Mayor of London's

Draft Climate Change Adaptation Strategy

Sustainability Appraisal Report
Part B: Appendices

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ABBREVIATIONS

ABI	Association of British Insurers
AQMA	Air Quality Management Area
BAP	Biodiversity Action Plan
BAU	Business as usual
BAU+50	Future business as usual in 50 years time
BME	Black and minority ethnic
BREEAM	BRE Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CCAS	Climate Change Adaptation Strategy
CCAS	Climate Change Adaptation Strategy
CEP	Collingwood Environmental Planning
CET	Central England temperature
CFMP	Catchment Flood Management Plan
CIWEM	Chartered Institution of Water and Environmental Management
CIRIA	Construction Industry Research and Information Association
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COMEAP	Committee on the Medical Effects of Air Pollution
CREH	Centre for Research into Environment and Health
CSO	Combined sewer overflow
DCLG	Department for Communities and
DCLG	Department for Communities and Local Government
DEFRA	Department for Environment Food and Rural Affairs
DMA	District metering area
DTI	Department of Trade and Industry
EC	European Commission
EDS	Economic Development Strategy
EEA	European Environment Agency
EEC	European Economic Community
EqIA	Equalities Impact Assessment
EU	European Union
FoE	Friends of the Earth
GCSE	General Certificate of Secondary Education
GLA	Greater London Authority
GOL	Government Office for London
GP	General practitioner
HIA	Health Impact Assessment
HMG	Her Majesty's Government
HSE	Health and Safety Executive
IIA	Integrated Impact Assessment
IPCC	Intergovernmental Panel on Climate Change
km	Kilometre
LCCP	London Climate Change Partnership
LDA	London Development Agency
LDF	Local Development Framework
LDD	Local Development Document
LDEPA	London Fire and Emergency Planning Authority
LHC	London Health Commission
LSC	London Skills Council
LSDC	London Sustainable Development Commission
MEP	Member of the European Parliament
MPA	Metropolitan Police Association
MPS	Metropolitan Police Service
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
ODPM	Office of the Deputy Prime Minister
OFWAT	Office of Water Services
PLA	Port of London Authority
PM10	fine particulate matter
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
RBMP	River Basin Management Plan
RFRA	Regional Flood Risk Appraisal
RPHG	Regional Public Health Group
SA	Sustainability Appraisal
SAC	Special Areas of Conservation
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SOER	State of the environment report
SPA	Special Protection Area
SPG	Supplementary Planning Guidance
SSSI	Sites of Special Scientific Interest
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TE2100	Thames Estuary 2100
TfL	Transport for London
UHI	Urban Heat Island
UK	United Kingdom
UKCIP	United Kingdom Climate Impacts Programme
UKCP09	UK Climate Projections 2009
UKWIR	UK Water Industry Research
WFD	Water Framework Directive
WHO	World Health Organisation
WRMU	Water Resources Management Unit

APPENDICES (PART B)

APPENDIX 7

APPRAISAL OF THE EFFECTS OF CLIMATE CHANGE IN LONDON IN THE ABSENCE OF THE DRAFT STRATEGY

Appraisal of the Sustainability Effects of Climate Change in London in the Absence of the Draft Strategy - Flooding, Drought and Overheating

Note: The matrices below represent an appraisal of the projected sustainability effects of climate change in London in relation to impacts on flooding, drought and overheating, taking account of current and planned adaptation. The potential sustainability effects are considered over the medium-term (to 2020s) and long-term (2050s and beyond). The matrices also include the predicted sustainability effects of climate change projections in the absence of current and planned adaptation. These were used to provide context for the appraisal of the future climate projections taking into account current and planned adaptation, as well for the appraisal of the draft CCAS and alternative CCAS at the strategic level (Section 5).

These matrices are based on:

- Likely evolution of the sustainability baseline topics in the absence of the Draft Strategy (Table 8, Section 4)
- Future climate in London projections (Table 9, Section 4)
- Current and planned adaptation summaries (Tables 10 – 12, Section 4)
- Causal chains mapping effects of flooding, drought and overheating in London due to climate change (Section 4)

1. Appraisal matrix: predicted sustainability effects of climate change in London – Flooding

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

Climate Projections (2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding in London (2020s).
Current Adaptation (to 2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding together with the influence of current and planned adaptation (2020s).
Long-term Adaptation (to 2050s onwards)	Potential sustainability effects of longer term climate change impacts on rainfall and flooding (2050s – 2100) together with the influence of current and planned adaptation.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
People and health				
1. Governance	**+?**	**+**	**+**	**Future Climate (2020s):** Uncertain minor positive effects are predicted on governance over the medium-term period. The impacts of climate change themselves are not expected to have direct effects on the governance of flooding in London, however responding to the potentially significant effects of climate change on flooding and the impact of storm events and more extreme rainfall may drive, through necessity, a more coordinated, cross-sectoral response in London, for example between London Boroughs, utility providers and developers, which has the potential to result in improved governance. **Current Adaptation (2020s):** The current and planned adaptation described in Table 10 seeks to promote joint working in relation to managing long-term flooding in the Thames region, and is likely to improve governance in London over the medium-term. Minor significant positive effects are therefore predicted. **Long-term Adaptation (2050+):** The results of adaptation described in Table 10 are likely to lead to long-term changes in the governance of flooding in London. While the risk of all types of flooding are projected to increase significantly in the period to 2050 and beyond, this will not in itself impact on governance, so the effects are predicted to remain unchanged.
2. Education and Awareness	**+**	**+/++**	**++?**	**Future Climate (2020s):** Minor positive effects are predicted in relation to education and awareness over the medium-term period. As the effects of climate change become clearer (for example due to increased flooding events in London or elsewhere) this may lead to increasing awareness among the general public, and other stakeholders (e.g. private companies). **Current Adaptation (2020s):** The current and planned adaptation in Table 10, in particular ongoing and emerging Government and Environment Agency programmes such as an enhanced flood warning service, is likely to increase awareness of flood risk in the capital. As a result positive effects are predicted, which could be of minor or major significance. **Long-term Adaptation (2050+):** In the longer-term it is likely that the effects of climate change on flooding in London will become increasingly apparent and as a result further increase awareness flooding. Major positive, but uncertain, effects are predicted as there is a high degree of uncertainty relating to the impacts of increased flood risk and

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				programmes to raise awareness in the long-term.
3. Health and Well-being	--	-	--?	**Future Climate (2020s):** Increased frequency and intensity of rainfall and extreme weather events and increased risk of all types of flooding are predicted to have potentially major significant negative effects on health and well-being over the medium-term period. More heavy rainfall is likely to contribute to surface water flooding and run-off, as well as increased risk of sewerage overflows. These may cause increased direct health impacts (illness, injury, stress) and indirect impacts due to disruption. Damage to property and infrastructure may also impact negatively on quality of life and well-being. Increased frequency of fluvial and tidal flooding may have a significant impact on health and well-being, particularly through damage to property, disruption and increased likelihood of water-borne illness and disease. **Current Adaptation (2020s):** Current and planned adaptation described in Table 10 may help reduce the impacts of increased flooding on health and well-being, however overall negative effects are still predicted. **Long-term Adaptation (2050+):** Major significant, but uncertain, negative effects are predicted in the long-term as the effects identified above are likely to become significantly worse as the impact of climate change become more severe. For example, by the end of the century tidal flood risk will decrease from 1 in 2000 to 1 in 100 (without enhancement to flood defences), potentially increasing the frequency and severity of tidal floods. However, the longer-term adaptation response is uncertain, and therefore the overall long-term effects cannot be predicted with confidence.
4. Equality and Diversity	-	-	-/--?	**Future Climate (2020s):** Vulnerable people and groups may be less able to respond and cope with flooding and extreme weather events, therefore minor negative effects are predicted over the medium-term period. The elderly, long-term ill and low-income groups may be at particular risk as they may be least able to receive flood warnings (less connected to modern communications), and less able than other groups to respond (lack of money to pay for alternative accommodation, less able to respond quickly and make property and possessions safe, less likely to have adequate insurance, etc.). **Current Adaptation (2020s):** The current and planned adaptation identified in Table 10 is considered unlikely to change these effects significantly as the number of people classed as vulnerable are likely to increase over the medium and long term as the population of London gets older (due to predicted demographic changes) and health and economic inequalities increase. **Long-term Adaptation (2050+):** In the longer-term the negative effects identified above are likely to become more significant due to underlying trends in population and demographic changes, which are predicted to potentially increase exposure of vulnerable groups to flood risks and associated effects. Negative effects are predicted in the long-term, which could be of minor or major significance, these effects are uncertain as the exact nature of such long-term changes cannot be predicted with confidence.
5. Safety and Security	-	-/0	--?	**Future Climate (2020s):** The impacts of climate change on flooding and rainfall over the medium-term period are predicted (based UKCP09 projections) to increase winter precipitation by an average of 6%, increase the risks of all types of flooding, and increase storminess and extreme rainfall events. These impacts are predicted to have negative effects on individual and community safety in London as it will increase the risk of flooding from all sources. No significant effects are predicted on security.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Current Adaptation (2020s): The current and planned adaptation identified in Table 10 may help to reduce the risk of flooding and improve awareness of flooding and flood warnings in at risk communities, thus reducing the significance of the negative effects predicted in relation to safety and security. Mixed neutral and minor negatives effects are predicted. **Long-term Adaptation (2050+):** In the long-term the increased risk of major tidal flooding in London has the potential to cause very significant negative effects on individual and community safety in the capital, especially towards the end of the century (2070 – 2100) unless new tidal flood defences are constructed. Major significant, but uncertain, negative effects are predicted. The effects are uncertain as the long-term adaptation response to increased tidal flood risks is cannot be predicted with confidence.
Place				
6. Liveability and Place	**-**	**-/0**	**-/--?**	**Future Climate (2020s):** Minor significant negative effects are predicted over the medium-term, as flooding and extreme rainfall events could lead to reduced amenity of waterways (e.g. due to increased run-off and pollution), damage to infrastructure and the public realm and changes to land-uses and landscape/townscape. Frequent flooding and inundation could also impact negatively on green / open spaces and biodiversity. **Current Adaptation (2020s):** Current and planned adaptation described in Table 10 such as policies in the London Plan to encourage SUDs, the current standard of tidal flood defences in London, and the construction of the London Tideway Tunnels are likely to reduce the significance of these predicted negative effects. However construction of the Tideway Tunnels and other possible flood alleviation measures may cause disruption and disturbance as well as the potential loss of open and green space due to construction. Overall minor negative and neutral effects are predicted. **Long-term Adaptation (2050+):** In the long-term there could be a significant increase in the severity of climate change impacts likely to have negative effects on liveability and place, such as increased risk of surface water flooding due to changing rainfall patterns. At the same time current adaptation is seeking to improve liveability and place. However, overall uncertain negative effects of minor or major significance are predicted. The effects are uncertain as the long-term effects and adaptation response cannot be predicted with confidence.
7. Accessibility and Availability	**-**	**-**	**--?**	**Future Climate (2020s):** Over the medium-term, flooding of all types is likely to impact negatively on accessibility, especially due to disruptive effects on transport, such as inundation of tube / railway lines, closure of roads and damage to infrastructure. Increased storminess and rainfall may also make cycling / walking less attractive and reduce accessibility for those without access to a car or local public transport. Specific flood events may also lead to the closure / damage to specific buildings, such as hospitals, schools or libraries, either due to flood damage or risk, or as a result of insufficient staff being unable to get to work. There is the potential that this will have a disproportionate effect on vulnerable groups such as the elderly or unwell. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 10 is considered unlikely to change these effects significantly. **Long-term Adaptation (2050+):** In the long-term the risk of surface water flooding is likely to increase significantly due to changing rainfall patterns, which could have increasingly significant negative effects on accessibility and availability. Major negative, but uncertain, effects are predicted. The effects are uncertain as the exact impact of

