than have formal meetings. The reason for this was that many residents did not want to be seen talking to officials.

Overall Project Management

Grouping the work with decent homes improvements: Grouping the adaptation works with the Decent Homes works was very useful. The improvement in energy efficiency and the promise of new kitchens and bathrooms was a great attraction to residents.

Meeting resident requirements: during the initial resident engagement period, the project team found that residents had other issues that needed to be addressed. It was found that these could be incorporated in the design work. For this project, residents felt it was important to have CCTV cameras installed as well as a new door entry system. Including these requests in the project helped to ensure acceptance for the project.

Whilst every effort was made to reduce disruption during the works, there was recognition that shift workers would need to be accommodated. The demonstration flats were used for this purpose. The project team reported that two people needed to be rehoused over the duration of the project.

Demonstration flats: before intensive works began on site, LBBD identified two empty flats in the blocks. These flats were fitted with as much as possible of the features that would be fitted in all the other flats. As well as the Decent Homes kitchens and bathrooms, adaptive measures such as the water meter (though not connected), extraction systems, water-saving taps, toilets, baths and showers and new windows with blinds were fitted. In addition to being useful show flats for residents, they were also used for Residential Liaison Officer (RLO) meeting rooms and occasionally as a respite space for residents who needed to be moved during works.

Extensive Resident Liaison Officer work: during the works the project team found the Resident Liaison Officers invaluable. The RLOs kept residents involved, informed of timetables of work and were available to answer any questions that residents had. They were able to feed back any crucial information about the works or potential problems to the main contractor and were generally there to ensure smooth liaison between the project teams and the residents. For this project, one RLO per block was employed rising to three RLOs on site during peak works. Peak works were those involving internal works and it was found that less RLOs were required during external works.

Support was maintained through consideration for residents throughout the project. A flat was converted into a show flat so residents could envisage their new homes. This also served as a respite unit, where residents could relax away from the building work. External mast climbers were used rather than scaffolding to prevent blocking the light from homes and to improve security. Additional support for the local community included:

- eight local people employed as apprentices
- 50 days work experience on the flexible learning service for young apprentices
- site visits for 90 students
- activities with seven local schools and participation in mock interviews
- football coaching and street dance courses during school holidays

Overall Project Management

Running the project effectively

Including the design team on the interview panel for selecting contractors: This was particularly useful: When the contractor proposed solutions that were not compatible with adaptation measures these could quickly be identified and fed back to the contractors. Each member of the design team had unique specialties, which would not necessarily be known by the client alone during the interview process.

Development of a highly detailed specification: Due to the innovative aspects of the climate change adaptation works, LBBD took a strong interest in ensuring the project objectives were met. To make sure the improvements were optimised, LBBD, in partnership with the initial design team, developed a detailed specification before tendering. This involved detailing the specifications for individual adaptive measures but not necessarily the brand or manufacturer. Overall the specification development process took about nine months but resulted in a document that could be used for the tendering process. In addition the advantages and disadvantages of each option could be explored at design stage, identifying options that affected other works in the project.

Having experienced framework contractors assisted significantly: LBBD had carried out some adaptation works before the Colne and Mersea project so had experience of the kind of measures that would be installed. In addition, it was important that the contractor understood the adaptation issues. Mitigation issues appear to be well understood in the sector, but adaptation measures less so.

Value engineering possibility: despite the detailed design work being carried out prior to tendering, it was found that further value engineering could be achieved by the contractor. An example was where two central boiler units were combined into one, saving around £75,000. Although this example was not related to climate change adaptation, other examples were found, particularly on overheating prevention measures. These will be described later in the report.

Securing additional adaptation work: As well as the climate adaptation work for this project, LBBD also managed to secure further adaptation work for four other properties at a reduced price in the local area. This project was able to use the same site facilities as the Colne and Mersea project and also gave the contractor further experience on adapting building archetypes other than flats.

Good practise on site

The following points are probably applicable to all major works of this scale as opposed to uniquely applicable for climate change adaptation work. Nonetheless they are included here as passing on good practice:

- All contractors on site wore United House clothing and could be identified by a unique reference number on their Personal Protective Equipment (PPE). This was whether they were direct employees of United House or sub-contractors to United House and each individual contractor knew this was the case.
- As described earlier, part of the works involved renewing lift access, which in turn meant intermittent lift closure. Plenty of warning was provided to residents. In addition a works lift, which was installed to

Overall Project Management

facilitate the installation of the new heating system, was also made available to residents who for deliveries of goods. For this project the works lift was reported to have been used six times by residents for the course of the whole project.

- Each floor on the blocks had a floor marshal, whose responsibility it was to ensure that all walkways on the floors were clear during the works. The marshals were in addition to the RLOs. As well as ensuring that all hazards were removed in a highly visible manner, this procedure had the added benefit of helping to prevent malicious accident claims.

There was also some useful learning about interaction with research. An important point about the usefulness of the UK Climate Impacts Programme was raised. The projections are portrayed as a series of likelihood of outcomes given a range of future carbon emissions trajectories. For instance, a low emissions trajectory is projected to lead to a 10 per cent likelihood that mean summer temperature will be above 1oC higher than historical summer temperatures, but a high emissions scenario is projected to lead to a 90 per cent likelihood that mean summer temperature will be lower than 3oC higher than historical summer temperatures. There are many permutations of the likely precipitation rates and mean summer temperatures and timescales. The project team commented that it would be useful if guidance were given on which projection they should plan for. This suggestion is included in our recommendations.

Resident Feedback on General Project Work

On the whole, resident feedback was very positive on works at the time that they were completed. There were points that were raised on the general works progress and these are shown below. Comments relating to specific climate change adaptations are reported in later sections of this report.

What residents said about overall works

89%

of residents felt positively about the works

11%

of residents felt negatively about the works

Overall Project Management

Residents were generally positive about the final outcome, but none mentioning specific climate change adaptations. Examples of positive responses were:

"I'm very happy with the work, it is so much better from when I first moved in. I've seen how good the windows were for energy efficiency in the winter and I'm expecting to save money when it [payment for bills separately] comes in. My friends can now come visit and I'm happy"

"I'm pleased they put central heating in, windows were drafty before and the sitting room was freezing in the winter. I usually and have for years got dampness in the bedroom and sitting room but no damp this year. I used to have to use the immersion heater, which uses so much energy and money so I'm happy now"

"Not very good but excellent!"

"Energy monitors are brilliant, great to see what you are using"

"It was done really well. We always got notices and we didn't have to be in, we could just leave our keys, it was about having trust"

"Nice place to live and come home to."

^ *New kitchen (Permission United House).*

What could be better?

The overall opinion of the works was positive, but, as probably could be expected, there were comments made by half of the residents in regards to the building works being disruptive due to noise from drilling and having people coming in and out of the property while people still lived there. 30% of the residents mentioned that it would be highly beneficial to have an option to move out while the main work was going on. Some residents specifically raised concerns over their health in regards to increased levels of stress and asthma conditions worsening.

Just over 30% of the residents stated a concern about a lack of communication between the contractors and themselves. Some residents suggested a contractor could walk through the flat explaining what has been done and how it works (for example the extraction fan and where the stop cock is located). Some residents were still experiencing problems with the door and intercom system and the heating system. One resident suggested that the contractors be obliged to follow up with maintenance for one year after the improvements.

Overall Project Management

Lessons Learnt and Recommendations

The key lessons learnt from the project management side were:

- Resident acceptance for climate change adaptation was made considerably easier when combined with other more desirable work such as decent homes and increased security measures. This should be considered for other adaptation works.
- The climate change adaptation works are not generally viewed as important compared to Decent Homes works by residents. Therefore raising awareness prior to adaptation works should be considered.
- Detailed specification works helped ensure that the project stayed client led and also ensured that climate change adaptation works stayed a key focus of the project. This should be considered for future works.
- Project teams should receive guidance on the large range of UK Climate Impact Projections they should plan for.
- Value engineering is possible in adaptation works and should be encouraged.
- Have framework contractors who are experienced at adaptation works.
- It was possible in this project to secure additional adaptation works for other properties and should be considered in future projects.
- Delivery times for this project slipped due to optimistic planning. The timelines actually experienced for this project could inform planning of other projects.
- RLOs are invaluable for works of this nature as they can address any issues that residents have at a very early stage. RLOs should therefore always be used for these kind of works.
- Despite best efforts by the contractors, it appears that some residents feel that there was not enough communication. Perhaps formal logging of communications, signed by residents, would help demonstrate the full effort undertaken to communicate with residents.
- Good contractual practice ensures smooth project running and should be used for all major social housing projects.

Adaptive Water Measures

Considerations

The case study focused on considering the recommendations made in YHCC in order to test them in a real project. The sections below, list the considerations made by the project design team on measures to reduce water usage in the flats.

1. Low flow showers – the existing flats had no showers. It was felt that showers with aerated shower heads with a flow rate of 8 litres per minute would be acceptable and no issues were anticipated by installing low flow showers. United House had no problems either sourcing or buying low flow showers for the project.

2. Low flush toilets – dual flush toilets with a full flush of 6 litres and part flush of 4 litres were specified and installed throughout. The style of toilet was where the handle was pushed or pushed and held for different flush levels. No problems were anticipated from residents. United House found no problems in either sourcing or buying low flush toilets for the project. It was crucial that residents agreed to have new bathrooms for this project. This was because the existing layout consisted of a separate toilet and bathroom in each flat, each room having a separate window. The new layout was that the toilet and bathroom would be combined into one, with one room single window replacing the two existing ones.

^ *New bathroom. (Permissions LBBD).*

3. Low flow bathroom taps – Hans Grohe taps with a flow rate of 2.5 litres per minute were specified and installed in the bathroom wash basins. On initial commissioning exceptionally low flow rates were experienced on the top two storeys of the blocks. This was due to a low head of pressure from the cold water storage on the top of the blocks. The flow rates were easily rectified by plumbers on site by changing the restrictors in the taps.

4. Low flow kitchen tap adaptor – kitchen taps with a flow rate of 5.8 litres per minute were specified and installed in the new kitchens. No problems were encountered in either sourcing or installing the taps. Some residents had opted to keep their existing kitchens as they had already upgraded them using their own resources. This was easily accommodated by United House and LBBD.

In addition to the recommendations from YHCC the project team considered other works. These are listed below, together with considerations.

5. Low volume baths: the project team decided to use the bathroom replacements as an opportunity to install low volume baths. They had problems sourcing a suitable bath. There were a range of low volume acrylic baths, but LBBD required a longer-lasting metal bath. The project team eventually found a Twyford Celtic 140 bath that was suitable. After installation the team did experience complaints from some residents about the narrowness of the baths (see residents' feedback later in this section). It was felt by the project team that the installation of new showers went some way to compensate for this complaint.

6. Water meters: although not specifically recommended in YHCC it is known that homes with water meters use less water than those without.[20] The installation of water meters was a key part of the overall refurbishment project. Before renovation there were no meters and

Adaptive Water Measures

water usage was included in the tenants' rents as a flat rate, regardless of the amount of water they used.

^ *Meter showing water and power use (Permission United House).*

The intention after renovation was that tenants would pay for water as they used it. As described earlier in this report, the water would be supplied by a new entity called Utilita, managed by LBBD. This meant that although there would be a reduction in rental income, some of the reduction would be offset by some income from the sale of water. In addition, tenants would make some savings on energy bills where hot water usage was reduced in showers, baths and hot water taps.