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				such long-term changes on accessibility and availability is not known.
8. Landscape, Historic and Cultural Environment	**-**	**-/0**	**-/--?**	See objectives 5 and 6. Flooding of all types will increase the risk of damage to historic buildings and land/cityscapes. In addition construction of the Tideway Tunnel and other flood alleviation measures could cause damage to historic buildings and archaeological sites.
9. Biodiversity	**-**	**-?**	**--?**	**Future Climate (2020s):** Over the medium-term, increased inundation of habitats with saline water, fluvial flooding and (potentially contaminated) surface water flooding are predicted to have potentially significant minor negative effects on biodiversity in London. Tidal flooding may lead to inundation of habitats with saline water, leading to damage and negative biodiversity effects. Fluvial flooding, together with surface water-runoff and an increased incidence of sewer flooding may lead to a decline in river water quality with impacts on aquatic species, as well as negative impacts on riparian vegetation and green spaces within flood plains. **Current Adaptation (2020s):** The current and planned adaptation described in Table 10 indicates that some adaptation responses could increase negative effects on biodiversity, for example building flood defences that adversely affect intertidal habitats. However, there is also the potential that building flood defences could be positive for biodiversity, for example by increasing the amount of land set aside as flood plain. Uncertain minor negative effects are predicted due to the wide range of potentially positive and negative habitat and biodiversity impacts. **Long-term Adaptation (2050+):** In the long-term it is likely that the negative effects outlined above will be exacerbated as climate change impacts become more significant. However, uncertain major negative effects are predicted as the exact nature of such long-term changes and impacts cannot be predicted with confidence.
10. Air Quality	**0/-**	**0?**	**-?**	**Future Climate (2020s):** More frequent and severe rainfall over the medium-term described in the future BAU scenario is likely to lead to a rise in the number of sewer flooding incidences. These may result in localised odour pollution. **Current Adaptation (2020s):** The current and planned adaptation in Table 10, specifically the construction of the London Tideway interceptor tunnels, are likely to reduce the incidences of sewer flooding and help reduce negative effects to odour quality. However, the construction of the London Tideway tunnels may also lead to local air pollution, for example due to dust and vehicle emissions. During operation energy will be used to pump sewerage to the treatment plant, which could have negative effects to local air quality depending on the fuel source used. **Long-term Adaptation (2050+):** The Tideway interceptor tunnels are likely to have an operational life-span for much of the century (to 2100). However, the increased risk of other forms of flooding may lead to more frequent localised sewer flooding which may lead to reduced odour problems. Minor negative, but uncertain, effects are predicted as the exact nature of such long-term changes is uncertain.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
Climate change				
11. Climate change and energy[1] **11.1 Mitigation**	**0/-**	**-**	**--?**	**Future Climate (2020s):** Limited effects predicted, however responding to more frequent flooding events (e.g. pumping, construction etc.) will lead to some increase in energy use and therefore greenhouse gas emissions over the medium-term. Poorer water quality as a result of flooding (see Objective 12.1) may require increased amounts of water treatment which could also increase energy use and emissions. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 10 is predicted to have minor negative effects on climate change mitigation. This is due to the emissions associated with construction and operation of (for example) the London Tideway tunnels. **Long-term Adaptation (2050+):** In the long-term the need for new or improved flood defences, and potentially increased flood events may have significant negative effects on climate change mitigation, due to emissions relating to construction, pumping, recovery etc. Major negative, but uncertain, effects are predicted as the exact nature of such long-term changes is uncertain.
11.2 Adaptation	**-**	**+/-**	**-?**	**Future Climate (2020s):** Minor negative effects are predicted as the impacts of climate change may reduce London's adaptive capacity in dealing with the effects of climate change on flood risk. For example, climate change is predicted to lead to an increase in the frequency and severity of droughts in London. Extended drought periods can reduce the capacity of the ground to absorb rainfall, increasing the risk of surface water flooding. Thus climate change may reduce London's ability to adapt to an increase in flood risk. Over the medium-term, the risk of all types of flooding is predicted to increase, together with a predicted rise in sea level and increased incidence and frequency of storm events. This will increase the exposure and vulnerability of communities, infrastructure and buildings. **Current Adaptation (2020s):** Both negative and positive effects are predicted in relation to current and planned adaptation described in Table 10 as there are a number of policies, plans and actions seeking to encourage or increase adaptive capacity in relation to flooding. In addition, existing tidal flood defences in London are predicted to be adequate for at least the next 20 years, and the Thames Barrier to 2070. However, the projected increase in London's population together with pressure on land for development potentially leading to more development in areas at risk of flooding may increase exposure and vulnerability to flooding. **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts, together with likely long-term underlying trends, may exacerbate negative effects identified as London becomes more vulnerable to flooding and extreme rainfall events, and exposure and consequences increase (e.g. due to increased population and development). Minor negative, but uncertain, effects are predicted, as the exact nature of long-term changes is uncertain.
Water management				
12. Water Quality and	**--**	**-?**	**--?**	**Future Climate (2020s):** Increased frequency and intensity of rainfall is predicted to increase the risk of surface water flooding which could have potentially significant negative impacts on water quality over the medium-term. More

[1] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
Water Resources[2] **12.1 Water quality**				heavy rainfall is likely to contribute to an increase in surface run-off, surface water flooding, and incidence of sewage overflows. These may have direct impacts on water quality in rivers in the capital, especially the Thames and the Lee due to the high number of combined sewage overflow outlets present. Sewage disposal systems, including treatment works, could also be put out of action during flood events. **Current Adaptation (2020s):** Current and planned adaptation described in Table 10 may help to reduce the negative effects of an increase in heavy rainfall events, however these effects are uncertain. Examples of adaptation include the completion of the interceptor sewer (Thames Tideway tunnels) planned for London which is intended to reduce the number of combined sewer overflows, and policies, such as those in the London Plan seeking to encourage SUDs. However, some adaptation action is uncertain, such as the potential for the draft Flood and Water Management Bill to clarify responsibility for surface water management. Such actions could also help to reduce the negative effects on water quality of flooding and increased rainfall. **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts is likely to exacerbate negative effects identified above. Major negative, but uncertain, effects are predicted as the exact nature of such long-term changes and the adaptation response is uncertain.
12.2 Water resources	--	-?	--?	**Future Climate (2020s):** Increased frequency and intensity of rainfall is predicted to increase the risk of surface water flooding which could have potentially significant negative impacts on water resources over the medium-term. Frequent periods of heavy rainfall during winter months may lead to saturated soil, therefore reducing the amount of water infiltration and recharge of London and the surrounding area's groundwater. In addition, increased surface water run-off and increased incidence of sewage overflows could decrease water quality in London's rivers (especially the Thames due to the high number of combined sewer overflow outlets present), potentially resulting in the need for more water treatment and the potential for contamination of drinking water supplies in flood events. Sewage disposal systems, including treatment works, could also be put out of action during flood events. **Current Adaptation (2020s):** As outlined in objective 12.1 above, the current and planned adaptation described in Table 10 could potentially reduce the negative effects of increased frequency and intensity of rainfall on London's water resources, however these effects are uncertain. **Long-term Adaptation (2050+):** See objective 12.1.
Waste management and resource use				
13. Waste management	0/-	-	-?	**Future Climate (2020s):** The impacts of climate change on flooding and rainfall over the medium-term are predicted to have limited significant effects on waste management in London. Flooding and increased storminess may impact negatively on waste management sites (e.g. increased leachate), and lead to increased detritus contamination in London's waterbodies. In addition, flooding of toxic waste sites and chemicals previously stored above ground could become more significant as the risk of flooding increases over time. **Current Adaptation (2020s):** The current and planned adaptation described in Table 10 may increase the significance of the negative effects identified. The construction of the London Tideway Tunnels and flood defences, as outlined in TE2100, are likely to result in the creation of construction waste and increased use of resources. The

[2] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				potential flooding of waste management facilities could result in negative effects to waste management in London, possibly spreading disease. **Long-term Adaptation (2050+):** In the long-term the potential need to construct new tidal flood defences (e.g. a new Thames Barrier) could result in significant construction projects being required, leading to further waste production and resource use. The relative scale of this effect is not considered to be of major significance, and the effect is uncertain as the exact nature of such long-term changes is uncertain.
Economy				
14. Economy	--	-	--?	**Future Climate (2020s):** Major significant negative effects are predicted over the medium-term. The risk of all types of flooding is considered likely to increase, with potentially significant negative effects on insurance costs / premiums, especially for businesses and households living in areas at risk of flooding. Increased flood risks and frequency and intensity of extreme rainfall events and storminess will also have direct and indirect economic costs. Flooding can cause significant direct damage to buildings and infrastructure, as well as having negative economic impacts due to disruption, lost work time (damage to facilities, illness and workforce absenteeism etc.). There is also the potential for very minor positive effects related to business opportunities in producing flood resilient materials and technologies, and in skilled construction / planning related to minimising flood risk impacts on businesses, homes and infrastructure. These minor positive effects are likely to be relatively insignificant compared to the negative effects on the economy of flooding. **Current Adaptation (2020s):** Although the current standard of tidal flood defence in London is predicted to be sufficient over the medium term, and the current and planned adaptation described in Table 10, may help to reduce these negative economic impacts, overall minor negative effects are predicted due to the potentially very significant economic costs associated with other types of flooding. **Long-term Adaptation (2050+):** In the long-term flood risk is projected to further increase in the capital. Although the protection provided by existing flood defences are deemed adequate for at least the next 20 years, and the Thames Barrier to 2070 , the risks associated with fluvial and surface water flooding are likely to increase significantly. Increased frequency and severity of rainfall and storminess is also likely to cause disruption and damage to property and infrastructure with further negative economic effects. Major negative, but uncertain, effects are predicted as it is uncertain how London's economy will adapt to and innovate in response to climate change – there will be some economic opportunities, but it is unclear how businesses in London will respond.

Overall comments

In the medium-term (2020s) the impact of climate change on flooding is predicted to have potentially major negative effects on health and well-being, water quality and resources and economy. Negative effects are predicted, which could be of minor or major significance on all other SA objectives, except governance and education and awareness, where potential positive effects are predicted based on the assumption that as climate impacts become more apparent, people and businesses will become more aware of flood risk.

Overall the current and planned adaptation is predicted to reduce the negative effects predicted in relation to projected climate change impacts. Where significant negative effects were predicted in relation to the medium-term climate change scenario, the current and planned adaptation in most cases reduces the significance of the negative effects predicted. However, in relation to all objectives except governance and education and awareness, the assessment predicts that residual negative effects will remain. The residual negative effects predicted are all likely to be of minor significance or insignificant.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
This assessment implies that, based on known current and planned adaptation, the impacts of climate change projected over the period to the 2020s are still likely to have negative effects in relation to most SA objectives, in particular health and well-being, equality and diversity, accessibility and availability, climate change mitigation, waste management and economy, but also potentially biodiversity and water resources and water quality. In the longer term, in the period 2020s to the end of the century (2100), the projected increased severity of all climate change impacts associated with flooding are predicted to exacerbate the negative effects predicted in the medium-term. For many objectives the predicted effects are potentially of major significance, however in all cases these effects are predicted to be uncertain, as while there is increasing consensus in relation to climate change projections, the long-term adaptation responses and the exact nature of the effects of long-term climate change impacts on specific receptors cannot be known with certainty.				