During installation the incorporation of the water meters with the other metering presented unexpected difficulties. Other meters used were heat, water and electricity. A display device showed utility usage instantaneously and historically. The device used was manufactured by Secure Meters (UK) Ltd and enabled real time monitoring of hot water, electricity and water usage, in a convenient location (normally the hallway inside the flats). Individually the meters did not present a problem and have been installed on previous contracts by United House. However, this project required significant integration and was not resolved at design stage. United House overcame the problem by using in-house mechanical and electrical design teams and extra costs were incurred by having to install an extra valve in each flat to integrate water metering.

One further unexpected cost in this area was the location of the water meters. It was found necessary to locate the meters away from the electricity meters in the cupboards in the flats. The only way this could be achieved was by installing the meters in a ceiling void outside of the flats. Extra costs were incurred because there was extra pipework to install and access hatches had to be provided so that the meters could be read.

The following items were recommended in YHCC, but not installed for the reasons listed.

7. Cistern displacement – this is where devices, most commonly "Hippo bags" are placed in large toilet cisterns which means that less water is used to refill the cistern after flushing. This recommendation from YHCC was more relevant for individual householders but redundant for the Colne and Mersea project, as the existing toilets were to be replaced with low flush versions.

8. Variable flush retrofit – these are kits which allow conversion of existing toilets with large cisterns to dual flush versions. As with cistern displacement devices, this recommendation was not considered applicable as the toilets were being replaced.

9. Repair dripping taps – clearly a non-applicable recommendation for this project as all water devices were being replaced.

8. Garden watering from water butts: the flats have no gardens, so this recommendation was redundant for this project.

Adaptive Water Measures

9. Car washing: this was not considered relevant for this project, but it was suggested that most residents with cars used local car washing facilities instead of washing their cars outside the blocks.

10. Water efficient dishwasher: this was not considered relevant for the Colne and Mersea project, as LBBD did not intend to install dishwashers.

11. Water efficient washing machines: this was not considered relevant for the Colne and Mersea project as LBBD did not intend to install these for the residents.

The stated aim of the measures was to achieve water savings of 28,000 litres of water per person per year. This aim was extracted from the figures published in **Your Home in a Changing Climate**. No data was available to indicate the level of water usage from the blocks prior to renovation, therefore it was difficult to be precise about the actual levels of water saved. In order to go some way to calculating the possible savings the Water efficiency calculator for new dwellings[21] was used to determine the expected usage rate. The calculation methodology itself is used for building regulations compliance for new homes and for water calculation for the Code for Sustainable Homes. A **recent study** has found that approximately 10 per cent more water is actually used than calculated by this methodology when averaged over many homes.[22]

The environmental consultant, WYG, found that when the details of the installed water devices were input into the water efficiency calculator, a consumption level of 90 litres per person per day was calculated. When increased by 10 per cent in accordance with the recent study, 99 litres per person per day could be expected to be used. Thames Water data shows that average water usage for households without water meters is 160 litres per person per day. This would indicate that 61 litres per person per day was saved as a result of the water efficiency measures installed. Over 365 days this means that 22,265 litres per person per year was saved, which was close to the stated aim. In any case 99 litres per person per day is less than the Environment Agency's stated objective of 130 litres per person per day.

Although this amount of water may indeed be saved, at the time of writing, residents were unable to benefit from these savings financially. This was because contractual issues between LBBD and Utilita have delayed the switch between residents paying a flat charge in their rent, to paying a metered charge. The contractual issues revolve around who is responsible for maintenance of the meters. Currently residents can save as much water (and heat) as they want, but there are no financial incentives in place to do so at the moment.

21 Department for Communities and Local Government, The Water Efficiency Calculator for new dwellings, September 2009
22 Assessment of Water Use in Homes Built to Code for Sustainable Homes levels 3 and 4, Town & Country Housing Group, January 2012

Adaptive Water Measures

Resident Feedback

What Residents Said About Water Usage Reduction Measures

This study found that 72 per cent of residents are aware of water scarcity issues in London. From those who were aware, 69 per cent had heard about this through the news, in connection to the hosepipe bans of 2012. The responses to people's behavioural changes varied. Half of the survey sample did not think their behaviour had changed significantly because they were aware of water shortages previously and were already cautious when it came to water use.

Two interviewees thought they now use more water from their kitchen taps because they have to run the hot water in the kitchen to get cold water from the mixer taps. Slight behavioural shifts revealed include turning the tap off when cleaning teeth (22 per cent) and shifting from using a bath to shower more regularly (16 per cent). United House received feedback from residents that baths were too narrow. This is supported by the interview process where one resident also found this an issue. One interviewee stated that they flush the toilet less often when no one else was in the house.

28%

of residents were not aware of water scarcity issues in London

72%

of residents were aware of water scarcity issues in London

33 per cent of the residents stated that they had not changed their water usage behaviour despite the water efficiency measures being installed. One interviewee who was not concerned about the amount of water they use said:

"If I need to use water then I will"

The majority of the residents (61 per cent) did not know if they had saved money on their water bills.[23] However a third of residents think that their water usage will save them money.

"I think my bills will be lower"

23 The residents' water bills are inclusive of their rent. They were supposed to be implementing separate water bills however this had not happened at the time of writing.

Adaptive Water Measures

Lessons Learnt and Recommendations

- ☐ In general sourcing and installing low water usage devices is straightforward and should be considered as a matter of course for Decent Homes and other social housing refurbishment works.
- ☐ Narrow baths tend to raise complaints from residents and should be avoided.
- ☐ Showers are used when they are installed and should be installed as matter of course.
- ☐ Showers with flow rates of 8 litres per minute were acceptable to residents and should be installed more regularly.
- ☐ In order to measure the effect of water saving devices it would be useful to know the water usage rates prior to installation of water saving measures. However, given the accuracy of the water efficiency calculator, this may not be relevant in future projects.
- ☐ Installation of measures is likely to lead to significant savings.
- ☐ Water meters are generally accepted and used by residents.
- ☐ Integration of utility metering systems, including water meters, is not necessarily straightforward. It requires increased detailing and design work from specialist contractors, prior to installation. One particular point of learning from this project is that water meters could not be located near the electricity meters.
- ☐ Contracts with new energy suppliers need to be negotiated well in advance.
- ☐ There is general awareness of water scarcity issues in London at this point in time and it is recommended that this awareness is maintained to smooth future adaptation projects.
- ☐ Advice on water saving behaviours and purchasing water efficient white goods could be given to residents for very little cost on retrofit projects such as this.
- ☐ It is recommended that future maintenance be such that replacements of water saving devices are made on a like-for-like basis.

Overheating Reduction Measures

Considerations

The overheating calculations and modelling for the Colne and Mersea blocks were carried out using the Cymap package, which is one of the industry's standard packages. It uses steady state modelling and Chartered Institution of Building Service Engineers (CIBSE) equations to analyze the effects of a home's fabric and ventilation rates to calculate an internal temperature, given an external temperature.

As with water usage reduction measures, Your Home in a Changing Climate made recommendations on how to adapt homes for overheating. These are listed below, together with considerations made during the Colne and Mersea project, and where relevant, combined with overheating modelling.

1. Install external shading:

(i) Blinds: at an early stage in the project it was considered that if external shading was to be installed, then the windows would have to be selected so that they could open inwards. This was to permit good summer ventilation rates with external blinds shut. The windows chosen incorporated blinds in the external glazed section. This consideration for internal opening became redundant.

(ii) Awnings: the project team recognised that an awning would reduce solar gains in the flats and it was possible to source awnings that could be adjusted from within the flats. However it was found that they could only be maintained from the outside, which would make them expensive to maintain. In addition it was noted that extra detailing would be needed to show how they were to be fixed to the existing structure. It was even suggested that fixed shutters would be a cheaper alternative. In the end these were not installed. Windows with shading incorporated in the glazing were used.

(iii) Reflecting blinds: blinds were installed as part of the new windows. They were not particularly reflective but did shade out the sun. The project team ruled out tinted glass as a solution as it was felt that this would also block out winter daylight and hence make the flats look dark and necessitate additional internal electric lighting.

(iv) Shutters: the recommendation in the YHCC report was aimed at installing shutters which could be closed at will by the occupier. However an innovative solution was considered by the project team. This was to use a triple-glazed window unit, which had blinds incorporated in the third section of glazing. The blinds could be operated from inside the flat and used to control the amount of solar shading there. In line with the recommendations in **Your Home in a Changing Climate**, these were installed on south- and west-facing sides of the block. The east- and north-facing sides had the same windows installed but without the blinds.

United House did experience comments from residents on the east- and north-facing sides of the blocks to the effect that the residents there felt that they too ought to have the blinds in the windows. However, this was felt by United House to be unrelated to overheating on those sides of the block and more related to some residents not wanting to miss out on what was on offer to other residents.

An extra benefit is that the triple glazed windows will improve the energy efficiency of the flats. Samples of the type of window were presented to the project team by various manufacturers that helped convince them that these types of windows were a suitable option.

The project team recognised that this type of window was more expensive than a straight

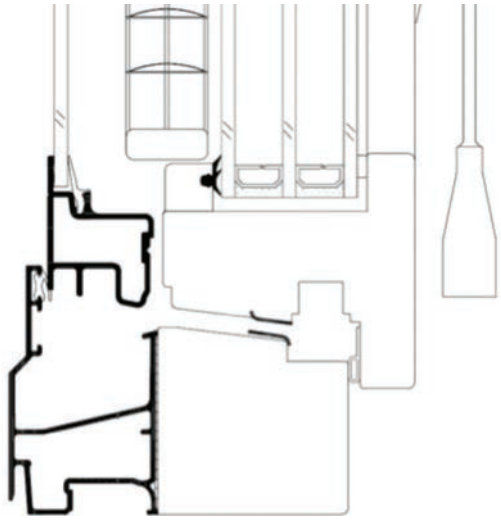
Overheating Reduction Measures

replacement of the existing double glazing. However, it was felt the extra cost was fully justified for three reasons:

- extra costs would have been incurred to ensure that the external walls were structurally sound to attach alternatives such as external awning or shutters
- ongoing maintenance costs of external solutions would have been expensive
- energy savings could be achieved by the resident with triple glazed units

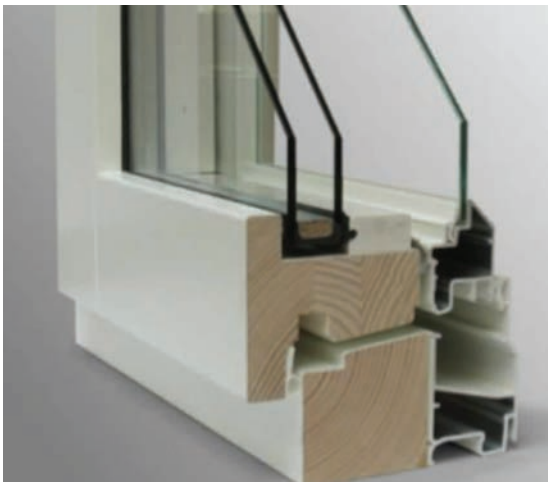
The project team reported that these kinds of windows are relatively common in Sweden and Finland. Considerable savings were made by United House in sourcing an alternative supplier to that identified by the project team. The windows installed were from the Swedish manufacturer Leiab. No particular difficulties were encountered in the installation, but a lead time of three months had to be allowed because the windows were manufactured to fit. No stocks were held by Leiab.

The technical details of the windows are as follows:



^ *Drawing showing position of venetian blind location in the window. Drawing permission of Leiab.*

- U-value of 0.8 W/m2/0K , "K" glazing, double low emissivity energy coatings, warm edge spacers and argon gas
- Venetian-blinds integrated in a split casement system of three glazed panels, the blind and then a final glazed panel
- British Fenestration Rating Council "A" rating
- Integral slot trickle-vents
- Significant sound reduction when compared to the existing PVC double glazed windows



^ *The style of window fitted in the Colne and Mersea blocks. The actual windows installed had four panes. (Photo with permission from Leiab).*

^ *Installed windows with blinds drawn. (Permission United House).*

Overheating Reduction Measures

^ *External cladding being applied (Permissions LBBD).*

2. Increase reflectivity on walls and roofs: this was achieved by selecting a light colour for the render system, which covered the previously dark-coloured brickwork. Some areas of the render were deliberately coloured differently between blocks so that residents could direct visiting friends to the correct block e.g. "come to the blue block".

3. Improve roof insulation: the idea is that extra insulation would prevent conduction of solar heat into the homes. Considerations here were related to whether or not the chosen roof insulation could also support PV panels. In addition the new insulation would have to allow for fixing a communal satellite dish. Individual dishes for each apartment were being removed (see wall cladding section).

The preferred option was an integrated warm roof from Kemper systems. This consists of securing insulation panels onto the existing roof with dedicated resins, then covering them with a layer of resin membrane. The benefits identified by the project team were that this system was inert to UV degradation, the roof could be walked on and it had a 30-year guarantee. Careful detailing was required for fixing the PV panels onto the finished roof.

No issues were reported by United House relating to the installation although a cost reduction was found by working around telecommunication equipment located on the roofs, rather than temporarily relocating them.

4. Install cavity insulation: as with the roof insulation, the idea here is to prevent penetration of heat from the outside into the home. Extensive surveying of the existing walls found that they were cavity walls, but doubts were expressed over the levels of insulation installed. It was recognised by LBBD that extra wall insulation would also benefit the thermal efficiency of the homes. Indeed, the mechanical and electrical design engineer maintained that the energy efficiency benefits far outweighed the overheating reduction benefits, a view which is reflected in the YHCC report. Best practice on overheating reduction is to prevent radiative heat entering the home via the windows. There is a very small amount of heat transfer through the walls and once temperatures inside a property exceed outside temperatures, the heat flow would be conducted from warm to cold i.e. conducted from the inside to the outside.

Nevertheless, LBBD reported that the levels of thermal comfort required by Decent Homes could have been achieved without external cladding and that the external cladding was selected as an additional overheating prevention measure. Therefore, for the purposes of this report, the external cladding will be considered as an overheating reduction measure with energy efficiency improvements as an added benefit, rather than vice versa.

Overheating Reduction Measures

The main consideration was to choose between a rainscreen or rendering system. Rainscreen systems were ruled out because they consisted of panels fixed to a heavy steel frame and may have required reinforcing the existing structure. Insulated render systems were favoured because they were lightweight and cheaper to install. An added benefit was that the rendering would transform the look of the building. The creation of deep reveals was not considered a significant problem as the windows were to be replaced anyway.

The Wetherby Building System was selected. This system consisted of panel beads fixed to the outside wall, rigid insulation panels fixed to the beads and then a final application of insulating, weatherproof render sprayed onto the panels. Condensation risk analysis provided by the supplier showed that there was no risk of condensation. It was found that for tower blocks of this type, often the walls are not as straight as might be imagined and hence the beading framework was necessary.

The project team were particularly careful to consider ventilation of the flats as external cladding often reduces air permeability into homes. United House had no particular difficulties sourcing or installing the render and again found opportunities for cost reduction using their existing supplier network. Access was achieved using a mast climber platform, negating the need for extensive scaffolding and lowered the risk of unauthorized passers-by climbing on potentially dangerous scaffolding.

5. Install double glazing with low e-coating: as described above, triple glazed windows were installed with incorporated blinds. The windows had double low emissivity glass which transmits solar light but not solar heat.

The following items were considered by the design team, over and above the recommendations made in YHCC.

6. Install ventilation units: although not mentioned in YHCC, the project team decided to fit each flat with a ventilation unit. This consisted of a fan driven extraction unit which was installed to extract steam from the bathroom. As well as extracting steam from the rooms, the units also extract heat, helping to prevent overheating in hot weather. The costs for the units were listed as part of the installation of the new heating systems.

7. Install mechanical extract fans: the design team originally considered a passive stack system. However the new door entry system to the lifts made this unworkable as mostly closed doors would not allow enough new air into the flats. Instead the mechanical extract fans were installed. This had a background mode, costing a few pence per day, which draws air through the trickle vents in the windows. There was also a boost made for extracting steam out of the bathrooms providing a powerful way of reducing condensation.

The following items were recommendations made in YHCC and considered by the design team, but not carried out.

8. Switch off unused appliances: this can only be offered as advice to residents and is not something that could be installed. The idea is that appliances that are left on generate internal heat unnecessarily. For the Colne and Mersea blocks, low energy bulbs were installed in communal areas which would also help reduce internal heat compared with incandescent bulbs.

9. Open windows at night: again this could only be offered as advice, especially effective where there are windows on two different aspects of the flat, which allows cross ventilation. Although the windows chosen for the works had a device restricting opening to reduce the risk of children falling out of flats, cross ventilation was usually still possible.

Overheating Reduction Measures

10. Use ceiling or desk fans: not considered as an option. It was thought that the installation of other overheating prevention measures would be sufficient to ensure comfortable temperatures in the homes, without having to install ceiling fans. Residents could choose to bring in desk fans if needed.

11. Replace carpets with wooden floors: the new flooring for the bathroom and kitchen as a result of the Decent Homes programme of works would be hard. There was no intention to replace any carpets that may have been in these rooms. It was also noted that some social landlords might not wish or allow tenants in flats to replace living-room carpets with hard floors, as this may transmit noise to other tenants living below.

^ *Picture showing light colouring on external cladding (Permission of LBBD).*

12. Install secondary glazing: a redundant consideration as triple glazed windows were installed.

Tree planting was also considered by the design team as a measure over and above those listed in YHCC . The benefits of tree planting are significant for our amenity and health. For a full list of the extensive benefits of trees in an urban environment see the useful **Green Benefits in Victoria Business Improvement District** report.[24] In helping to adapt to a changing climate, the subject of this report, two specific benefits stand out.

Firstly, through transpiration, trees can have a cooling effect on the local microclimate. Secondly, trees can have a shading effect on windows. Careful selection of the tree species is required: deciduous trees are ideal because their leaves provide the shading effect in the summer. In winter, when the leaves are shed, radiative heat from the sun is allowed in the home when it is most needed.

After consideration, this option was ruled out because it was felt that the asbestos concentration in the soil was not compatible with the disruption required for planting. A second option of having climbing plants up the side of the blocks was also ruled out due to concerns about ongoing maintenance. Nevertheless a raised bed was installed and planted, but the overheating benefits are likely to be minimal.

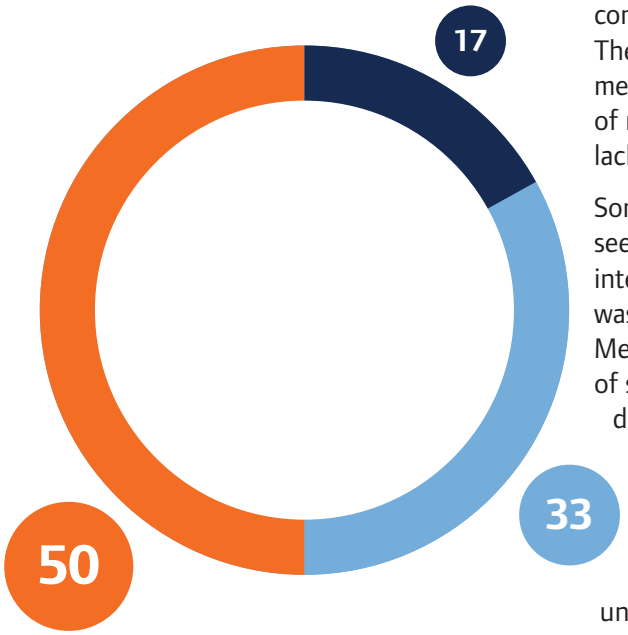
24 Green Benefits in Victoria Business Improvement District by the London Climate Change Partnership and Mayor of London and Tree Economics and the Victoria Business Improvement District, June 2012

Overheating Reduction Measures

Resident feedback

What residents said about overheating measures

Half of the residents interviewed were aware that summer temperatures are projected to be higher in the coming years. Nearly 30 per cent of the residents who were unaware of the projected higher temperatures mentioned that higher temperatures were currently not noticeable (reference to the low summer temperatures around the time of the study in July 2012). The majority of people that said they were aware of increasing temperatures linked this to climate change.



Number of residents who noticed cooler or more comfortable internal temperatures (%)

Yes | No | Don't know

Number of residents who noticed cooler or more comfortable internal temperatures (%)

Of the residents interviewed, 50 per cent noticed a difference in the inside temperature of their flat after the works. Since the retrofit, residents thought the rooms were cooler in summer:

"Usually the sofa's get really hot and we can't sit on them, it's made such a difference"

Other residents had not noticed a change in temperature; others found the temperature easy to control by using the blinds and opening the windows. Only one resident complained of overheating after the works. The same resident had turned off the mechanical extract fan due to perceived costs of running it, which may have been through a lack of awareness.

Some residents mentioned that the corridors seemed warmer. An observation made by the interviewers was that the Colne House block was generally warmer. This is because the Mersea House block receives a certain amount of shading during the day from the Colne block due to its geographical location and aspect.

Regarding the interior of each flat, every resident that has solar shading blinds (only flats with south and west elevation) said they found the blinds easy to use and understood how to use them. Residents commented that they are used for both to control heat and noise.

"they (blinds) are perfect, I was even shown how to work it and clean it"

Overheating Reduction Measures

What Could Be Better

Almost half of residents (40 per cent) mentioned that the windows can be hard to clean. Other issues raised were the need for an Allen key which was hard to access and flies frequently getting trapped in between the glass. One window was hard to open because the resident could not open the outer casing due to a restriction from the window frame.

Some residents with a dual aspect sitting room requested that both windows receive solar shading blinds and not just one (south or west elevation). This was for both practical and aesthetic reasons. Two residents without blinds on their east facing windows (mostly bedroom windows) mentioned that the room could overheat as early as 5 a.m., depending on the sunrise time. One found that this could be reduced by opening the windows. The other had turned the extract fan off because they believed that this consumed lots of electricity.

One resident highlighted her concern of the difficulty of choosing whether to sit in the heat or use the blinds. Choosing the latter means they need to use more electricity during the day as there is not enough light with the blinds down.

In conclusion, the overheating measures seem to have been effective and the external cladding had not made the homes uncomfortably hot. Nevertheless it was noted by the mechanical and electrical contractor that although some internal temperature sensors had been installed for monitoring purposes, monitoring was not being carried out because no facility had been installed to transmit the data to distant sensors. Once in place, this would allow more regular monitoring of internal temperatures.