2. Appraisal matrix: predicted sustainability effects of climate change in London – Drought

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

Climate Projections (2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding in London (2020s).
Current Adaptation (to 2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding together with the influence of current and planned adaptation (2020s).
Long-term Adaptation (to 2050s onwards)	Potential sustainability effects of longer term climate change impacts on rainfall and flooding (2050s – 2100) together with the influence of current and planned adaptation.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
People and health				
1. Governance	**+?**	**+**	**+?**	**Future Climate (2020s):** Uncertain minor positive effects are predicted in relation to governance over the medium-term. The impacts of climate change themselves are not expected to have direct effects on the governance of drought in London, however responding to the potentially significant effects of climate change on drought and the impact of decreased rainfall and increased abstractions is may, through necessity, drive a more coordinated, cross-sectoral response in London, for example between water companies, regulators, developers and consumers. **Current Adaptation (2020s):** The current and planned adaptation described in Table 11 seeks to promote joint working in relation to managing long-term drought risk in the Thames region, and is likely to improve governance in London over the medium-term. **Long-term Adaptation (2050+):** The results of adaptation described in Table 11 are likely to lead to long-term changes in the governance of drought in London. In the long-term, the effects of climate change are predicted to become more severe, with the risk of and more serious and frequent droughts. This will have other significant implications (see other Objectives, below) and may also increase the impetus for improved governance. The overall effects are however predicted to remain minor, and uncertain as the exact nature of long-term change cannot be predicted with confidence.
2. Education and Awareness	**+**	**+/++**	**++?**	**Future Climate (2020s):** Minor positive effects are predicted in relation to education and awareness over the medium-term. As the effects of climate change become clearer (for example due to increased frequency and severity of drought periods in London or elsewhere) this may lead to increasing awareness among the general public and other stakeholders (e.g. private companies). **Current Adaptation (2020s):** The current and planned adaptation in Table 11, in particular ongoing and emerging Government and Environment Agency programmes such as the restriction of non-essential water use during drought periods, and the increased penetration of water meters, may increase awareness of drought risk in the capital. **Long-term Adaptation (2050+):** In the longer-term it is likely that the frequency and severity of drought periods will continue to increase, particularly towards the end of the century (2100), further increasing awareness among Londoners. Uncertain major positive effects are predicted, as the long-term effects of climate change and

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				programmes to raise awareness are uncertain.
3. Health and Well-being	-	-	-?	**Future Climate (2020s):** Increased frequency and intensity of drought periods are predicted to have potentially minor negative effects on health and well-being over the medium-term. For example, the necessity for water rationing during drought periods could have negative impacts on Londoner's health, particularly on vulnerable people. Less rainfall could lead to an increase in subsidence and heave, damaging property and infrastructure which could impact negatively on quality of life and wellbeing. Reduced river flows could increase the concentration of water pollutants, potentially exposing people to polluted water and toxic algal blooms, as well as having potentially negative effects on visual amenity. **Current Adaptation (2020s):** Current and planned adaptation described in Table 11 may help reduce the impacts of decreased rainfall on health and well-being, however overall negative effects are still predicted. **Long-term Adaptation (2050+):** In the long-term the potential negative effects identified above are likely to become significantly worse as London's demand for water increases and the effects of a changing climate become more severe. However, these negative effects could be reduced as by the second half of the century if new water resources have been developed which would help London to cope with drought periods. Due to the uncertainty of the long-term adaptation response uncertain minor negative effects are predicted.
4. Equality and Diversity	0/-	-	-/--?	**Future Climate (2020s):** Vulnerable people and groups may be less able to respond to and cope with increasingly frequent and intense drought periods, therefore neutral or minor negative effects are predicted over the medium-term. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 11 includes measures to control non-essential water uses during droughts as well as increase water efficiency more generally (for example through metering and the installation of water efficient appliances). In addition, underlying trends such as an ageing population and an increase in economic and health inequalities may lead to a rise in the number of vulnerable people in London. These underlying trends, together with some adaptation responses may increase inequalities. For example, low-income groups may be more sensitive to the cost of metered water, and may use less than the recommended amount of water in order to lower their water bill. **Long-term Adaptation (2050+):** In the long-term the negative effects above are likely to become more significant due to further increase in population and ongoing demographic changes. However, uncertain negative effects, of minor or major significance, are predicted as the exact nature of such long-term changes is uncertain.
5. Safety and Security	0/-	0/-	-?	**Future Climate (2020s):** The impacts of climate change on rainfall over the medium-term are predicted (based UKCP09 projections) to decrease summer precipitation by an average of 7% and increase the risk of frequent and severe drought periods. These impacts are predicted to have either neutral or negative effects of minor significance on safety, as the potential risks of subsidence and water shortages will impact negatively on individuals and communities. **Current Adaptation (2020s):** No overall changes are predicted in the effects identified under future climate. The current and planned adaptation identified in Table 11 may help to reduce the impact of drought periods, thus reducing the significance of the negative effects predicted in relation to safety. However, the projected increase population and underlying demographic changes may increase vulnerability of communities and individuals.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Long-term Adaptation (2050+): In the longer-term uncertain minor negative effects are predicted. The impacts of climate change in the long-term are likely to further increase the severity and frequency of droughts, which may impact negatively on safety, however an uncertain effect is predicted as the long-term adaptation response is uncertain.
Place				
6. Liveability and Place	**-**	**0/-**	**-?**	**Future Climate (2020s):** Minor significant negative effects are predicted over the medium-term as drought could lead to reduced amenity of waterways (e.g. due to low flow levels and pollution), damage to infrastructure and the public realm (from subsidence and heave). Frequent or prolonged drought periods could also impact negatively on green / open spaces and biodiversity through loss of trees and visual amenity, for example. **Current Adaptation (2020s):** Current and planned adaptation described in Table 11 such as policies in the London Plan to improve water efficiency, or Environment Agency plans to reduce abstraction where negative environment effects are predicted, are likely to reduce the significance of these predicted negative effects. Neutral or minor negative effects are predicted as it is considered unlikely that current adaptation will mitigate for all negative effects of drought. **Long-term Adaptation (2050+):** In the long-term uncertain minor negative effects are predicted. The impacts of climate change in the long-term are likely to further increase the severity and frequency of droughts, which may impact negatively on liveability and place, however uncertain effects are predicted as the long-term adaptation response is uncertain.
7. Accessibility and Availability	**-**	**-**	**-?**	**Future Climate (2020s):** Drought conditions could impact negatively on green and open spaces, as well potentially increasing the risk of pollution / disease in water bodies, thus reducing opportunities for water based recreation. This could result in minor negative effects, reducing the quality of the local environment and the public realm. **Current Adaptation (2020s):** Some adaptation responses, such as the inclusion water attenuation (ponds) as part of SUDS measures may increase access to open spaces, which could have a minor positive effect on the provision and quality of open space for the enjoyment of the local environment. **Long-term Adaptation (2050+):** In the long-term the effects of climate change are projected to lead to more frequent and severe droughts. In the absence of appropriate adaptation responses, this may lead to changes in open / green space, and potentially damage to transport infrastructure due to subsidence and heave, which in turn may restrict or disrupt access. Uncertain neutral or minor negative effects are predicted as the nature of adaptation responses in the long-term is uncertain.
8. Landscape, Historic and Cultural Environment	**-**	**0/-**	**-/--?**	**Future Climate (2020s):** Water bodies or features are an important aspect of many of London's historic and cultural sites and buildings (e.g. the Thames, Trafalgar Square, Hyde Park, and Hampstead Heath). Drought could affect the health and visual amenity value of London's green and open spaces as well as the public realm through loss of street trees for example. Drought may also damage historic buildings and their settings and archaeological sites. Minor negative effects are therefore predicted. **Current Adaptation (2020s):** There is no explicit current adaptation relating to protecting the historic environment from droughts, however other measures to reduce water demand and protect resources may help reduce the significance of negative effects identified. Neutral or negative effects of minor significance are therefore predicted.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Long-term Adaptation (2050+): In the long-term more frequent and severe droughts are likely to exacerbate potential negative effects to landscape, historic and cultural assets. In the absence of specific adaptation measures, uncertain negative effects, which could be minor or major in significance, are predicted.
9. Biodiversity	**-/--**	**-/+**	**-/--?**	**Future Climate (2020s):** Over the medium-term, reduced rainfall and increased abstraction, and a potential reduction in the chemical and biological quality of London's waterways, are predicted to have potentially significant negative effects on biodiversity in London. Negative effects, which could be minor or major in significance, are predicted. Wetlands and watercourses can withstand some degree of seasonal fluctuation in rainfall, but extended drought periods will affect the ability of some species to survive. Low flows also reduce the dilution of any pollution or discharges entering a watercourse, therefore exacerbating the potential detrimental effects on flora and fauna. In addition, increased drought stress, or conditions that favour more disease and pest species, both have the potential to affect the parks and public realm in London. **Current Adaptation (2020s):** The current and planned adaptation described in Table 11 is predicted to have some positive effects on biodiversity as many of these measures are seeking explicitly to reduce the risk and severity of droughts. For example, reducing water consumption by improving efficiency would have the effect of reducing the need for abstractions, and thus provide some protection to river flows and groundwater levels in drought periods. However, some negative effects are also possible, for example the development and operation of the proposed desalination plant at Beckton could adversely affect habitat conditions by increasing the salinity of the Thames estuary, or due to the land take associated with the proposed reservoir in Oxfordshire. A significant proportion of adaptation measures relating to drought are aimed at securing water supply security for consumers, although the Environment Agency's plans (water resources strategy, CAMs etc) are seeking to protect the environment. **Long-term Adaptation (2050+):** In the long-term the effects of climate change are projected to lead to more frequent and severe droughts. In the absence of appropriate adaptation responses this could result in significant negative effects on habitats and biodiversity in London (particularly due to cumulative effects of temperature increases and changes to rainfall patterns). Uncertain negative effects, which could be minor or major in significance, are predicted as the nature of adaptation responses in the long-term is uncertain.
10. Air Quality	**0/-**	**0/-**	**-?**	**Future Climate (2020s):** Less frequent rainfall, and an increase in abstractions, over the medium-term, may increase the concentration of pollutants in the water environment. This may result in localised odour problems. Drier conditions may also increase dust from traffic, construction etc leading to an increase in particulate pollution. During drought periods it may be necessary to abstract, pump, or transport water, or even operate a desalination plant. Assuming that the energy used is derived from fossil fuels these activities could increase localised air pollution. **Current Adaptation (2020s):** The current and planned adaptation relating to drought in Table 11 is not predicted to have a significant effect odour problems or particulate air pollution. Some minor negative effects are predicted as the construction of (for example) new water resources could lead to localised dust problems. The proposed desalination plant at Beckton is planned to derive its energy from bio-diesel. While this may reduce the greenhouse gas emissions associated with the plants operation, it may still lead to localised air pollution.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Long-term Adaptation (2050+): As above, in the long term climate change impacts are likely to lead to reduced flows in London's rivers, which may lead to localised odour problems. Long-term adaptation responses, particularly those involving construction (e.g. of new resources or pumping stations) could increase dust and localised air pollution. Uncertain minor negative effects are predicted, as the exact nature of long-term impacts and responses cannot be predicted with confidence.
Climate change				
11. Climate change and energy[3] **11.1 Mitigation**	**0/-**	**-**	**-/--?**	**Future Climate (2020s):** Reductions in water quality associated with reduced flows and increased demand, may require more water treatment and transfers which could increase energy use and therefore greenhouse gas emissions over the medium-term. In extreme droughts, water transportation by tanker may be required which would result in increased energy use and greenhouse gas emissions, however this is not expected to be a significant contributor to London's overall greenhouse gas emissions. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 11 is predicted to have minor negative effects on climate change mitigation. This is due to the emissions associated with construction of new water resources such as the construction and operation of the desalination plant at Beckton. Although the desalination plant at Beckton is planned to derive some of its energy from renewable resources (bio diesel), there will still be greenhouse gas emissions associated with their use. **Long-term Adaptation (2050+):** In the longer-term, there is an identified need for new water resources to meet increasing demand, and in response to the risk of drought. Although no plans have currently been agreed, the construction of a major new resource (such as the proposed reservoir near Abington in Oxfordshire) would have potentially significant effects from energy use and emissions during construction and operation. If new resources are not developed, as the impacts of climate change become more severe in terms of reduced recharge during the winter and summer drought increasing demand, pumping and water transfer from other areas may be required, which could also increase emissions. Uncertain negative effects, which could be minor or major in significance, are predicted as the exact nature of long-term adaptation responses is not known with certainty.
11.2 Adaptation	**-**	**-**	**--/+?**	**Future Climate (2020s):** Minor negative effects are predicted as the impacts of climate change may reduce London's adaptive capacity in dealing with the effects of climate change on drought. For example climate change is predicted to increase average the incidences of heat-waves, and reduce cloud cover, which would increase evaporation from reservoirs and reduces their effectiveness when needed most. Thus climate change would reduce London's ability to adapt to increased frequency and severity of droughts. Over the medium-term the risk of drought is predicted to increase. This will increase the vulnerability of the natural environment, infrastructure and communities. **Current Adaptation (2020s):** Overall minor negative effects are predicted in relation to current and planned adaptation described in Table 11. While there are a number of policies, plans and actions seeking to encourage or increase adaptive capacity in relation to drought, these measures are not considered sufficient to address the predicted shortfalls between supply and demand. London's current water resources are not sufficient to meet its daily water needs, and this shortfall is likely to increase in the medium-term due to population increase, increasing per capita demand, and the length of time it will take to develop a major new water resource such as a reservoir.

[3] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Long-term Adaptation (2050+): In the longer-term the increased significance of all predicted climate change impacts, together with underlying trends of increased development and population, may exacerbate negative effects identified as London is exposed to frequent and prolonged drought periods. At the same time by the second half of the century new resources may have been developed (e.g. the proposed reservoir in Abington, Oxfordshire) and increased levels of efficiency may have been achieved in water use (e.g. full implementation of the Code for Sustainable Homes). Uncertain positive effects, which could be major or minor in significance, are predicted, as the exact nature of adaptation responses in the long-term is not known.
Water management				
12. Water Quality and Water Resources[4] **12.1 Water quality**	--	-/+	-?	**Future Climate (2020s):** Decreased summer rainfall and increased demand (due to predicted increase in temperatures) is predicted to increase the risk of prolonged drought periods in London. This could have potentially significant negative effects on water quality over the medium-term. Less rainfall, and increased demand, is likely to lead to higher abstraction levels, low river flows and reduced water quality. **Current Adaptation (2020s):** Current and planned adaptation described in Table 11 is intended explicitly to help reduce the negative effects of a decrease in summer rainfall and increased frequency of drought events. However, during extreme drought periods emergency legislation may in fact exacerbate poor water quality, by allowing abstraction to ensure supplies at the cost of river flows. Adaptation which could have a positive effect includes efforts to improve water efficiency in new and existing development, and the construction of new water resources. Adaptation which could have a negative effect includes the legislative instruments to increase abstractions and reduce river flows as low as 10% of normal levels during a drought period. **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts is likely to exacerbate negative effects identified above. However, at the same time by the second half of the century new resources may have been developed (e.g. the proposed reservoir in Abington, Oxfordshire) and increased levels of efficiency may have been achieved in water use (e.g. full implementation of the Code for Sustainable Homes). While these new resources could reduce the need for abstractions, protecting water flow and quality, the projected increase in London's population and per capita consumption may offset any potential reduction in abstraction. Minor negative effects are predicted, as new water resources and efficiency improvements may be offset by increased demand. Uncertain effects are predicted, as the exact nature of adaptation responses in the long-term is not known.
12.2 Water resources	--	-	--?	**Future Climate (2020s):** Decreased levels of rainfall are predicted to increase the risk of prolonged and severe drought periods, which is likely to have significant negative effects on water resources over the medium-term. Reduced rainfall will lead to over abstraction of ground water, depleted reservoirs and low flow levels in rivers that increase the concentration of pollutants. In some cases drought may cause direct disruption to the supply network, where subsidence / heave causes damage to pipes and infrastructure. **Current Adaptation (2020s):** As outlined in objective 12.1 above, the current and planned adaptation described in Table 11 is intended to protect existing water resources. Water companies are obliged to develop long-term Water

[4] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				Resources Management Plans (25 years) which should account for climate change impacts. However, overall minor negative effects are predicted as the effects of climate change together with underlying trends (population increase, more development) are still expected to have an overall negative effect on water resources. **Long-term Adaptation (2050+):** See 12.1. In the long-term the increased significance of all identified climate change impacts is likely to exacerbate negative effects identified above, and current and planned adaptation may be offset by trends related to population and per capita water usage. Uncertain effects are predicted, as the exact nature of adaptation responses in the long-term is not known.
Waste management and resource use				
13. Waste management	**0**	**0/-**	**-?**	**Future Climate (2020s):** The impacts of climate change on rainfall and drought over the medium-term are, in themselves not predicted to have significant effects on resource use and waste generation. There is the potential that drought conditions could increase localised dust problems associated with waste management facilities. **Current Adaptation (2020s):** Neutral or minor negative effects are predicted in relation to the current and planned adaptation described in Table 11. Some adaptation responses, such as the construction of the desalination plant at Beckton, may increase resource use and waste generation. **Long-term Adaptation (2050+):** In the long-term the potential need to construct new water resources, such as a major reservoir could result in significant construction projects leading to the production of construction waste, dust and resource use. In addition, localised dust problems associated with waste management facilities could be exacerbated. Uncertain minor negative effects are predicted, as the exact nature of long-term adaptation responses is not known.
Economy				
14. Economy	**-**	**-**	**-?**	**Future Climate (2020s):** Minor negative effects are predicted over the medium-term. The negative consequences of drought are predicted to increase, with potentially significant negative effects on water consumers, businesses, and those who depend on London's waterways for their livelihood. Drought can cause localised direct damage to buildings and infrastructure, as well as having negative economic impacts due to disruption (e.g. subsidence/heave leading to burst water pipes and associated road works). Drought periods are likely to negatively affect London's open and green spaces, which could impact negatively on London as an attractive place to work and live. There is also the potential for positive effects related to business opportunities in producing drought related technologies, such as water efficiency devices, and in skilled construction / planning related to construction of new water resources. However these potential positive effects are insignificant relative to the potential negative effects to London's economy due to drought. **Current Adaptation (2020s):** The current and planned adaptation described in Table 11 may help to reduce these negative effects and enhance the positive effects, however overall minor negative effects are predicted due to the potentially significant economic costs associated with droughts, such as disruption to water supplies from drought orders and the associated effects on business in the capital. **Long-term Adaptation (2050+):** In the long-term the risk of prolonged and severe drought is projected to further increase in the capital. Current water resources are not adequate, and with projected increases in population and per

Sustainability objective	Future Project. (2020s)	Current Adapt. (2020s)	Long-term (2050+)	Comments
				capita demand, the situation is likely to be significantly worse over the long-term. However, long-term adaptation responses may help reduce these negative effects (e.g. development of new resources), or at least prevent them from getting worse due to trends in population and per capita usage. Uncertain minor negative effects are predicted as the exact nature of long-term adaptation responses is unknown.

Overall comments

In the medium-term (2020s) climate change impacts on decreased summer rainfall and increased risk of drought is predicted to have significant negative effects on water quality and water resources, due to the impact drought periods would have on river flows and water supplies. Mixed and minor negative effects are predicted in relation to health and well-being, equality and diversity, safety and security, liveability and place, landscape and the historic environment, biodiversity, climate change and the economy. One minor positive effect is predicted in relation to education and awareness and governance, based on the assumption that the increasing visibility of climate impacts in relation to drought may lead to more people and businesses becoming more aware of drought.

Overall the current and planned adaptation (2020s) is likely to reduce the negative effects predicted in relation to the projected climate change impacts. However, in relation to health and well-being, accessibility and availability, economy and equality and diversity, the current adaptation is predicted to lead to no change or a minor worsening of negative effects. This is due to the potential health and equality effects of measures to manage water demand and increase efficiency, such as compulsory metering. Current and planned adaptation may also lead to negative effects on climate change mitigation, as the construction of new resources, pumping and treatment of water associated with adaptation to drought are all likely to increase energy use and greenhouse gas emissions.

Only in relation to governance and education and awareness is current and planned adaptation considered likely to result in significant positive effects. This implies that current and planned adaptation is not sufficient to mitigate the potentially significant negative effects of climate change in relation to decreased summer rainfall and increased frequency and severity of droughts.

In the long-term (2050s onwards), whilst the sustainability effects are uncertain the projected climate change impacts are expected to lead to significant negative effects due to further increases in the frequency and severity of droughts towards the end of the century. However, the long-term also provides the opportunity for more extensive adaptation responses, such as the construction of major new resources (e.g. a new reservoir) as well as improvements in water use efficiency and demand management.

3. Appraisal matrix: predicted sustainability effects of climate change in London – Overheating

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

Climate Projections (2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding in London (2020s).
Current Adaptation (to 2020s)	Potential sustainability effects of projected climate change impacts on rainfall and flooding together with the influence of current and planned adaptation (2020s).
Long-term Adaptation (to 2050s onwards)	Potential sustainability effects of longer term climate change impacts on rainfall and flooding (2050s – 2100) together with the influence of current and planned adaptation.

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
People and health				
1. Governance	**+?**	**+?**	**+?**	**Future Climate (2020s):** Minor positive but uncertain effects are predicted on governance over the medium-term. The impacts of climatic changes themselves are not expected to have direct effects on the governance of overheating in London, however responding to the potentially significant effects of climate change on overheating and the impact of increased summer temperatures is likely to require a more coordinated, cross-sectoral response in London, for example between local authorities, GPs, care homes and hospitals, which has the potential to result in improved governance. **Current Adaptation (2020s):** The current and planned adaptation described in Table 12 seeks to deliver new development that is heat resilient, and also to ensure that in case of a heatwave the appropriate actions are taken. It is possible that these will improve governance over the medium-term, but as the planned adaptation is relatively limited, any positive effects remain uncertain. **Long-term Adaptation (2050+):** In the long-term, climate change is projected to lead to higher average temperatures and increased frequency and severity of extreme hot weather events, however these impacts will not in themselves influence governance, so the overall effect on governance is predicted to remain unchanged.
2. Education and Awareness	**+/-**	**+/-**	**-**	**Future Climate (2020s):** The potential effects on education and awareness over the medium-term. As the effects of climate change become clearer (for example due to increased frequency and severity of heatwaves in London or elsewhere) it may lead to increasing awareness among the general public, and other stakeholders (e.g. health services and private companies) of climate change. However, there is also potential for the projected overheating in London to have direct negative effects on education, for example heatwaves could reduce educational attainment by making educational facilities uncomfortably hot. **Current Adaptation (2020s):** The current and planned adaptation in Table 12, such as the policies seeking to ensure new developments are heat resilient, may have a minor influence on people's awareness of overheating as an issue, however this is not considered likely to be a significant effect overall. As a result, no change to the potential effects on education and awareness is predicted. **Long-term Adaptation (2050+):** The increased impact of climate change on overheating in London may lead to raised awareness, however this effect is not known with certainty. As heatwaves become increasingly frequent there

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				is the potential for increasingly significant negative effects.
3. Health and Well-being	--/+	--/+	--/+?	**Future Climate (2020s):** Increased average temperatures and the frequency and intensity of heatwaves, exacerbated by the urban heat island, are predicted to have potentially significant negative effects on health over the medium-term. Extended periods of high temperature are likely to have negative health effects on vulnerable groups in particular. Heatwaves can cause high levels of mortality, especially in the elderly (with those in care homes at particular risk) and very young, and are therefore predicted to have potentially major negative effects on health. However, warmer winters are likely to have potentially positive effects on health, leading to fewer deaths and health issues related to cold temperatures for example. **Current Adaptation (2020s):** Current and planned adaptation described in Table 12 may help reduce the impacts of increased temperatures on health and well-being. However, as much of this adaptation is limited to ensuring new developments are adapted to higher temperatures it is not expected that these potentially positive effects would be significant given the small proportion this represents of the London's total building stock. Implementation of the Heatwave Plan for England should help to protect vulnerable groups from the effects of overheating, however the relative effect of this plan in relation to mitigating the effects of heatwaves on health and well-being in London is not predicted to be significant. **Long-term Adaptation (2050+):** In the long-term the potential negative effects identified above are likely to become significantly worse as London's average temperature, and the number of heatwaves, increase. These effects are likely to be compounded by the predicted increase in the incidence and severity of droughts in London which could reduce the cooling capacity of London's vegetation / green spaces. However, winter temperatures are expected to become increasingly mild which could have a positive effect on health in the long term.
4. Equality and Diversity	-/+	-/+	--/+?	**Future Climate (2020s):** Both positive and negative effects are likely on equality, however there are limited or no effects predicted on diversity. Vulnerable people and groups may be less able to respond to and cope with increasingly frequent and intense heatwaves. This is predicted to have minor negative effects on equality over the medium-term. Low-income groups may be particularly affected as they are likely to have more overcrowded and poorer quality housing and may be less able to afford mechanical cooling, and less able to respond in other ways to heatwaves (such as having access to shaded private gardens or leaving London for short periods). However, as noted under Objective 3, warmer winters may reduce winter heating costs, which may benefit low income groups in particular, in that heating costs tend to represent a larger relative proportion of costs in low income households. The elderly and long-term ill may also benefit from milder winters. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 12 is considered unlikely to change the effects predicted under Future Climate significantly as the potential beneficial effects of planned adaptation is likely to be offset by a projected increase in the number of vulnerable people over the medium and long term as the population of London gets older (due to predicted demographic changes) and health and economic inequalities increase. **Long-term Adaptation (2050+):** In the long-term the potential negative effects identified above are likely to become significantly worse as London's average temperature, and the number of heatwaves, increase. However, at the same time winter temperatures are expected to become increasingly mild. These effects are uncertain as the long-