Lessons Learnt and Recommendations

- ☐ Triple glazed windows with incorporated blinds are common in other European countries and can be viably installed in the UK for retrofit projects. They should be considered for future projects.
- ☐ Value engineering is possible when using triple glazed windows with integral blinds and should be encouraged.
- ☐ Mast climber access is better than traditional scaffolding and should be considered for future projects.
- ☐ Jealousy issues can arise between residents who have extra equipment and those who do not. These must be managed carefully.
- ☐ Installing external cladding has the extra benefit of improving energy efficiency whilst at the same time helping prevent overheating. However a conscious effort must be made to ensure that ventilation devices are also installed.
- ☐ Existing walls on tower blocks are often not straight and some kind of framework is necessary when installing external cladding. It is recommended that experienced contractors are used for external cladding works.
- ☐ Many of the recommendations in **Your Home in a Changing Climate** are more applicable for social housing providers to provide to residents as advice, rather than as installed measures.
- ☐ Some residents complained about lack of advice; others clearly stated that advice was given. Perhaps the advice given and to whom could be more formally recorded, so that all parties are sure that advice has been effectively communicated.
- ☐ Consider installation of remote sensors when monitoring internal temperatures.

Flood Risk Measures

Considerations

Before detailing the design team's responses to the flood risk measures recommended in **Your Home in a Changing Climate**, it is useful to describe the flood risk analysis provided by the hydrologists for the project, Paul Owen Associates (POA).

The Mersea block is partially located in both the Thames and Roding flood plains, in zone 3. Flood zone 3 represents an area of high flood risk from tidal or/and river flooding. The main reason for this categorisation is its proximity to the River Thames and River Roding. However flood defence infrastructure is in place and maintained to protect these areas from flooding. For this reason, the risk of flooding from these sources is in reality very low.

For the purposes of this project only flood risk arising from the River Roding or surface water run-off have been considered along with the adaptive measures required to counter the risks. It was found that the banks of the River Roding were protected against a 6.5 m rise in water level and that risk of a breach was very low. The second risk is surface water flooding. Surface water flooding happens when the volume of rainwater overwhelms the drainage system.

Boroughs are the Lead Local Flood Authorities (LLFAs) and have full responsibility for managing flood risk from surface water, groundwater and ordinary watercourses. Each London Borough will have to investigate (by 2015) measures to address flood risk problems and develop and maintain a public register for Flood Risk Management Assets. Drain London has been working to assess the condition of London's drainage assets, and secure a better understanding of the risk from surface water flooding, so that boroughs and the GLA can manage and improve drainage assets and mitigate the risk from this type of flooding. For further information see **Drain London**.

Many people are currently affected by flooding. Projections outline that extreme rainfall events are even more likely to occur and the number of people affected is likely to rise. To express the severity and likelihood of a flood event, hydrologists use the terms "design flood level" and "return period". The design flood level for the area in a 100 year return period rainfall event was 4.68 m above sea level and for an 1,000 year return period, 5.59 m. The calculations for these flood levels include an allowance for climate change and are not purely based on previous occurrences.

Return periods longer than 1,000 years are not normally considered in flood risk assessments of this nature. The finished floor levels of Colne and Mersea blocks are 4.75 m and 4.55 m above sea level. This means that for a 100 year return period rainfall event only the Mersea block would flood, but for the 1,000 year return period rainfall event, with higher volume of rainfall, both blocks would flood. It also meant that any flood would only directly affect the ground floor, but could disrupt residents on all floors. The design team did consider changing the function of the space on the ground floor to something other than housing, that would be less vulnerable to flood damage (e.g. car parking), but LBBD did not want to lose rental income, so this idea was discarded.

With this analysis complete the design team made the considerations detailed below when assessing which of the recommendations in **Your Home in a Changing Climate** to implement.

1. Relocate meters above flood level: the nature of the refurbishment work for the new heating system meant that new meters would be fitted for all flats. It was ensured that the meters for the ground floor flats were raised above the design flood level. This did not present a problem to United House.

Flood Risk Measures

2. Raise the boilers above flood level: the new heating systems consisted of a central gas boiler located in a dedicated building outside the blocks. Pipework from the boiler led to heat exchangers in each flat and the meters for the heat exchangers were located above flood level. In addition, a special plinth was built for the boiler-house to raise it above the design flood level.

3. Rewire, raising electrical points above flood level (with wiring drops from above): this was incorporated into the Decent Homes works and did not present a problem for United House. However, it was noted that there was potential for a clash with Lifetime Homes requirements, which is particularly important for social landlords. Lifetime Homes requires that switches are located between 450 mm and 1200 mm from finished floor level.

4. Seal gaps around pipe and cable entries: this presented no problem for United House. However POA did point out that care must be taken, particularly around seals on access points for maintenance. They have found that these are often damaged and/or not replaced after maintenance work, They therefore recommend that owners of these access points should ensure that any works carried out on these access points requires that the seals are re-instigated afterwards.

5. Provide air brick covers: POA commented that the covers are readily available. Existing air bricks were covered as part of the new external cladding and did not present a problem for United House.

6. Fit non-return valves on mains drains: these were designed in and fitted. United House found no problems sourcing and installing the valves. POA gave advice to the effect that regular maintenance of the valves should be carried out. Sometimes solid waste entering the drains can wedge the valve open, rendering it useless in an actual flood situation. Therefore, regular maintenance checks should be carried out to ensure that the valves are not blocked.

^ *One way valve prior to installation in the drainage system (Permission United House).*

7. Replace carpets with vinyl and ceramic tiles and/or rugs: part of the Decent Homes works was to install solid concrete floor and tiling. This did not present a problem to United House.

8. Replace timber floors with solid concrete: as described above, this was carried out as part of the Decent Homes works.

9. Install demountable doors: this was to prevent damage to doors in a flood event. Rising hinges were fitted to enable doors to be easily removed. POA commented that in order to be useful, occupants must know that their doors were removable. It was also noted that sometimes social landlords have people on the ground floor because they are less able to go to higher floors and are less likely to be able to remove doors should the need to do so arise. This means that in order to benefit from the rising hinges, social landlords must have a means in place to assist those living in lower floors to remove the doors.

Flood Risk Measures

10. Check the EA flood map: this was carried out as part of the formal flood risk assessment for the project. As mentioned above, the hydrologist commented that the flood map highlighted areas that were in flood risk zones, but flood defences were in place to prevent flooding. The hydrologist also commented that the flood map is a live website, constantly being updated. It was therefore necessary to look at the current version when making plans, rather than rely on older information. The EA flood map will only indicate flood risk from tidal and river sources. Check with the Lead Local Flood Authority for other sources of local flooding, for example, surface water and groundwater.

11. Repoint brickwork on external walls: this was carried out by default, as the entire outside wall was overclad for overheating reduction purposes. The cladding at all levels, including ground level, was waterproof.

12. Install waterproof membrane on external walls: as with repointing, this action was carried out by default and presented no problems to the installation contractors.

13. Flood pathways to enable drainage: no new flood pathways were considered because of the contaminated land issue. However the existing drainage systems were investigated on recommendation from POA. As a result, it was identified that some sections of the pipework would have to be replaced and some relined. There was an incentive to reline pipes in situ rather than replacing them, because the disposal of waste excavated from contaminated land would be very costly. POA advised that they generally find that pitch fibre pipes, as installed for the Colne and Mersea block, need to be relined. This can be done without digging up the pipes in this case. In the event, it was found that more pipework had to be replaced than originally anticipated and this increased the costs (see cost benefit section later).

The following items were recommendations in YHCC that the design team considered, but did not implement.

14. Register with EA flood warning scheme: this was not carried out for the Colne and Mersea buildings. POA considered this as good advice but commented that whoever was warned would also have to know the emergency response to imminent flood events.

15. Fit drainage bungs for drains, sinks and toilets: the idea was that bungs could be fitted to sinks and toilets to prevent water getting into homes from rising water levels on the outside of the building. POA did not recommend them because it was not clear who would install the bungs in the event of a flood. The design team also chose to exclude them because it was felt that the one-way valves would be sufficient. As general advice, excluding water from a home may not be the right strategy for some homes where there is a high design flood level. This is because the difference in water levels between the outside and inside of a building may cause pressure difference and hence structural damage to the building.

16. Install a sump and pump below ground level: this was not considered as there was no basement area from which to pump water should it be necessary. This recommendation is mainly meant for areas that require protection but are underground. The idea is that water flows from the basement area into a sump where it is stored until it can be pumped away after the flood event.

17. Raise door thresholds: this was not considered feasible for social housing, as a maximum threshold of 15 mm was required for wheelchair users.

Flood Risk Measures

18. Store valuables and paperwork upstairs: this can only be given as general advice to residents and not be considered for works contracts.

19. Turn off gas, water and electricity mains: this can only be given as advice to residents. However, it was noted that the distribution board in the flats would cut off in the event of a flood.

20. Use dry-bags to protect soft furnishings: this can only be given as general advice to residents and not be considered for works contracts.

21. Use water resistant paint for the lower portions of internal walls: due to the low risk of flooding, LBBD decided to view the kitchens and bathrooms on the ground floor flats as sacrificial: they would replace them (excluding white goods) in the event of a flood. This would also mean that paintwork would be renewed in the event of a flood.

22. Relocate white goods on a plinth above flood level: this was not considered necessary. In addition, the design flood level was nearly a meter above finished floor level, so a plinth for white goods would not be a reasonable option in this case.

23. Use porous materials or open structures on driveways: this option was not considered, because it was not on the buildings themselves so was beyond the remit of the works. In addition, the LBBD knew that the surrounding area was on capped contaminated land and did not want to undertake disruptive work there.

24. Large scale rainwater harvesting: this would involve below ground storage tanks and the contaminated land issue meant that this intervention could not be installed. Large scale rainwater harvesting may be very useful on other schemes considering reducing surface water run-off.

25. Green roofs: these were considered by the design team, but were discounted because it was seen that there would be insufficient room for the solar PV that was to be installed as part of the energy efficiency measures. Other sites may find that they have room for green roofs. While this was the view taken in this instance, there is some evidence that green roofs and solar PV are not just compatible, that they are complementary.

Often solar PV is placed on dark or grey roofs. These roofs can heat up significantly in summer. The surface temperature of roofs can effect the ambient temperature of the air around the panels. Research suggests that PV panel loses 0.5% efficiency per degree above 25 degrees C. On green roofs the cooling effect of the plants help maintain an ambient air temperature around a PV panel or 20-28 degrees C. The shading of the PV panels also helps increase the number species inhabiting the roof.[25] Please note that the same can not be said of solar thermal. The impact of green roofs on solar thermal is neutral. Green roofs do not help solar thermal units function more efficiently.

26. 48-hour water storage: one of the LDA's funding requirements was that there should be sufficient water storage in the blocks to enable residents to stay in their flats for 48 hours in the event of a flood. There was already provision for 24-hour water storage but it was found that the roof was not strong enough to support a tank containing 48 hours' worth of water. As a result LBBD secured agreement that this requirement be waived.