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				term adaption response is currently unclear.
5. Safety and Security	**-?**	**-?**	**-?**	**Future Climate (2020s):** The predicted increase in summer temperatures, heatwaves, and the effects of the urban heat island, could result in increased public order offences due to increased alcohol consumption on hot and sunny days. Warmer summers could lead to an increase burglary due to people being more likely to leave windows open. There is also the potential for an increase in drowning as more people swim in rivers and lakes to cool off during hot weather. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 12 may help to reduce the impact of high temperatures on safety during the summer months. However, the identified adaptation is seeking to ensure new development is adapted to higher temperatures and these potential positive effects are not likely to be significant given the small proportion this represents of the London's total building stock. **Long-term Adaptation (2050+):** In the long-term, as average temperatures and the frequency and intensity of heatwaves are predicted to increase, the potential negative effects on safety may become more significant, however the magnitude of these effects is likely to remain of relatively minor significance. These effects are uncertain as the long-term adaption response is currently unclear.
Place				
6. Liveability and Place	**0/-**	**+/-**	**-?**	**Future Climate (2020s):** While overheating is not predicted to have many significant effects on social cohesion or the public realm, higher temperatures, and the effects of the urban heat island, could lead to reduced amenity and use of open and green spaces especially during heatwaves through loss of vegetation / trees. However, increase temperatures could also encourage people to spend more time outdoors taking part in physical activity. **Current Adaptation (2020s):** Current and planned adaptation described in Table 12 such as policies in the London Plan to improve new development's resilience to overheating are not predicted to change the effect predicted under Future Climate as planned adaptation generally is focussed on ensuring new developments are adapted to higher temperatures and this only represents a small proportion of the London's total building stock. However, current and planned adaptation related to increasing the amount of vegetation and tree cover in the capital may improve London's resilience to higher temperatures, helping to reduce negative effects on liveability and place. **Long-term Adaptation (2050+):** In the long-term, as average temperatures and the frequency and intensity of heatwaves are predicted to increase, the potential negative effects on liveability and place could become more significant. However, the exact nature of these effects and the long-term adaptation response is uncertain.
7. Accessibility and Availability	**-/+**	**-/+**	**--/+?**	**Future Climate (2020s):** Higher average summer temperatures, and the effects of the urban heat island, is likely to negatively affect transport infrastructure in the capital. Key issues from high temperatures are; passenger health and comfort on public transport and while walking and cycling; thermal expansion of rails and bridges; impact on temperature-sensitive equipment; the effect on road surfaces (melting tar binder); and the security of power supply to transport infrastructure given increased energy demand for cooling across all sectors. These effects may reduce the attractiveness of public transport in London, potentially resulting in more people choosing to travel by car, increasing congestion. However, warmer, drier summers and milder winters could make walking and cycling a more viable transport option for some people, which would have the opposite effect. Heatwaves, especially if prolonged for a number of consecutive days, could cause rail tracks to buckle and roads to

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				melt, which would result in disruption, delays and reduced accessibility. **Current Adaptation (2020s):** Current and planned adaptation described in Table 12 could potentially reduce temperatures on the London Underground system for example, although any reductions could be offset by the planned increases in capacity and other ongoing changes, such as the installation of video-screen advertising which emit heat. Thus current and planned adaptation is potentially unlikely to adequately address the predicted effects of climate change. **Long-term Adaptation (2050+):** In the long-term, as average temperatures and the frequency and intensity of heatwaves are predicted to increase, the potential effects identified above may increase in significance. Potential major negative effects are predicted on accessibility, as the considerably higher temperatures predicted towards the end of the century may have increasingly negative effects on transport infrastructure discouraging public transport use, walking and cycling. However, the exact nature of these effects and the long-term adaptation response is uncertain.
8. Landscape, Historic and Cultural Environment	**-**	**0/-**	**-?**	**Future Climate (2020s):** Increased extremes of wet and dry can heighten the risk of ground subsidence, and accelerated decay of stonework could pose a threat to many historic buildings in London. In addition, changes in hydrology could put buried archaeological remains at risk. The combination of hot weather and drought could have a negative effect on historic landscapes and townscapes through adverse effects on flora and fauna. Minor negative effects are predicted due to the effects of heatwaves and higher temperatures on the settings of historic and cultural sites, such as impacts on the flora and fauna of historic gardens and parks. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 12 is potentially unlikely to adequately address the predicted effects of climate change. **Long-term Adaptation (2050+):** In the long-term the potential negative effects on historic landscapes and townscapes could become more significant, especially due to prolonged heatwaves. However, the exact nature of these effects and the long-term adaptation response is uncertain.
9. Biodiversity	**-**	**-**	**--?**	**Future Climate (2020s):** Over the medium-term, increased average temperatures, the urban heat island effect, and increased frequency and severity of heatwaves, are predicted to have potentially significant minor negative effects on biodiversity in London. For example, reduced oxygen levels in rivers and streams due to higher temperature will negatively affect habitats and species. Amenity grassland may be more difficult to maintain due to increasing temperatures as it is highly susceptible to drying out. Higher winter temperatures may increase the amount of pests and diseases in the capital, The impacts of overheating could be compounded by the predicted increase in frequency and severity of droughts. **Current Adaptation (2020s):** The current and planned adaptation described in Table 12 is not predicted to change the direction or significance of the effects predicted, although green roofs and living walls could improve biodiversity. **Long-term Adaptation (2050+):** In the long-term, the potential negative effects on biodiversity identified above could become more significant, especially due to prolonged heatwaves. However, the exact nature of these effects and the long-term adaptation response is uncertain.
10. Air Quality	**--**	**--**	**--?**	**Future Climate (2020s):** Air quality in London is does not currently meet European emission standards, and the predicted decrease in cloud cover, and increase in average temperatures, are likely to exacerbate existing problems

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				with London's air quality. Major negative effects are predicted as temperature and solar radiation are among many factors leading to poor air quality in London. **Current Adaptation (2020s):** The current and planned adaptation in Table 12 is considered unlikely to change the direction or significance of the potentially negative effects of climate change. **Long-term Adaptation (2050+):** In the long-term, as the impacts of climate change on average temperatures and summer cloud cover become more extreme, the negative effects identified above could be exacerbated. However, the exact nature of these effects and the long-term adaptation response is uncertain.
Climate change				
11. Climate change and energy[5] **11.1 Mitigation**	**-/+**	**-/+**	**--/+?**	**Future Climate (2020s):** Both positive and negative effects are predicted on climate change mitigation over the medium-term. Minor effects are predicted as heating and cooling represent only one aspect of London's overall energy use and source of emissions. Increased summer temperatures and increased frequency of heatwaves are likely to increase energy demand, particularly associated with air conditioning and other mechanical cooling for the domestic, commercial and transport sectors. In addition, there is the possibility of a negative feedback loop in urban areas as air conditioning generates considerable waste heat, adding to the urban heat island effect. Although increased winter temperatures may reduce energy demand associated with heating, this is likely to be insignificant compared to energy demand associated with increased cooling as cooling in more energy intensive. **Current Adaptation (2020s):** The current and planned adaptation identified in Table 12 is generally focussed on ensuring that new developments are adapted to higher temperatures. While this will help reduce the additional emissions from cooling these new buildings make, overall this is not predicted to change the nature and significance of effects of climate change. **Long-term Adaptation (2050+):** In the long-term the effects identified above could become more significant, as summer temperatures and the frequency and intensity of heatwaves are predicted to further increase, but winters are also predicted to become milder. Potentially major negative effects are predicted in relation to energy use and greenhouse gas emissions as cooling may become a relatively more significant energy use in the long-term. However, the exact nature of these effects and the long-term adaptation response is uncertain.
11.2 Adaptation	**-**	**0/+**	**-?**	**Future Climate (2020s):** Minor negative effects are predicted as climate change may reduce London's adaptive capacity to deal with increased temperatures. Increased temperatures, and increased drought, are likely to have negative effects on vegetation in London, reducing the capability of London's green spaces to reduce the temperature in urban areas. Thus over the medium-term the risk climate change reducing the adaptive capacity of London to respond to overheating. **Current Adaptation (2020s):** Minor positive effects are predicted in relation to the current and planned adaptation described in Table 2. Measures designed to increase the amount of urban greening in the capital may improve the adaptive capacity of London to cope with higher temperatures, but these measures may be limited by the projected increase in the frequency and severity of drought periods. In addition, there is some planned adaptation in relation to

[5] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				(for example) ensuring new developments are adapted to higher temperatures, and measures included in the Strategic Emergency Plan for London and the Heatwave plan for England. However overall there is limited current and planned adaptation in relation to overheating in London. **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts, together with likely long-term underlying trends, may significantly reduce the adaptive capacity of London to respond to higher temperatures and increase the exposure and consequences of this reduced adaptive capacity (e.g. due to increased population and development). Minor negative effects are predicted, as the exact nature of the long-term changes are uncertain.
Water management				
12. Water Quality and Water Resources[6] **12.1 Water quality**	**-**	**-**	**-?**	**Future Climate (2020s):** Increases in the frequency and severity of heatwaves, compounded by the urban heat island effect, may increase abstractions (e.g., due to demand for drinking water and water for gardening) as well as increasing evapo-transpiration from water bodies. This may contribute to reduced flows and thus decreased dilution of pollutants, which would have a negative effect on water quality. This will be compounded by the effect of increased frequency and intensity of drought periods. Higher temperatures are also likely to have deleterious effects to water quality, for example by reducing oxygen levels or enhanced algal growth and toxic blooms. **Current Adaptation (2020s):** Current and planned adaptation described in Table 12 is considered unlikely to reduce the negative effects on water quality of climate change. **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts, together with likely long-term underlying trends such as the projected rise in population, may exacerbate negative effects identified. However, overall the effects are considered likely to remain of relatively minor significance. Uncertain effects are predicted as the exact nature of long-term changes and adaptation is uncertain.
12.2 Water resources	**-**	**-**	**-?**	**Future Climate (2020s):** Increased average summer temperatures and heat-waves, are likely to increase water demand and evapo-transpiration. Combined with predictions of increased frequency and severity of drought periods, population increase and increases in per capita demand, this is considered likely to impact negatively on water resources. In addition, increase temperature is likely to have generally negative effects to water quality (e.g. reducing dissolved oxygen content) which may cause water treatment to be more difficult, **Current Adaptation (2020s):** As outlined in objective 12.1 above, the current and planned adaptation described in Table 12 is considered unlikely to reduce the negative effects on water quality of climate change **Long-term Adaptation (2050+):** In the long-term the increased significance of all identified climate change impacts, together with likely long-term underlying trends such as the projected rise in population, may exacerbate negative effects identified. However, overall the effects are considered likely to remain of relatively minor significance. Uncertain effects are predicted as the exact nature of long-term changes and adaptation is uncertain.
Waste management and resource use				
13. Waste management	**0/-**	**0/-**	**-?**	**Future Climate (2020s):** The increased in average temperature as a result of climate change, exacerbated by the urban heat island effect, could potentially affect waste management through; potential changes in the profile and volume of municipal waste; impacts on the waste management process (from collection through to treatment and

[6] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	Future Climate (2020s)	Current Adapt (2020s)	Long-term (2050+)	Comments
				final disposal); and impacts on waste assets (people and infrastructure)., Higher average temperatures (especially in winter) may also facilitate the spread of disease, and high summer temperature may encourage unsustainable waste disposal, for example due to quicker putrification of organic waste. **Current Adaptation (2020s):** The current and planned adaptation described in Table 12 is considered unlikely to reduce the potential negative effects of climate change. **Long-term Adaptation (2050+):** In the long-term the potential negative effects identified above could become more significant, as the effects of climate change become more extreme (higher temperatures and increased frequency and intensity of heatwaves). Uncertain minor negative effects are predicted as the exact nature of long-term changes and adaptation is uncertain.
Economy				
14. Economy	**-?**	**-?**	**-?**	**Future Climate (2020s):** Higher average temperatures and heatwaves could impact negatively on London's economy, for example due to transport disruption caused by buckling of train tracks and melting roads. Equally heatwaves may increase congestion as public transport becomes less attractive to use and more people chose to travel by car. Heatwaves may also increase costs associated with negative health effects, such as absenteeism and reduced productivity. There may be costs to businesses associated with adapting to higher temperatures, such as installing cooling mechanisms, or increased cooling bills. **Current Adaptation (2020s):** The current and planned adaptation described in Table 12 is considered unlikely to significantly reduce potential negative effects or enhance potential positive effects. **Long-term Adaptation (2050+):** In the long-term the impacts of climate change are projected to become increasingly severe (higher temperatures, increased frequency and intensity of heatwaves). These may exacerbate the negative effects identified above, however overall the effects are considered likely to remain minor in significance. The exact nature of these effects and the long-term adaptation response is uncertain.

Overall comments

Overall the projected medium term future climate (2020s) is predicted to have mixed or minor negative effects on the sustainability objectives. A number of these effects are also considered to be uncertain. Both negative and positive potential effects are predicted on health and well-being, education and awareness, equality and diversity, accessibility and availability and climate change mitigation. In general, these effects reflect on the one hand the predicted effects of higher summer temperatures and heatwaves (generally negative), and on the other the milder winters (generally positive). For example, in relation to health, heatwaves can lead to high levels of mortality, especially in the elderly, however warmer winters will reduce the number of deaths associated with the cold.

Minor negative effects are predicted on biodiversity, water quality and resources, climate change adaptation, landscape, historic and cultural environment and the economy. Major negative effects to air quality are predicted. The current and planned adaptation identified in Table 12 is in most cases not predicted to significantly mitigate or enhance the effects identified in relation to the future climate. This is due to the fact that adaptation plans and policies relating to overheating remain relatively limited in number and scope. Those considered to have the most significant influence are those seeking to ensure new development is adapted to higher temperatures, and measures seeking to increase urban greening and reduce the effects of the urban heat island.

In the long-term (2050+), the increasing severity of climate impacts on average temperatures and heatwaves is predicted to exacerbate many negative effects predicted. However, in many cases the effects are predicted to remain minor in significance. All long-term effects are considered uncertain, as while there is increasing consensus in relation to climate change projections, the long-term adaptation responses and the exact nature of the effects of long-term climate change impacts on specific receptors cannot be known with certainty.

APPENDIX 8

APPRAISAL MATRICES FOR THE POLICIES AND ACTIONS INCLUDED IN THE DRAFT STRATEGY (SEPTEMBER 2009)

Appraisal Matrices for the Policies and Actions Included in the Draft Strategy (September 2009 Version)

Below are the appraisal matrices for flooding, drought and overheating undertaken using the versions of the draft Strategy provided by the GLA in September 2009. These matrices cover the predicted effects of climate change on sustainability of the BAU alternative ("without CCAS" – taken from Appendix 7), the draft Strategy on its own ("CCAS") and with the draft Strategy and existing / planned adaptation ("with CCAS"). See Appendix 5 for an explanation of the scoring system. See Appendix 9 for how the final draft Strategy (February 2010) changed this assessment.

1. Appraisal of the Flooding Policies and Actions Included in the Draft Strategy (September 2009 Version)

Policy and Actions included in the draft Strategy (September 2009)

Policy 1: Flooding

The mayor will work with partners to reduce and manage flood risk in London through:

1.1 Improving the standard of flood defence

1.2 Increasing permeability and flood storage capacity

1.3 Encouraging Boroughs at shared flood risk to work collaboratively on flood risk management measures

1.4 Ensuring that Borough development plans consider emergency flood risk management measures.

1.5 Requiring that development built at flood risk is flood resilient and can remain safe and operational during a flood.

1.6 Encouraging critical infrastructure (transport, utilities and health services) owners and managers to assess and manage their climate risks.

1.7 Raising public awareness of flood risk and their capacity to respond to a flood.

Actions:

1. Update the map of areas at flood risk for tidal, fluvial and surface water flooding today and assess how climate change will increase this risk in the future (extent, depth and frequency) in the future.
2. Update the map of the critical infrastructure and vulnerable communities at risk now and in the future (note that some of this information will be subject to security restrictions).
3. Develop a London-wide surface water management plan, identifying areas at risk and develop more detailed plans for priority areas.
4. Create a web-based portal for collating and sharing information on surface water flood risk management.
5. Create a single data capture form for recording flood incidents that is adopted and by Drain London members.
6. Implement flood risk management policies with particular attention to flood risk mitigation and resilience measures.
7. Reduce the probability of surface water flood risk in high-risk areas.

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

Without CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London, taking into account current and planned adaption to the 2020s and 2050+. This corresponds to the scores predicted in the appraisal matrix of predicted sustainability effects of climate change in London – Flooding. See Section 5 and Appendix 7 of the SA Report for a full description of these predicted effects.
CCAS	Predicted impacts of the Draft Strategy (Policy 1: Flooding, and associated Actions (1 – 7) to 2020s and 2050+) in isolation (i.e. predicted effects on sustainability of the draft Strategy as an initial framework for adaptation)
With CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London to the 2020s and 2050+, taking into account current and planned adaption, and the predicted sustainability effects of Policy 1: Flooding, and associated Actions (1 – 7).

Sustainability objective	2020s	2050+	Comments
People and health			
1. Governance	Without CCAS **+**	Without CCAS **+**	Policy elements and actions which seek to facilitate or encourage partnerships and collaborative working may improve the governance of flooding in London, by encouraging organisations to work together to respond to increasing flood risk. In addition a number of the actions encourage partnership working, and the delivery mechanisms propose that the Mayor will work with other organisations. **Sustainability implications 2020s:** Policy elements 1.3 and 1.6, and a number of the actions are predicted to have positive effects on governance in the short to medium-term as they encourage partnerships / collaborative working between organisations with responsibility for managing flood risk in London. However, in the context of current and planned adaptation the additional influence of these actions is predicted to be relatively minor in significance and they are not considered likely to change the overall significance of the effects over and above current and planned adaptation on governance in London. **Sustainability implications 2050+:** Policy 1 is not predicted to have additional significant positive effects on governance over and above the influence of current and planned adaptation. The Roadmap to Resilience (Chapter 9 of draft CCAS) indicates that the majority of actions to deliver Policy 1 are to be delivered by 2010 / 2011, although Action 6 is considered "ongoing". However if implemented fully many of the actions will have long-term positive effects on governance of flooding in London. It is not possible to predict with confidence such long-term effects, and these effects are not predicted to be more significant than those over the short-medium term.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS **+**	With CCAS **+**	
2. Education and Awareness	Without CCAS **+/++**	Without CCAS **++?**	Policy element 1.7 seeks to raise public awareness of flood risk, and Actions 1 – 5 are intended to "improve the understanding of flood risk", although no actions directly address education or awareness. **Sustainability implications 2020s:** Policy 1 seeks to raise public awareness and their capacity to respond, and Actions 1 – 5 seek to improve understanding of flood risk. Action 2, for example may help raise awareness as it encourages sectoral workshops, which by bringing groups / organisations together could facilitate learning and increased awareness around flooding issues. However, Policy 1 and associated actions are not predicted to have a significant additional influence on education and awareness over and above current and planned adaptation. This reflects the significant amount of existing action and initiatives which are predicted to have positive effects on education and awareness.
	CCAS **0/+**	CCAS **0/+**	

Sustainability objective	2020s	2050+	Comments
	With CCAS **+/++**	With CCAS **++?**	**Sustainability implications 2050+:** If implemented fully many of the actions will have potential long-term positive effects on the level of understanding of flood risks in London. However, it is not possible to predict with confidence such long-term effects, and these effects are not predicted to be more significant than those over the short-medium term.
3. Health and Well Being	Without CCAS **-**	Without CCAS **--?**	Flood events can have very significant negative physical and mental health impacts. The Policy's main aim is to reduce and manage flood risks, and if the policy elements were delivered fully this would have positive effects on health by reducing the risk of negative health effects from flooding, and reducing stress associated with worry about flooding risk and / or recovery from flooding events. However, most of the actions to deliver the Policy are preparatory in nature and as a result are not predicted to have significant direct effects on health and wellbeing. Actions 6 and 7 which seek directly to reduce flood risks, by implementing flood risk management policies and reducing the risk of surface water flooding may have positive health effects.
	CCAS **0/+**	CCAS **0/+**	**Sustainability implications 2020s:** As noted, Policy 1 and associated actions are seeking to reduce and manage flood risk in London, and if effective this would have positive effects on physical and mental health. However, as all of the actions except Action 7 are considered to be preparatory in nature the Policy and actions are not predicted to have a significant influence on the effects on health and wellbeing due the impact of climate change on flooding over the period to 2020s, taking into account current and planned adaptation.
	With CCAS **-**	With CCAS **--?**	**Sustainability implications 2050+:** The Roadmap to Resilience (Chapter 9 of draft CCAS) indicates that the majority of actions to deliver Policy 1 are to be delivered by 2010 / 2011, although Action 6 is considered "ongoing". However if implemented fully many of the actions will have long-term positive effects on the management of flood risks in London, as they seek in particular to improve the knowledge base in relation to many aspects of flooding and vulnerability. This may in turn have positive physical and mental health effects. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, and the influence of existing and planned adaptation, the policy and actions are not predicted to change the overall effects.
4. Equality and Diversity	Without CCAS **-**	Without CCAS **-/--?**	The overall aim of Policy 1 and associated actions is to reduce and manage flood risk in London will, if realised, have positive effects on equality, as vulnerable individuals and groups are often more at risk, and less able to respond and recover to flooding events when they occur. Action 2 may have particular positive effects, as it seeks to update the map of critical infrastructure and vulnerable communities at risk now and in the future. If implemented, this action would provide a useful tool to inform the protection of vulnerable groups from flooding, and plan appropriate response measures to flood events. No significant effects are predicted on diversity, although in some areas of London minority ethnic groups may constitute a high proportion of vulnerable families / individuals.

Sustainability objective	2020s	2050+	Comments
	CCAS **0/+**	CCAS **0/+**	**Sustainability implications 2020s:** As noted Policy 1 and associated actions aims to reduce and manage the risk of flooding in London, which could have positive effects on equality in London. The majority of the actions are seeking to improve understanding of flood risk, and will thus have limited direct effect on equality, although Action 7, which seeks directly to reduce the probability of surface water flooding could have positive effects on equality where it reduces the frequency and severity of surface water flooding. Minor positive effects are predicted due to the policy and actions, however these effects are not considered to be significant enough to influence the overall effects on equality of the impacts of climate change on flooding, over the medium-term and taking account of existing and planned adaptation. **Sustainability implications 2050+:** The Roadmap to Resilience (Chapter 9 of draft CCAS) indicates that the majority of actions to deliver Policy 1 are to be delivered by 2010 / 2011, although Action 6 is considered "ongoing". However if implemented fully many of the actions will have long-term positive effects on the management of flood risks in London, as they seek in particular to improve the knowledge base in relation to many aspects of flooding and vulnerability. Action 2 for example, seeks to map critical infrastructure and vulnerable communities (although this would need regular updating to remain relevant). Thus the actions may have positive long-term effects on equality, as vulnerable groups and individuals may be better protected from, and more able to respond to flooding events. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, and the influence of existing and planned adaptation, the policy and actions are not predicted to change the overall effects.
	With CCAS **-**	With CCAS **-/--?**	
5. Safety and Security	Without CCAS **-/0**	Without CCAS **--?**	The overall aim of Policy 1 and associated actions is to reduce and manage flood risk in London, which will, if realised, have positive effects on community safety – one of the SA criteria (see Appendix 4, Part A) is to reduce the risk of flooding now and in the future. Actions 1 and 2 seek respectively to update mapping of areas at flood risk, and critical infrastructure and vulnerable communities at risk. These actions may in particular provide information / knowledge to enhance community safety. No significant effects are predicted on security. **Sustainability implications 2020s:** The policy and associated actions specifically addresses the reduction of flood risk now and in the future, however, as the majority of actions are preparatory in nature, only minor positive effects are predicted. These effects are considered to have a potentially positive influence on the overall effects on community safety, mitigating the predicted minor negative effect from the impacts of climate change on flooding in London, and taking into account current and planned adaptation. **Sustainability implications 2050+:** In the long-term the significance of the impacts of climate change on flooding in London is projected to have potentially very negative safety effects. Full implementation of the policy would bring long-term benefits in relation to reduced flood risks, and even though most of the actions are to be delivered by 2010 / 2011, they in many cases are seeking to provide information and understanding of flood risk which will have long-term benefits and applications. As a result the policy and associated actions are predicted to have minor positive effects on safety in the long-term. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
	CCAS **+**	CCAS **0/+**	
	With CCAS **0/+**	With CCAS **--?**	
Place			