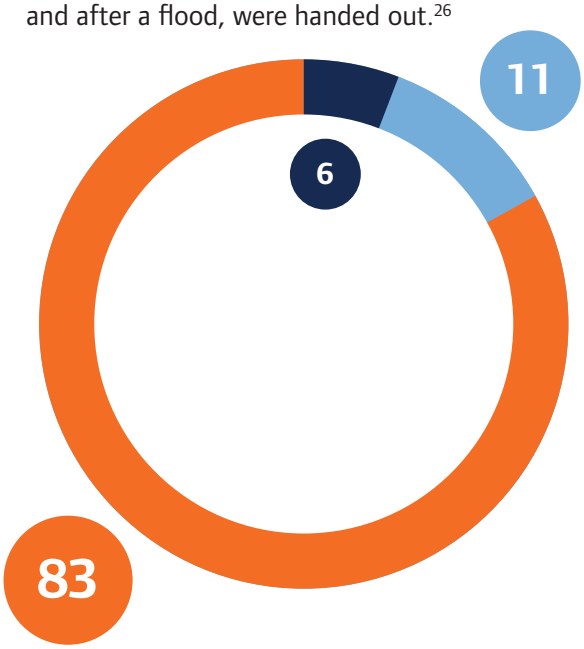
25 For further information on the compatibility of green roofs and solar PV systems the **Living Roof website** may be of assistance

Flood Risk Measures

Resident Feedback

What Residents Said About Flood Risk Measures

More than 80 per cent of the residents interviewed were unaware of any flooding risks in the area or in their tower block. None of the residents knew what to do if flooding was to occur. During the resident interview process, leaflets from the Environment Agency informing residents what to do before, during and after a flood, were handed out.[26]



Number of residents aware of flood risk problems in their block (%).

No Yes Don't know

What Could Be Better

One ground floor resident was unaware of any flooding risk and what to do if there was a flood. Residents were also unaware of any specific flood risk adaptation features that had been installed to their flats. The tenants on lower floors are at a higher risk of flooding and therefore extra measures should be taken to inform these tenants about what to do in the event of a flood. For this scheme LBBD will provide advice to all new tenants. A "stay put" policy for evacuation will be undertaken.

Where new residents move into properties that are at risk, landlords should inform them of actions they can take. Landlords should also advise tenants in higher flats on what to do if the ground floor floods. For example, what would be the means of communicating with tenants and when should evacuation procedures be started.

26 What to do before, during and after a flood, Environment Agency, November 2010

Flood Risk Measures

Lessons Learnt and Recommendations

- The recommendations in **Your Home in a Changing Climate** relating to physical works to properties presented no problem to the contractor when incorporated as part of the Decent Homes programme.
- Sacrificial kitchens were a preferred option to LBBD as opposed to extensive flood prevention measures. This was not a recommendation of YHCC.
- The recommendations in YHCC that do not relate to physical works on the properties are better given as advice. Landlords need to have a communications plan to inform residents of how to prepare, dealing with floods and managing afterwards.[27]
- Initial non-intrusive drainage surveys cannot always identify which pipes need replacement.
- Residents on the ground floor need to be shown the rising doors and other flood damage prevention measures. This advice could be part of the tenants' handbook.
- None of the resident interviewed knew what to do if flooding occurred. Residents need information on what to do before, during and after a flood. Landlords should provide advice tailored to properties. Where this is not possible the Environment Agency's extremely useful "**What to do before, during and after a flood**" leaflet could be distributed to residents.[28]
- Ensure that sealed access points on the drainage system are resealed when maintenance works are carried out. This may involve a regular inspection regime.
- Although not listed in YHCC, it is recommended that social landlords should consider surveying and, if necessary, upgrading existing drainage.
- The residents interviewed in this survey were not aware of what they should do in the event of a flood. It is recommended that social landlords develop and communicate plans for when a flood occurs.

27 What to do before, during and after a flood, Environment Agency, November 2010
28 What to do before, during and after a flood, Environment Agency, November 2010

Financial Analysis

Financial Analysis

The detailed costs information received from Tweeds (the employer's agent) was analysed and is summarised in this section. During the project some unexpected costs arose for some items of the project. At the time of writing it was undecided whether or not all or some of these costs will be borne by LBBD or United House. For that reason they are reported here, in case it is decided that LBBD will bear the cost and so that other social landlords can benefit from knowing these details.

For each set of adaptation measures a comparison was made against the estimated cost range reported in YHCC. To enable this, the costs itemised as general costs have been added to individual itemised costs. As a reminder, the overview of tendered costs for the project were:

General items (including scaffolding, design work and survey work)
£2.71 million

Water usage reduction measures
£0.14 million

Overheating reduction measures
£1.90 million

Flood risk measures
£0.03 million

All other works
£5.92 million

Total
£10.70 million

As can be seen, the general items account for 25 per cent of the contract value. So for this section the itemised costs for individual interventions have been increased by 25 per cent to account for the general design work. An example is outlined here. When the itemised costs of "insulated render to facades" is listed as £701,792.22 in the tender document, this has been increased by 25 per cent to account for associated "general items". In reality, some of the general items may be absorbed by Decent Homes works, but insufficient information was available to carry out analysis to this level of detail.

Finally, a costs and benefits analysis is presented. There may well be long term financial benefits to LBBD from the investment that they have made. These may include reduced voids and lower rent arrears, but detail was not available to include this in the analysis. Therefore the costs and benefits analysis is taken from the point of view of costs to LBBD and savings made by the residents.

Financial Analysis

Water Usage Reduction Measures – Unexpected Costs

Locating the water meters: the water meters had to be located away from the electricity meters in the flats; this was not envisaged at the outset. The extra costs for doing so were £15,691 and at the time of writing it is undecided whether LBBD or United House will bear the extra cost.

Integrating the water meters: the electricity, water and heating supply were all to be integrated so that the information could be relayed to the display monitor located in the hallway of each flat, which allowed residents to see their utility consumption instantaneously. To the design team's knowledge, this was the first time this kind of integration had been carried out in the UK and as such there were a lot of design and specification changes after the original tender had been agreed. The extra cost of this was £159,643 and at the time of writing it is still undecided whether LBBD or United House will bear this cost. It is clear that this cost is not solely down to the water meter, but nevertheless it is included here. As the metering represented three utilities it has been assumed, for the purposes of this report, that a third of the extra cost can be attributed to the water, i.e. £53,214.

Extra electrical supply: connected with installation of the electricity meters, it was found that an extra electrical supply was needed to allow installation. The full extra cost was £20,952 and as the meter dealt with three services, it has been assumed for the purposes of this report that a third of this cost can be attributed to the water metering, i.e. £6,984

Water Usage Reduction Measures – Cost Comparison With YHCC

As with flood and overheating measures, QS data relevant to water installations was analysed and itemised costs include an apportioned amount for general items.

Measure	Actual cost (£)	Cost per flat (£)	YHCC cost (£)	Comment
Low water using devices	157,988	790	1-1000	Includes four different devices that were each £1-£1000 YHCC price range and low volume baths.
Water meter	91,722	455	n/a	Apportioned from electricity and heat meters
Repair leakages	0	0	1-100	Not necessary
Total water measures	**249,710**			

All measures compare well with those reported in YHCC.

Financial Analysis

Overheating Reduction Measures – Unexpected Costs

- The satellite system: this had to be upgraded to a four-channel system to meet the needs of the residents (note: a single channel satellite system had already been specified because it was known that occupiers of flats would not be able to fix individual satellite dishes outside their flats after the new cladding system was applied). Extra costs of £7,849 were incurred.
- Extra window restrictors: the new window arrangement meant that a new sill was formed which was easily accessible to young children. This caused concern that children could override the existing restrictor and fall out of the window. Although the specified windows already had restrictors fitted, additional restrictors were required to satisfy LBBD concerns. The £11,450 extra cost borne by LBBD
- Return visits for window installation: United House could not gain access to a number of flats when installing the new windows at the scheduled time. Extra costs of £18,897 were incurred because the installers had to make return trips from Sweden. At the time of writing it was undecided which party would pay this extra cost.
- Pigmentation: extra coloured sections of the external cladding render were required during the contract, to increase reflection therefore helping to prevent overheating. The colouring incurred an extra cost of £3,648 and at the time of writing it was undecided whether LBBD or United House would bear this extra cost.
- Floor finishing: some residents had already tiled their kitchens and bathrooms to their own satisfaction. LBBD inspected the quality of the work and found them to be acceptable. As a result, £2,382 was not spent when compared to the original tender price. As the floors were to be finished under the Decent Homes portion of the works, this cost reduction has not been considered under adaptation works.

Financial Analysis

Overheating Reduction Measures – Cost Comparison With YHCC

As with flood measures, QS data was analysed and costs include an amount for general items.

Measure	Actual project cost (£)	Cost per flat (£)	YHCC cost (£)1	Comment
Insulated roof and fascia detail	120,087	600	1-1000	None
Insulated render to facades	880,888	4,404	101-1,001+	None
External window reveals	28,500	143	included with insulated render to facades	None
Remedial works to existing brickwork	11,875	59	included with insulated render to facades	None
Relocation of tenants' satellite dishes	18,774	94	included with insulated render to facades	None
Triple glazed windows	1,353,591	6,768	101-1,001+	None
Increase reflectivity through light coloured painting	0	0	1-1000	Done as part of over-cladding
Total overheating measures	**2,413,715**			

As can be seen from the table above, the actual costs do align with those suggested in YHCC. Careful choice of colouring of the overcladding will mean that reflectivity can be increased through no extra cost.

Flood Risk Measures– Unexpected Costs

Drainage: the original intention was to reline existing drainage pipework and replace only limited sections. This was a result of the design team wanting to minimise invasive works on the asbestos contaminated sites, which would incur high works costs and waste disposal costs. In the event, more pipework was replaced than expected. The additional cost of £70,113 was incurred by the LBBD.

Financial Analysis

Flood Risk Measures – Costs Comparison With YHCC

The costs are taken from the quantity surveyor (QS) values in the original tendered contract after value engineering. The extra, unexpected costs described above have been incorporated into the table below.

Measure	Actual project cost (£)	Cost per flat (£)	Cost per ground floor flat (£)	YHCC cost (£)1	Comment
Install floodshield doors	21,613	108	2,702	101-1,001+	None
Install air-duct covers	7,410	46	1,158	1-101	None
Seal gaps around pipe and cable entries	891	4	111	1-101	None
Non-return valve	2,375	12	297	101-1,001+	None
Renew drainage	79,048	395	9,881	n/a	None
Move meters above flood level	0	0	0	101-1,001+	Done as part of other works
Repoint brickwork	0	0	0	1,001+	Done as part of over-cladding
Apply waterproof render to walls	0	0	0	1,001+	Done as part of over-cladding
Apply waterproof membrane on external walls	0	0	0	1,001+	Done as part of over-cladding
Replace carpets with vinyl and ceramic tiles and/or rugs	0	0	0	1,001+	Done as part of other works
Total flood measures	**111,337**				

Note 1 – YHCC described the cost of interventions as low (£1-£100), medium (£101-£1,000) or high costs (£1,001+). These bands are used in this table.

Financial Analysis

As can be seen, the comparison with the YHCC values depends very much on whether the costs are shared between all the flats or just those on the ground floor, which are most likely to be affected. On balance, the measures listed would only benefit those on the ground floor, so fitting the non-return valve appears to be comparable to YHCC, sealing gaps almost equivalent to YHCC and the remainder more expensive than YHCC. Interestingly, other measures listed as high cost in YHCC are covered in the costs of other works such as overcladding and Decent Homes works. An important recommendation out of this work is that, provided a degree of forethought goes into the planning of these works, some flood measures can be incorporated at zero cost.

Cost Benefit Analysis

The table below summarises the final costs of the interventions and includes adjustments for unexpected costs as listed in the previous section.

Item	Cost (£)
Water usage reduction measures	249,710
Overheating measures	2,413,715
Flood risk measures	111,337
Total costs	2,774,762

Against this are the benefits gained from the project. The aim of the adaptation measures was to reduce water scarcity, reduce risk of flood damage and to prevent negative health impacts of overheating. Each of these aims has social benefits which are not necessarily easy to quantify in monetary terms. In addition, there was no aim to make a profit. However, it is recognised that in order for the adaptive works to be carried out on a wider scale, there must also be an economic case for social landlords. For this reason, the expected monetary benefits to tenants are reported here for information, with a view to gaining an understanding of what level of external money is required to ensure that adaptive works can be carried out on an external scale. They are not intended to be a justification of the works.