Sustainability objective	2020s	2050+	Comments
6. Liveability and Place	Without CCAS **-/0**	Without CCAS **-/--?**	Potential minor positive, and negative, effects are predicted. Improving flood defences and increasing flood storage capacity (policy elements 1.1 and 1.2), could have both negative and positive effects on liveability and place, for example increasing land take associated with flood storage, or by blocking river views due to increased height of flood defences. However flood storage measures could also lead to the creation of open spaces, providing amenity and local environmental improvements. The actions are predicted to have limited effects on liveability and place, as they are predominantly focussed on promoting partnership working, and building information and understanding, rather than promoting physical changes. **Sustainability implications 2020s:** Policy 1 and associated actions are predicted to have positive and negative effects of minor significance on liveability and place over the medium term. However due to the nature and extent of the current and planned adaption and the significance of likely climate change impacts on liveability and place, no change is predicted in the overall effects. **Sustainability implications 2050+:** If implemented fully the policy and associated actions are likely to have positive and negative long-term effects on liveability and place, as outlined above. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
	CCAS **-/+**	CCAS **-/+**	
	With CCAS **-/0**	With CCAS **-/--?**	
7. Accessibility and Availability	Without CCAS **-**	Without CCAS **--?**	Potentially minor positive effects are predicted. The main aim of Policy 1 is to reduce and manage flood risk, which, if realised is likely to reduce the risk of disruption to the accessibility of key services and amenities including public transport . For example, policy element's 1.5 and 1.6 are specifically focussed on improving flood resilience of development and critical infrastructure, and Action 2 seeks to update the map of critical infrastructure and vulnerable communities at risk, which will provide important information in planning to avoid disruption by protecting transport and other infrastructure from risk. Action 7 to reduce the probability of surface water flooding is also predicted to have a positive effect on accessibility, potentially reducing disruption (such as due to road closures) during extreme weather events. **Sustainability implications 2020s:** Minor positive effects are predicted on accessibility over the medium-term. However due to the nature and extent of the current and planned adaption and the significance of likely climate change impacts on accessibility (disruption, damage to infrastructure etc), no change is predicted in the overall effects. **Sustainability implications 2050+:** If implemented fully the policy and associated actions are likely to have positive long-term effects on accessibility, as outlined above. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-**	With CCAS **--?**	
8. Landscape, Historic and Cultural Environment	Without CCAS **-/0**	Without CCAS **-/--?**	Potentially positive and negative effects of minor significance are predicted to landscape, historic and cultural environment. The construction of new or improved flood defences may negatively impact on the landscape / cityscape of London, as well as the historic environment / buildings and their settings. However reducing flood risks and improving defences could also, in the long-term, protect London and its historic environment from the adverse effects of flooding. **Sustainability implications 2020s:** Policy 1 and associated actions are predicted to have positive and negative effects of minor significance on landscape (cityscape) and the historic and cultural environment in the medium-term. However, even though limited current and planned adaptation exists, due to the significance of likely climate change impacts on liveability
	CCAS **-/+**	CCAS **-/+**	

Sustainability objective	2020s	2050+	Comments
	With CCAS **-/0**	With CCAS **-/--?**	and place, no change is predicted in the overall effects. **Sustainability implications 2050+:** If implemented fully the policy and associated actions are likely to have both positive and negative long-term effects on the landscape, historic and cultural environment of London, as outlined above. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
9. Biodiversity	Without CCAS **-?**	Without CCAS **--?**	Although habitats and biodiversity are not addressed explicitly in the policy or associated actions, potentially uncertain positive and negative effects of minor significance are predicted on biodiversity in London. For example measures to improve the standards of flood defence (policy element 1.1) or increase flood storage capacity (policy element 1.2) could have both positive and negative effects on biodiversity, depending on the measures used. As a result these effects are considered uncertain.
	CCAS **-/+?**	CCAS **-/+?**	Action 7 could have positive effects on biodiversity and habitats where surface water flooding is prevented and therefore pollution reduced. Other actions may have indirect positive effects where improved knowledge and understanding leads to better management of flood risk. **Sustainability implications 2020s:** Policy 1 and associated actions are predicted to have uncertain positive and negative effects of minor significance on biodiversity in the medium-term. However, even though limited current and planned adaptation exists, due to the potential significance of likely climate change impacts on biodiversity, no change is predicted in the overall effects.
	With CCAS **-?**	With CCAS **--?**	**Sustainability implications 2050+:** As above, if implemented fully the policy and associated actions are predicted to have uncertain positive and negative long-term effects on the biodiversity. However, in the context of the scale of predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
10. Air Quality	Without CCAS **0?**	Without CCAS **-?**	No significant effects are predicted on air quality. The main aim of Policy 1 is to reduce and manage flood risk, and the associated actions reflect this aim. Some flood risk reduction actions (such as construction of improved defences) could lead to air pollution (dust, vehicle emissions). Improving the standard of flood defences (policy element 1.1), and reducing surface water flood risk (Action 7), could have potentially positive effects on air quality as they could reduce odour problems associated with flooding (especially sewer flooding). However the actions are focussed predominantly on building knowledge and understanding and promoting partnership working.
	CCAS **0**	CCAS **0**	**Sustainability implications 2020s:** Although some positive and negative effects are possible over the medium-term, they are considered unlikely to be significant. No changes in overall effects are predicted.
	With CCAS **0?**	With CCAS **-?**	**Sustainability implications 2050+:** Although some positive and negative effects are possible over the long-term, they are considered unlikely to be significant. No changes in overall effects are predicted.
Climate change			

Sustainability objective	2020s	2050+	Comments
11. Climate change and energy[7] **11.1 Mitigation**	Without CCAS **-**	Without CCAS **--?**	The construction and operation of flood defences (policy element 1.1) could increase energy use and greenhouse gas emissions, and thus have a negative effect on climate change mitigation. However the majority of policy elements and associated actions are seeking to promote partnership working and improve knowledge and understanding of flood risks. As a result neutral or negative effects of minor significance are predicted on mitigation. **Sustainability implications 2020s:** Minor negative and insignificant effects are predicted on mitigation. However, in the context of current and planned adaptation, no change is predicted in the overall effects. **Sustainability implications 2050+:** Given the scale of the projected impacts of climate change on flooding, in the long-term, reducing flood risk and improving flood defences (policy element 1.1) may require more significant construction activity and energy use, which would increase associated greenhouse gas emissions. The policy and associated actions are therefore predicted to have a minor negative effect in the long-term. However, in the context of current and planned adaptation to the predicted climate change impacts on flooding in the long-term, the policy and actions are not predicted to change the overall effects.
	CCAS **-/0**	CCAS **-**	
	With CCAS **-**	With CCAS **--?**	
11.2 Adaptation	Without CCAS **+/-**	Without CCAS **-?**	The policy and actions have as their central aim the reduction and management of flood risk in London taking into account the increased risks of flooding over time due to climate change. The actions seek to improve understanding and knowledge, and facilitate partnership working to manage flood risks / identify infrastructure and communities at risk and improve planning and monitoring of flooding in London, as well as seeking to ensure new development accounts for flood risk and is flood resilient (Action 6) and to directly reduce the possibility of surface water flooding (Action 7). Positive effects are predicted on climate change adaptation, however, as the actions are predominantly focussed on preparation (rather than prevention, response or recovery), these effects are considered likely to be minor in significance. **Sustainability implications 2020s:** As above, minor positive effects are predicted in the medium-term. Although the influence of the actions associated with Policy 1 in the medium-term will depend significantly on the effective use of outcomes of the information and partnership building actions proposed, they are considered to provide important foundations for an effective adaptation response. As a result in the medium-term Policy 1 and associated actions are predicted to improve the overall ability of London to adapt to the impacts of climate change on flooding. **Sustainability implications 2050+:** Full implementation of the policy would bring long-term benefits in relation to reduced flood risks, and even though most of the actions are to be delivered by 2010 / 2011, they in many cases are seeking to provide information and understanding of flood risk which will have long-term benefits and applications. As a result the policy and associated actions are predicted to have minor positive effects on climate change adaptation in the long-term. If future actions and activities make effective use of (and where necessary provide updates of information, such as mapping), in the long-term Policy 1 and associated actions is predicted to improve the overall ability of London to adapt to climate change, although the overall effect remains potentially negative and of minor significance.
	CCAS **+**	CCAS **+**	
	With CCAS **0/+**	With CCAS **-/0**	

[7] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	2020s	2050+	Comments
Water management			
12. Water Quality and Water Resources[8] **12.1 Water quality**	Without CCAS **-?**	Without CCAS **--?**	The main aim of the policy is reduced flood risk. Policy element 1.1 seeks improved flood defences, and Action 7 seeks to reduce the probability of surface water flooding. As flooding of all types can have a direct negative impact on water quality and some flood risk management solutions can also have water quality benefits for example SUDS, the policy and associated actions are predicted to have minor positive effects on water quality. The effects are considered likely to be of minor significance, as the majority of actions are preparatory in nature rather than seeking to prevent or respond to flood risk. **Sustainability implications 2020s:** As above, the policy and associated actions are predicted to have minor positive effects on water quality in the medium-term. However given the scale of projected climate change impacts on flooding in London, and the influence of other existing and planned adaptation, the policy and actions are not predicted to change the overall effects. **Sustainability implications 2050+:** Full implementation of the policy would bring long-term benefits in relation to reduced flood risks, and even though most of the actions are to be delivered by 2010 / 2011, they in many cases are seeking to provide information and understanding of flood risk which will have long-term benefits and applications. As a result the potential positive effects on water quality are also likely in the long-term. However in the context of existing and planned adaptation, and due to the scale of predicted climate change impacts on flooding in the long-term, no change to the overall effects are predicted.
	CCAS **+**	CCAS **+**	
	With CCAS **-?**	With CCAS **--?**	
12.2 Water resources	Without CCAS **-?**	Without CCAS **--?**	Flooding of all types, and particularly surface water flooding and sewer flooding, can lead to contamination of water resources, and the need for increased treatment. By reducing flood risks, the policy and associated actions could have positive effects on water resources. **Sustainability implications 2020s:** See 12.1 above. **Sustainability implications 2050+:** See 12.1 above
	CCAS **0/+?**	CCAS **0/+?**	
	With CCAS **-?**	Without CCAS **--?**	