Water Bill Reductions

The water savings come from reduced water usage charged at Thames Water's rates. These are potential at the moment, until metered charges replace the existing flat rate. At 61 lpd saving and occupancy of 2.5 people per flat at a charge of £1.2263 per m3, the potential saving is £68 per flat per year, so £13,600 for both blocks.

Financial Analysis

Energy Bill Reductions

Although this was not an aim of the adaptive measures, the external cladding, the triple glazed windows and the water saving measures do bring about energy bill savings for residents. These are calculated as follows:

- Exact figures for potential space heating savings as a result of external cladding and triple glazing were not available for this project. For the purposes of this report the energy bill savings are estimated as £200 for the external cladding and £20 per year for the windows (based on **carbon assessment analysis of existing homes** carried out by the authors[29]) for each flat, so £44,000 for both blocks.
- Reduced need for air conditioning: YHCC addressed this issue by looking at the costs of power (but not installation) of air conditioning required to cool homes to a comfortable level and this method has been used for this report. A figure of 220kWh has been used to for the cooling required for July and August in the bedroom and living room. An electricity charge of 12.5p per kWh has been used to arrive at a value of £28 per property, so £5,600 for both blocks.
- Reduced energy for heating water: exact figures to this level of detail were not available for this project. To estimate this, the approach used in SAP has been adopted. This involves calculating the energy required to heat hot water from the volume of water, its specific heat capacity and the efficiency of the hot water heating system:

Specific heat (W/°K/litre) x temperature raise (°K) x volume of water saved per day (litre) x days

Water heater efficiency x 3600
(to convert to kWh)

$$\frac{4.190 \times 37 \times 40 \times 365}{0.93 \times 3600} = 676 \text{ kWh/yr}$$

The exact charges to residents for hot water supply was not available, but assuming this is comparable to normal gas charges, this may be approximately 3.5p per kWh. At an occupancy of 2.5 people per flat this equates to an annual saving of £59 per flat, so £11,800 for both blocks.

29 Carbon Reduction Options for Housing Managers, Sustainable Homes, 2011

Financial Analysis

Flood Damage Reductions

The actions taken in the project have reduced the likelihood of flood damage to the kitchens on the ground floor flats. Had the actions not been taken the risk of flood damage would remain. Although the risk of flooding can be quantified, it cannot be predicted how many floods will occur and when they will occur, in any given time period

Therefore, for the purposes of this report, the cost saving is assumed to be the savings from not having to replace kitchens after a flood event, multiplied by the risk of a flood event occurring in any one year. Note that costs can be high if temporary accommodation of tenants during drying out and refurbishment period is included and damage to personal possessions. It should also be acknowledged that there will be considerable stress associated with flood damage, but this is difficult to quantify in monetary terms. The **National Flood Forum** suggest[30] that insurance claims for floods were between £13,000 to £30,000 per household, so £22,000 has been used for this analysis. If the flood risk is 1% and 8 flats are potentially at risk, this can be represented as an annual saving of £1,760, which has been used to quantify the costs savings for this analysis.

The table below summarises the monetary benefits to residents and, in the case of kitchen replacements, to LBBD.

Item	Benefit (£/yr)
Water savings	13,600
Flood:	
Avoidance of kitchen replacement in the event of a flood	1,760
Avoidance of disruption for residents	50
Energy saving (as a result of overheating measures):	
Reduced space heating bills	44,000
Avoidance of air conditioning	5,600
Reduced water heating costs	11,800
Total annual savings	**76,810**

The total costs of carrying out the works was £2,774,762. The project was never intended to be a profit-making enterprise, but it is instructive to compare costs with benefits.

A simple payback of the costs and benefits indicate that the payback period for the total works is approximately 36 years. However, a similar comparison can be made looking at water reduction measures alone. As well as saving water, water heating costs can also be saved. Together these savings amount to £25,400 per year. When compared to the costs of installing the measures (£249,710) the simple payback period is 9.8 years which may be more acceptable to social landlords.

30 Delivering benefits through evidence, Environment Agency, January 2010

Financial Analysis

A major contribution to the overall costs is that of the external cladding, costing £940,037. As noted above, the cladding can also negate the need to waterproof external brickwork and act as a reflective external surface. However, in order to reduce the costs to social landlords it may be necessary to introduce external funding to make this work viable. At the time of writing a new funding stream for external cladding works is near to becoming available which would mean that the costs of external cladding would potentially be zero for a social landlord. The fund is the Energy Company Obligation (ECO)[31] and is available from the UK's major energy suppliers. It is intended to fund energy efficiency improvements in homes, where the energy savings of the energy efficiency measures do not pay back the installation costs within 25 years. Should this be exploited in full, the case for external cladding becomes viable.

Another possible source of support may come as a result of the health and wellbeing boards. The boards have been established to identify all the possible resources in a particular area to see how they can be used to further the health and wellbeing of the population in that region. Housing factors and the risks that climate change presents to health and wellbeing have been **documented**.[32]

Another major cost for overheating reduction is the triple glazed windows. However as reported above, for this project LBBD considered this a more viable option than attaching external shading because of the additional structural and maintenance costs of doing so.

It may also be possible that a number of these costs could be brought down considerably with small changes in maintenance regimes for other social housing providers. For example, whenever water fittings need to be changed a low flow and/or capacity alternative can be specified as a matter of course, rather than as a specific project. Maintenance teams may object to this in the short term, but as most new homes coming into asset management are already fitted with low flow fittings, this appears to be something that they will have to come to terms with sooner or later.

A payback period may not be the correct way to judge the success of a social housing project. There are potential social benefits to this kind of project and these are explored in the next section.

31 Energy Companies Obligation, Ofgem, 2012
32 DH (2011) HYPERLINK "http://www.dh.gov.www.dh.gov.uk/health/2011/10/health-and-wellbeing-boards/

Social Benefits

As seen above, a simple monetary cost benefit analysis is a blunt instrument for judging the success or otherwise of a project such as this, where there are costs and benefits that cannot easily be internalised. For example, the disruption caused by the works is a cost, not borne by the client nor contractors, but by the residents themselves. Another example is the effect of carbon emissions on populations elsewhere in the world, that are likely to be affected by climate change.

Benefits In A Human Needs Context

The benefits of the project are detailed below, but this time in the context of which human needs are satisfied.

1. Thermal comfort: sufficient thermal comfort is a basic need. The external wall insulation and the blinds have contributed to reduction in overheating risk and thus improved thermal comfort for the residents. As an added benefit the same measures have contributed to the winter warmth of the flats, which is also an improvement in thermal comfort.

2. Reduced emissions: as described above, the overheating measures have, as an added benefit, also improved the thermal efficiency of the flats. This means that less carbon emissions will be associated with keeping the flats warm. As carbon emissions contribute to climate change, which in turn will lead to effects elsewhere in the world, there are social benefits to reducing these emissions. As some climate change effects are projected to be severe flooding and crop failures elsewhere in the world, it can be concluded that the reduction in carbon emissions has a direct contribution to helping others in the world satisfy their basic need for shelter and food.

3. Increased wealth: increased thermal efficiency of the flats and reduced water usage will result in lower utility bills. This in turn means that residents will have more disposable income to pursue other activities that satisfy higher needs and hence improve their general wellbeing. In addition 180 people were employed for the project, including six local apprentices, at least three of which gone on to full-time employment. This means that all those people will now have money to pursue their needs.

4. Increased health: it is known that reduced thermal comfort is associated with poor health, particularly amongst vulnerable sectors of society. In particular there are increased deaths associated with heatwaves and also with extreme cold. The overheating reduction measures improve the thermal efficiency of the flats, so we can conclude that residents' health will also improve. As with wealth, better health will allow people to pursue other activities that satisfy higher needs and hence improve their general wellbeing.

5. Increased knowledge: the project has led to some key learning for the contractor and for the client, which will enable the stakeholders to carry out further climate change adaptation measures in the future. In addition, this report will spread this learning, allowing others in the sector to learn from the project.

6. Increased fuel security: the improved thermal efficiency of the flats means that less fuel will be required to keep the flats warm. This means that less fuel will be used in the future, contributing to fuel security.

7. Increased water security: the water saving measures installed in the project will have a direct positive contribution to the preservation of water security in the UK.

Social Benefits

8. Increased security from flooding: the flood prevention measures installed will contribute to increased security from flooding.

9. Improved engagement between contractors and the community: The LBBD and United House noted that trust the community had in contractors and their work increased as they engaged on this project. In particular participation in meetings increased throughout the project. Contractors and others involved in the project also reported that residents illustrated an increased sentiment for the properties and said that they felt more secure. This security meant, for instance, that people were more likely to leave bikes or other belongings unlocked in communal landings. It is possible that where people are happier and more secure in their homes, they are less likely to leave. This could impact on voids.

Costs In A Human Needs Context

As well as social benefits from the project, there have been some social costs. These are indicated below.

1. Disruption: although kept to a minimum, there was unavoidable disruption to the daily lives of residents during the renovation works. However, at no time was any resident denied basic needs such as shelter, food and water. Nevertheless the disruption would have prevented residents from pursuing their normal lives.

2. Materials usage: The project had to use materials extracted from the world's natural resources. If not responsibly sourced, there is a risk that the extraction or harvesting of the materials will result in social disruption elsewhere in the world, particularly around mineral extraction sites and depletion of fossil fuels. United House, however, operate a policy of responsible sourcing of materials and so any detriment to social wellbeing elsewhere in the world is likely to be minimal.

3. Waste disposal: the project generated waste which, if unsustainably disposed of, can impact on the lives of others near the disposal sites. United House report that they have fully complied with the law, typical for this size of contractor. Also, typically for contractors working in the social housing sector, very high diversion from landfill rates were achieved.

Conclusions and Recommendations

There are a host of detailed learning outcomes from this project. Many are of a technical nature and the details are included in the bulk of the report and recommendations for future works can be drawn from them.

This study shows that works to adapt homes to our changing climate can be incorporated into standard improvements to properties. As a result of the works people in the Colne and Mersea blocks will be able to live more secure lives, regardless of the effects of climate change.

Many of the suggestions here can easily be applied to maintenance, responsive repairs and refurbishment programmes. Landlords are encouraged to adopt these measures. There is a clear social benefit case for all adaptation works and often the economic case is favourable.

Specific technical recommendations are set out below.

Water Efficiency Measures

Residents were happy to accept most water efficient fittings (including low flow showers and water meters) as part of the Decent Homes package. As a result of the measures installed, it is estimated that the water usage is 99 litres per person per day, against an Environment Agency ambition of 130 litres per person per day.

Steel low volume baths were difficult to source and attracted negative comments from some residents, but there may be some allowance to have large baths given the calculated savings are better than the Environment Agency ambition. It appears financially favourable to install the measures with a simple payback period of 9.8 years. Given these findings it is recommended that:

- Water efficient fittings should be installed as a matter of course. This could be achieved by changing the Decent Homes standard to include water efficient appliances and products These include low flow showers (even when not already installed), low volume toilets, low flow taps and water meters.
- Adopt the Environment Agency's objective of 130 litres per person per day for all renovation works. This would mean that project teams would not have to discern a target based on UKCIP projections. The water efficiency calculator for new dwellings can be used for this purpose but its output must be increased by 10 per cent. In other words where the tool calculates 120 litres per person per day, this must be increased to 132 litres per person per day. The tool is only valid where water meters will be fitted.
- Investigate the potential for allowing larger capacity baths, but still remain within the 130 litres per person per day objective.
- Social landlords' maintenance and responsive repairs contracts should specify low flow rate and capacity water fittings.

A number of low-cost steps can be taken. When a property becomes void, it is recommended that landlords:

- Install water displacement devices in toilets that are not already low flush. This will require training operatives to recognise high flush toilets
- Install a water aerator into showerheads with high flow rates where present. Again, training will be required to ensure that operatives can recognise a high flow rate shower.

Conclusions and Recommendations

In addition water saving advice can be passed on residents via normal social landlords' communications. It is recommended that the advice should include:

- The background to water scarcity issues in the UK
- General behavioural tips on saving water
- Tips on purchasing water efficient white goods (washing machines and dishwashers)
- The fact that savings could be made from efficient use of hot water in the home

Overheating Measures

The overheating measures installed in this project were generally favoured by the residents and did not cause overheating when used in conjunction with the ventilation measures provided. However the high costs may require some external funding to make this intervention more attractive. Energy Company Obligation funding may be appropriate for external cladding works as there is considerable space heating savings.

Measures for overheating reduction vary and may depend on other works being carried out and so a single solution cannot be recommended. This is especially important when external cladding is installed as this also reduces air permeability into a building which means that ventilation is very important.

Cymap methodology was used to aid decision making for this project but another methodology may be worth noting for social landlords and this is the **Standard Assessment Procedure** (SAP)[33] which is mainly used for generating legally required Energy Performance Certificates (EPCs). One of the outputs of SAP is the risk of overheating in a new build home.

A reduced data version of SAP (rdSAP) is used by social landlords and their contractors to generate EPCs that are a legal requirement when re-letting properties. However, there is no overheating risk assessment routinely generated from the rdSAP, even though it could be adopted to do so. An additional problem is that the overheating risk assessment is based on historical summer temperatures and not projected ones.

It is recommended that:

- The risks of overheating of homes in a landlord's stock should be calculated. This can be triggered when Decent Homes works requires thermal improvement, when an EPC is generated, when complaints of overheating are received from residents or when any major refurbishment or renovation works are initiated. The risk assessment can be carried out using Cymap or consider using the calculations in SAP.
- Along with the Department Communities and Local Government we will continue to make the case for the inclusion of climate change risk assessments in EPC calculations. We will also continue to make the case that assessments should be based on projected summer temperatures and not historical.
- Solutions or combinations of solutions can be modelled using the same methodology until the risk of overheating is projected to be low.
- Depending on which solutions work best for a particular home, the following recommendations are made based on this report: (see table on next page)

33 The Government's Standard Assessment Procedure for Energy Rating of Dwellings, Published on behalf of DECC by BRE, 2011

Conclusions and Recommendations

Solution	Recommendations
External cladding	When specifying ensure that the following are included: a condensation risk assessment is carried out; a light colour is specified to aid reflectivity; the material is flood resilient. Seek ECO or other funding aimed at improving energy efficiency funding for these works.
External shading	Ensure that full costs of installing and maintaining external shading are considered as installing windows with integral blinds may work out more cost effective than other options such as awning or shutters. Security issues must also be considered. Funding for external shading options may have to be sought for other sources. Work could be undertaken to investigate funding from health trusts or other sources. Reduced overheating should lead to lower admissions to hospitals during heatwaves.
Ventilation	Openable windows and trickle vents are no extra cost and should be ensured when replacing windows. If mechanical extraction is specified then the landlord must be sure that all residents are informed of the benefits and that they understand the low costs of running the extraction. This is especially the case where background mechanical extraction is specified.

- Landlords should use their normal communication channels to highlight actions that residents can carry out to help reduce overheating in their homes. It can also be included in a resident's handbook for new tenancies. The information should include:
    - Raise awareness of overheating due to climate change
    - How to report overheating homes to the landlord
    - Knowledge of ventilation systems already installed
    - Advice to switch off appliances when not in use
    - Advice to use desk fans to aid cooling

Conclusions and recommendations

Flood Risk Measures

Flood risk reduction measures can be a significant cost. The real benefit comes when the home is proven to be resilient in the event of a flood, but it is never known when or if this will happen. In addition there was little awareness amongst residents about the measures installed and what to do in the event of a flood. In this particular case, LBBD preferred to accept sacrificial kitchens and bathrooms and pay for their renewal should a flood arise. The financial benefits to reducing flooding are significantly greater in areas of high flood risk.

Many of the recommendations made in YHCC are best passed on as advice to residents. Nevertheless there were important general points that came out of the report. Based on this information the following recommendations can be made:

- The social landlord should carry out a flood risk assessment of their entire stock. This can be done relatively easily using EA flood maps, anecdotal evidence and insurance databases. GIS consultants can do this analysis based on postcode data at relatively low cost. The EA flood maps do not show all sources of flooding, but do highlight locations at greater risk from tidal and river flooding, and therefore homes within these zones should be prioritised. Local authorities may also have identified areas of flood risk from other sources, for example surface water and groundwater.
- For the homes at highest risk, the social landlord should first ensure that the local drainage systems are maintained and that they are still fit for purpose and consider installing non-return valves and sealing other flood water entry points into the home. There is a cost attached to this and external sources of funding may be required.
- The Environment Agency and local authorities could investigate sources of funding for existing drainage repair and maintenance works.
- When Decent Homes works or any other works that require re-wiring are commissioned for homes in high risk areas, the electricity meters and electricity sockets should be raised above the design flood level, taking care to ensure that the heights of switches still comply with Lifetime Homes requirements. The Decent Homes standard should be amended to reflect this requirement and little extra cost is required to do so.
- If air-brick covers are found necessary, or there is a preference to provide drainage bungs for drains, sinks and toilets instead of non-return valves, then the social landlord must have systems in place to initiate their use. This may involve showing residents how to use them or having caretakers trained in their use.
- Where landlords elect to accept the risk of flood damage to kitchens and bathroom, the residents should be informed of this and advised to take out insurance for any goods that are not covered by the landlord. Washing machines, fridge freezers and dishwashers are particular examples. Residents should be advised to register with the **EA flood warning scheme**. However, landlords are advised to also consider the mental health impacts of flooding, before committing to a sacrificial strategy.

Conclusions and recommendations

- Consideration should be given to work flows. The rising hinges should not be undertaken where kitchens or bathrooms are going to be replaced because the associated rooms are to be sacrificed.
- Flood measures that include raising threshold levels may not be appropriate for social landlords due to issues of wheelchair access and should be carefully considered before installation.
- If non-return valves or manhole sealing have been undertaken, the social landlord must ensure that an inspection regime is initiated to ensure that the measures do not fall into disrepair.
- Where external cladding is to be installed, ensure that it is flood resilient

Many of the actions from YHCC are best communicated to residents and not physically carried out by social landlords. These include:

- Store valuables and paperwork upstairs (or in a high place in the case of ground floor flats)
- Instructions on when and how to turn off gas, water and electricity mains
- Use dry-bags to protect soft furnishings

Overall

This study shows that works to adapt homes to our changing climate can be incorporated into standard improvements to properties. As a result of the works people in the Colne and Mersea blocks will be able to live more secure lives, regardless of the effects of climate change.

Many of the suggestions here can easily be applied to maintenance, responsive repairs and refurbishment programmes. It is hoped that the lessons and evidence set our here inform other landlords and enable more homes to be adapted to our changing climate.

Conclusions and recommendations

Recommendations for Social Landlords

- Resident acceptance for climate change adaptation was made considerably easier when combined with other more desirable work such as decent homes and increased security measures. This should be considered for other adaptation works.
- The climate change adaptation works are not generally viewed as important compared to Decent Homes works by residents. Therefore raising awareness prior to adaptation works should be considered.
- Detailed specification works helped ensure that the project stayed client led and also ensured that climate change adaptation works stayed a key focus of the project. This should be considered for future works.
- Have framework contractors who are experienced at adaptation works.
- It was possible, in this project, to secure additional adaptation works for other properties and should be considered in future projects.
- Narrow baths tend to raise complaints from residents and should be avoided.
- Showers are used by residents when they are installed and should be installed as matter of course. Showers with flow rates of 8 litres per minute were acceptable to residents.
- In order to measure the effect of water saving devices on it would be useful to know the water usage rates prior to installation of water saving measures. However, given the accuracy of the water efficiency calculator, this may not be relevant in future projects.
- Installation of water saving measures is likely to lead to significant water and cost savings for residents and do not cost contractors extra money. Social landlords' maintenance and responsive repairs contracts should specify low flow rate and capacity water fittings.
- Water meters are generally accepted and used by residents.
- Integration of utility metering systems, including water meters, is not necessarily straightforward. It requires increased detailing and design work from specialist contractors, prior to installation. One particular point of learning from this project is that water meters could not be located near the electricity meters.
- When setting up an ESCO, contracts with new energy suppliers need to be negotiated well in advance.
- Advice on water saving behaviours and purchasing water efficient white goods could be given to residents for very little cost on retrofit projects such as this.
- It is recommended that future maintenance programmes and responsive repairs works should specify water saving devices when these devices are being replaced.
- Triple glazed windows with incorporated blinds are common in other European countries and can be viably installed in the UK for retrofit projects, to help reduce overheating risk. They should be considered for future projects, especially when external cladding is being carried out. This option can be considerably cost effective when compared to the whole life costs of installing and maintaining external shutters or awnings.

Conclusions and recommendations

- Jealousy issues can arise between residents who have extra equipment and those who do not. These must be managed carefully.
- Installing external cladding has the extra benefit of improving energy efficiency whilst at the same time helping reduce the risk of overheating, provided that adequate ventilation devices are also installed.
- Many of the recommendations in **Your Home in a Changing Climate** are more applicable for social housing providers to provide to residents as free advice, rather than as installed measures.
- Some residents complained about lack of advice on operating new ventilation systems and consequently suffered overheating; others clearly stated that advice was given and did not suffer from oveheating. Perhaps the advice given and to whom could be more formally recorded, so that all parties are sure that advice has been effectively communicated.
- Consider installation of remote sensors when monitoring internal temperatures so that efficacy of measures can be assessed.
- Sacrificial kitchens were a preferred option to LBBD as opposed to extensive flood prevention measures. This was not a recommendation of YHCC. The non-financial issues associated with residents having to be temporarily re-housed and mental stress, should be considered before adopting this policy.
- The flood prevention measures recommended in YHCC that do not relate to physical works on the properties are better given as advice. Landlords need to have a communications plan to inform residents of how to prepare, dealing with floods and managing afterwards.
- Residents on the ground floor need to be shown the rising doors and other flood damage prevention measures. This advice could be part of the tenants' handbook.
- None of the resident interviewed knew what to do if flooding occurred. Residents need information on what to do before, during and after a flood. Landlords should provide advice tailored to properties. Where this is not possible the Environment Agency's extremely useful "**What to do before, during and after a flood**" leaflet could be distributed to residents.[34]
- Ensure that sealed access points on the drainage system are resealed when maintenance works are carried out. This may involve a regular inspection regime.
- Although not listed in YHCC, it is recommended that social landlords should consider surveying and, if necessary, upgrading existing drainage to ensure that flood damage is minimised.
- The residents interviewed in this survey were not aware of what they should do in the event of a flood. It is recommended that social landlords develop and communicate plans for when a flood occurs.
- The social landlord should carry out a flood risk assessment of their entire stock. This can be done relatively easily using EA flood maps, anecdotal evidence and insurance databases. GIS consultants can do this analysis based on postcode data at relatively low cost. The EA flood maps do not show all sources of flooding, but do highlight locations at greater risk from tidal and river flooding, and therefore homes within these zones should be prioritised. Local authorities may also have identified areas of flood risk from other sources, for example surface water and groundwater.

34 What to do before, during and after a flood, Environment Agency, November 2010

Conclusions and recommendations

- For the homes at highest risk, the social landlord should first ensure that the local drainage systems are maintained and that they are still fit for purpose and consider installing non-return valves and sealing other flood water entry points into the home. There is a cost attached to this and external sources of funding may be required.
- If air-brick covers are found necessary, or there is a preference to provide drainage bungs for drains, sinks and toilets instead of non-return valves, then the social landlord must have systems in place to initiate their use. This may involve showing residents how to use them or having caretakers trained in their use.
- Landlords should use their normal communication channels to highlight actions that residents can carry out to help reduce overheating in their homes. It can also be included in a resident's handbook for new tenancies. The information should include:
    - Raise awareness of overheating due to climate change
    - How to report overheating homes to the landlord
    - Knowledge of ventilation systems already installed
    - Advice to switch off appliances when not in use
    - Advice to use desk fans to aid cooling

A number of low-cost steps can be taken. When a property becomes void, it is recommended that landlords:

- Install water displacement devices in toilets that are not already low flush. This will require training operatives to recognise high flush toilets
- Install a water aerator into showerheads with high flow rates where present. Again, training will be required to ensure that operatives can recognise a high flow rate shower.

In addition water saving advice can be passed on residents via normal social landlords' communications. It is recommended that the advice should include:

- The background to water scarcity issues in the UK
- General behavioural tips on saving water
- Tips on purchasing water efficient white goods (washing machines and dishwashers)
- The fact that savings could be made from efficient use of hot water in the home

Conclusions and recommendations

Recommendations for Policy Makers

- It is recommended that policy makers make adopt the Energy Performance Certificate (EPC) generation process to take into account climate change. EPCs are a legal requirement for every newly sold or rented home and provide an easy mechanism for calculating overheating risk, flood risk and water efficiency.
- Another easy mechanism is the rolling programme of Decent Homes works. The Decent Homes standard should be amended such that climate change adaptation is taken into account. This will ensure that, overtime, each home will be adapted to climate change.
- EPC are generated as a result of energy modelling in SAP. The data and methodology are already in place for new build overheating risk calculation and just need to be implemented for existing homes, with very slight modification. One of the main modifications would be to base calculations on future summer temperatures and not historical temperatures, as is presently the case.
- Along with the Department Communities and Local Government policy makers should continue to make the case for the inclusion of climate change risk assessments in EPC calculations.
- Guidance on the large range of UK Climate Impact Projections should be issued so that project teams on this type of project are clearer on what scenario to design for. This is particularly relevant for flooding and overheating where the range of impacts for. For water scarcity, the worst case scenario can be accommodated very easily with good choice of readily available water fittings.
- There is general awareness of water scarcity issues in London at this point in time and it is recommended that this awareness is maintained to smooth future adaptation projects.
- The Environment Agency and local authorities could investigate sources of funding for existing drainage repair and maintenance works.
- Water efficient fittings should be installed as a matter of course. This could be achieved by changing the Decent Homes standard to include water efficient appliances and products These include low flow showers (even when not already installed), low volume toilets, low flow taps and water meters, which were all acceptable to residents in this project.
- Adopt the Environment Agency's aspiration of 130 litres per person per day for all renovation works. This would mean that project teams would not have to discern a target based on UKCIP projections. The water efficiency calculator for new dwellings can be used for this purpose but its output must be increased by 10 per cent to reflect correlation with actual usage. In other words, where the tool calculates 120 litres per person per day, this must be increased to 132 litres per person per day. The tool is only valid where water meters will be fitted and so water meters should also be fitted as a matter of course.

Investigate the potential for allowing larger capacity baths, but still remain within the 130 litres per person per day objective.

Conclusions and recommendations

Recommendations for Planners

Planners are in an ideal position to ensure that climate change adaptation works are considered at an early stage in any major refurbishment. Furthermore, many of the adaptation works do not require additional cost to any refurbishment costs and therefore should be encouraged, via the planning system, as a matter of course. These are:

- Where projects involve new bathrooms and kitchens, water efficient devices should be installed, such that the projected water usage is no more than 130 litres/person/day
- Flood risk and associated resilience measures should be considered
- When external finishes are included, light, reflective colours should be favoured to prevent overheating
- Where windows are being replaced, windows with integral blinds should be considered, again to prevent overheating
- Ventilation measures should also be a planning requirement where extensive cladding and window installation is carried out.
- Provide guidance for which of the UK Climate Change Projection scenarios should be designed for, in their particular area

Recommendations for those Working in Construction

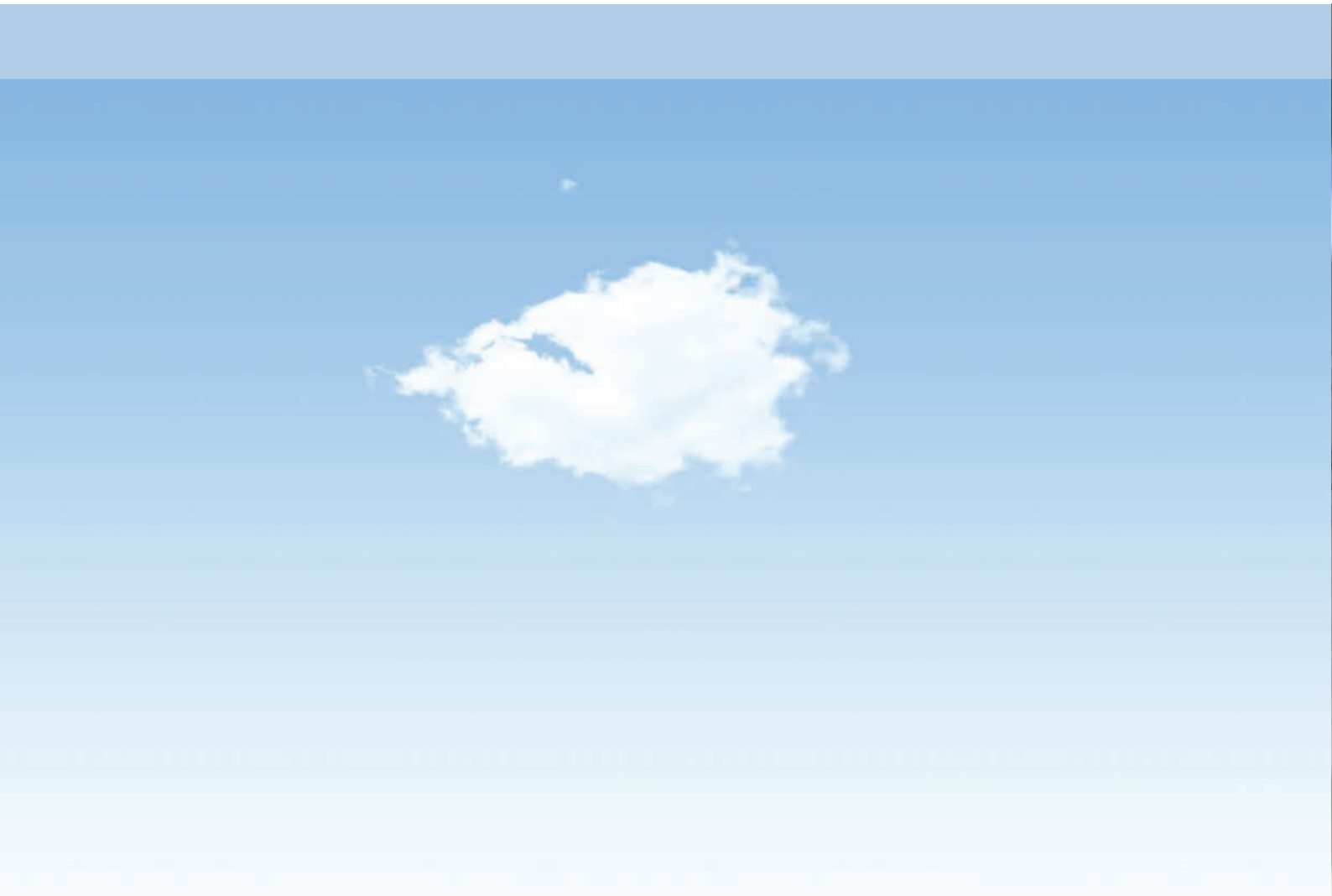
- Value engineering is possible in adaptation works and should be encouraged.
- The delivery timelines actually experienced for this project could inform planning for other similar projects.
- RLOs are invaluable for works of this nature as they can address any issues that residents have at a very early stage. RLOs should therefore always be used for these kind of works.
- Despite best efforts by the contractors, it appears that some residents feel that there was not enough communication. Perhaps formal logging of communications, signed by residents, would help demonstrate the full effort undertaken to communicate with residents.
- Good contractual practice ensures smooth project running and should be used for all major social housing projects.
- In general, sourcing and installing low water usage devices is straightforward and should be considered as a matter of course for Decent Homes and other social housing refurbishment works.
- Value engineering is possible when using triple glazed windows with integral blinds and should be encouraged.
- Mast climber access is better than traditional scaffolding and should be considered for future projects.
- Existing walls on tower blocks are often not straight and some kind of structural frame is necessary when installing external cladding. It is recommended that experienced contractors are used for external cladding works.

Conclusions and recommendations

- The recommendations in Your Home in a Changing Climate relating to physical works to properties presented no problem to the contractor when incorporated as part of the Decent Homes programme.
- Initial non-intrusive drainage surveys cannot always identify which pipes need replacement and contractors must be prepared to replace inadequate drainage systems when found during works.
- When Decent Homes works or any other works that require re-wiring are commissioned for homes in high flood risk areas, the electricity meters and electricity sockets should be raised above the design flood level, taking care to ensure that the heights of switches still comply with Lifetime Homes requirements. The Decent Homes standard should be amended to reflect this requirement and little extra cost is required to do so.
- Depending on which solutions work best for a particular home, the following recommendations are made based on this report:

Solution	Recommendations
External cladding	When specifying ensure that the following are included: a condensation risk assessment is carried out; a light colour is specified to aid reflectivity; the material is flood resilient. Seek ECO or other funding aimed at improving energy efficiency funding for these works.
External shading	Ensure that full costs of installing and maintaining external shading are considered as installing windows with integral blinds may work out more cost effective than other options such as awning or shutters. Security issues must also be considered. Funding for external shading options may have to be sought for other sources. Work could be undertaken to investigate funding from health trusts or other sources. Reduced overheating should lead to lower admissions to hospitals during heatwaves.
Ventilation	Openable windows and trickle vents are no extra cost and should be ensured when replacing windows. If mechanical extraction is specified then the landlord must be sure that all residents are informed of the benefits and that they understand the low costs of running the extraction. This is especially the case where background mechanical extraction is specified.

Your social housing in a changing climate



London Climate Change Partnership
City Hall
The Queen's Walk
More London
London SE1 2AA

www.climatelondon.org
enquiries 020 7983 4100