[8] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	2020s	2050+	Comments
Waste management and resource use			
13. Waste management	**Without CCAS** **-**	**Without CCAS** **-?**	Insignificant, minor positive and minor negative effects are predicted on waste management. If the policy and actions lead to reduced frequency and severity of flooding this could reduce potential impacts on waste management facilities, such as increased leachate or the flooding of waste management facilities. Action 2 which seeks to update the map of critical infrastructure at risk could help lead to improved protection of waste management sites. At the same time the construction of new or improved flood defences would generate construction waste. However, as the majority of the actions focus on preparation – developing information and understanding and encouraging partnership working, the effects predicted are not expected to be significant. **Sustainability implications 2020s:** Potential positive and negative effects of minor significance are predicted on waste management in the medium-term. However these effects are not predicted to be significant, and in the context of current and planned adaptation, no change in the overall effects is predicted. **Sustainability implications 2050+:** In the long-term the effects are predicted to be similar to the medium-term. However, some actions may have potential long-term positive and negative effects. For example improving mapping of areas and infrastructure at risk may lead to long-term improvements in the protection, or location of waste management facilities. However ensuring reduced flood risk in the long-term is likely to require the construction of new and improved defences, which is likely to produce construction waste. These effects are predicted to be minor in significance, and are not predicted to change the overall effects.
	CCAS **0/-/+**	CCAS **0/-/+**	
	With CCAS **-**	**With CCAS** **-?**	
Economy			
14. Economy	Without CCAS **-**	Without CCAS **--?**	Flooding from all sources is likely to pose a significant risk to London's economy, a threat which is likely to increase with climate change. As the policy's central aim is to reduce and manage flood risks positive effects are predicted on the economy, particularly its resilience to future climate change. However, as the majority of the specific actions focus on building understanding and promoting partnership working these effects are predicted to be of minor significance. **Sustainability implications 2020s:** Although positive effects are predicted, these are of minor significance. In the context of the potentially significant negative effects on the economy of flooding due to climate change, the policy and associated actions are not predicted to change the effects overall. **Sustainability implications 2050+:** In the long-term, the implementation of many of the actions will provide important information and understanding for the effect management of flood risks in London, and therefore potential positive effects of minor significance are possible on the economy. However, in the long-term the potential negative effects of flooding on the economy are also more significant, and the policy and associated actions are not predicted to have a significant influence on the overall effects predicted.
	CCAS **0/+**	CCAS **+**	
	With CCAS **-**	With CCAS **--?**	
Overall comments Policy 1 and associated actions (1 – 7) are predicted to have generally positive effects of minor significance in addressing the sustainability implications of climate change on flooding, both in the medium-term (2020s) and long-term (2050+). No effects of major significance are predicted. A few potential negative effects, of minor significance are predicted, on landscape, historic and cultural environment, biodiversity, climate change mitigation and waste and resources. These potential negative effects are associated			

Sustainability objective	2020s	2050+	Comments
with the construction of improved flood defences and the potential for other flood risk management measures to have negative effects on, for example, resource use, waste generation and the cityscape (e.g. impact on views of the Thames). The effects are in most cases likely to be very similar in the medium and long-term. This reflects the fact that although the specific actions are intended to be delivered generally by 2010 / 2011, they are predominantly preparatory in nature which means: 1) they are not considered likely to have significant direct impacts in the short to medium-term; and, 2) they are seeking to develop knowledge and understanding and promote partnership working, which are all likely to facilitate improved flood risk management in the long-term. These long-term effects are dependent on appropriate future actions and initiatives. However, although Policy 1 and associated actions are considered positive from a sustainability perspective, the influence they are predicted to have is not felt sufficient to alter the majority of predicted effects of the impact of climate change on flooding in London, both in the medium and long-term. However as the central aim of Policy 1 is to reduce and manage flood risk, it is predicted to have a positive influence on the overall effects predicted on climate change adaptation and safety and security sustainability objectives. These effects are predicted based on the assumption that future actions and activities will make appropriate use of the information, knowledge and partnership building actions associated with Policy 1 in the draft CCAS. This will necessitate future revisions to the draft CCAS.			

2. Appraisal of the Drought Policies and Actions Included in the Draft Strategy (September 2009 Version)

Policy and Actions included in the draft Strategy (September 2009)

Policy 2: Drought

The Mayor will work with partners to manage and reduce the risk of drought through:

2.1 Encouraging the water companies to repair and replace London's water mains

2.2 Rolling out a domestic water and energy efficiency improvement programme for existing homes

2.3 Ensuring that Borough development plans promote water efficiency in new development

2.4 Communicating water efficiency measures and benefits to Londoners

2.5 Supporting the development of a water resources emergency plan

2.6 Exploring the concept of 'water neutrality' and how it can be implemented.

Actions:

8. Improve the energy and water efficiency of 1.8million homes across London by 2015, (saving on average £62 on household utility bills and equates to 46,000 litres of water and 0.48 tonnes of CO2 per home per year)
9. Publish a strategic water resources emergency plan for London that sets out how responsible agencies will manage water shortages for up to 200,000 people.
10. Publish a water strategy for London that presents a London-specific view of managing water resources, with the goal of improved water management – both the water we want (such as drinking water) and the water we don't (such as sewage and floodwater in the wrong place).

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: - - Uncertain:? Mixed: -/+

Without CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London, taking into account current and planned adaption to the 2020s and 2050+. This corresponds to the scores predicted in the appraisal matrix of predicted sustainability effects of climate change in London – Drought. See Section 5 and Appendix 7 of the SA Report for a full description of these predicted effects.
CCAS	Predicted impacts of the Draft Strategy (Policy 1: Flooding, and associated Actions (1 – 7) to 2020s and 2050+) in isolation (i.e. predicted effects on sustainability of the draft Strategy as an initial framework for adaptation).
With CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London to the 2020s and 2050+, taking into account current and planned adaption, and the predicted sustainability effects of Policy 2: Drought, and associated Actions (8 – 10).

Sustainability objective	2020s	2050+	Comments
People and health			
1. Governance	Without CCAS **+**	Without CCAS **+?**	Policy 2 states that the Mayor will "work with partners" and Actions 8, 9 and 10 seek explicitly to encourage partnership working and the involvement of "key stakeholders". Minor positive effects are therefore predicted on governance. **Sustainability implications 2020s:** Although the actions to deliver Policy 2 seek partnership working, and minor positive effects are predicted, the additional influence of these actions is predicted to be relatively minor in significance and they are not considered likely to change the overall significance of the effects of current and planned adaptation on governance in London. **Sustainability implications 2050+:** Policy 2 is not predicted to have additional significant positive effects on governance over and above the influence of current and planned adaptation. The Roadmap to Resilience (Chapter 9 of draft CCAS) indicates that Action 8 is to be fully implemented by 2015. Actions 9 and 10 seek the development of an emergency plan and the water strategy respectively. The Water Strategy has recently been consulted upon. The water resources emergency plan and water strategy when implemented are likely to influence the long-term governance of water in London, however it is not possible to predict with confidence long-term effects, and these effects are not predicted to be more significant than those over the short-medium term.
	CCAS **+/0**	CCAS **0?**	
	With CCAS **+**	With CCAS **+?**	
2. Education and Awareness	Without CCAS **+/++**	Without CCAS **++?**	Policy elements 2.2, 2.3 and 2.4 which all seek to raise awareness of / communicate benefits of water efficiency may have positive effects on awareness of drought and appropriate responses. The home efficiency programme outlined in Action 8 seeks to directly improve energy and water efficiency in 1.8million homes. Such intervention may raise awareness of water efficiency in those households affected. Minor positive effects are predicted on education and awareness. **Sustainability implications 2020s:** Action 8, if implemented fully, is predicted to have positive effects on awareness. This action is intended to be implemented in full by 2015, and thus over the medium-term this effect is considered to be of sufficient significance to positively influence the overall effects predicted. **Sustainability implications 2050+:** If implemented fully Action 8 may have a long-term influence on awareness. Equally, in the long-term the influence of the water resources emergency plan and water strategy proposed by actions 9 and 10 might have positive effects on education and awareness. Minor positive, but uncertain effects are predicted in the long-term. However, in the context of the significant changes in awareness predicted in the long-term (without the draft CCAS), and the influence of existing and planned adaptation, the policy and actions are not predicted to change the overall effects.
	CCAS **+**	CCAS **+?**	
	With CCAS **++**	With CCAS **++?**	
3. Health and Well Being	Without CCAS **-**	Without CCAS **-?**	Insignificant and minor positive effects are predicted on health and wellbeing. If Action 8 is implemented fully it may help reduce pressure on water resources which could help mitigate some of the negative health effects associated with drought. These effects may not be significant, however, in the context of overall water use in London, and the scale of new development and population growth predicted in London. The development of a water resources emergency plan, may also have minor positive effects once adopted, if it improves the management of drought events and reduces the risk of emergency measures, such as water rationing. **Sustainability implications 2020s:** Although positive effects of minor significance are predicted over the medium-term, these are not considered likely to influence the overall effects on health and wellbeing of the impact of climate change on
	CCAS **0/+**	CCAS **0/+?**	

Sustainability objective	2020s	2050+	Comments
	With CCAS **-**	With CCAS **-?**	drought in London. **Sustainability implications 2050+:** In the long-term Policy 2 and associated actions could have positive effects, depending on the influence of the water resources emergency plan and water strategy proposed by Actions 9 and 10. These effects are, however, considered to be uncertain, and are not considered likely to influence the overall long-term effects predicted.
4. Equality and Diversity	Without CCAS **-**	Without CCAS **-/--?**	Investment in water efficiency measures is likely to have positive effects on equality, especially where low-income / vulnerable households are provided with direct support to implement efficiency in the home. However, some water demand / supply management measures (such as replacing mains, or installing water meters) may have negative effects on equality where water bills rise, or in large households where metering can increase water costs. Positive and negative effects of minor significance are predicted, however these effects are uncertain as they will depend to a large extent on specific measures adopted. No significant effects are predicted on diversity, although in some areas of London minority ethnic groups may constitute a high proportion of vulnerable families / individuals. **Sustainability implications 2020s:** The effects predicted are not considered likely to influence the overall effects on equality of the impact of climate change on drought in London. **Sustainability implications 2050+:** In the long-term the effects on equality are considered uncertain, as they will depend on future revisions to the CCAS and on the potential long-term influence of the water resources emergency plan and water strategy proposed by Actions 9 and 10. Water efficiency measures are generally likely to have positive effects on equality, however some measures to manage water demand may increase costs and thus result in negative effects on vulnerable and low-income households. No changes to the overall effects on equality of the impact of climate change on drought in London are predicted.
	CCAS **-/+?**	CCAS **-/+?**	
	With CCAS **-**	With CCAS **-/--?**	
5. Safety and Security	Without CCAS **-/0**	Without CCAS **-?**	The main aim of Policy 2 and associated actions is to manage and reduce the risk of drought in London. Action 8 is explicitly seeking to improve water (and energy) efficiency of 1.8 million homes by 2015. Actions 9 and 10 seek to plan strategically for the improved management of water resources. As a result minor positive effects are predicted as improved management of water resources will help increase London's resilience to change and decrease community and household / individual vulnerability. These effects will depend on the successful implementation of the water resources emergency plan and water strategy proposed by Actions 9 and 10. **Sustainability implications 2020s:** The effects predicted are not considered likely to influence the overall effects on safety of the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 are likely to influence long-term management of drought risk, although this will depend on how they are implemented in practice. Minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **+**	CCAS **+?**	
	With CCAS **-/0**	With CCAS **-?**	

Sustainability objective	2020s	2050+	Comments
Place			
6. Liveability and Place	Without CCAS **-/0**	Without CCAS **-?**	Reducing the risk of drought in London could have positive effects on liveability and place, as it would help to protect waterways and public spaces (especially parks and green spaces) from the negative effects of drought on amenity, and help to reduce the risk and impacts of subsidence and heave. All policy elements seek to encourage efficiency or reduce leakage. However, only Action 8 is likely to have a direct influence on water efficiency and reduce demand. The effects of Actions 9 and 10 will depend on the implementation of the strategic planning they propose. Neutral or minor positive effects are therefore predicted. **Sustainability implications 2020s:** The effects predicted are not considered likely to influence the overall effects on liveability and place of the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 are likely to influence long-term management of drought risk, however this will depend on how they are implemented in practice. Insignificant or minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS **-/0**	With CCAS **-?**	
7. Accessibility and Availability	Without CCAS **-**	Without CCAS **-?**	Drought conditions could impact negatively on green and open spaces, as well potentially increasing the risk of pollution / disease in water bodies, thus reducing opportunities for water based recreation. Managing and reducing the risk of drought in London, which is the central aim of Policy 2 would help reduce these potential negative effects. However, only Action 8 is likely to have a direct influence on water efficiency and reduce demand. The effects of Actions 9 and 10 will depend on the implementation of the strategic planning they propose. Insignificant or minor positive effects are therefore predicted. **Sustainability implications 2020s:** The effects predicted are not considered likely to influence the overall effects on accessibility and availability of the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Insignificant or minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS **-**	With CCAS **-?**	
8. Landscape, Historic and Cultural Environment	**Without CCAS -/0**	**Without CCAS -/--?**	Although no policy elements or actions are specifically seeking to protect landscapes, the historic or cultural environment, if Policy 2 achieves its aim of reduced risk of drought in London this could mitigate some of the potential negative effects on historic buildings and their settings, archaeological sites and London's historic parks and open spaces. **Sustainability implications 2020s:** See Objective 6 and 7. **Sustainability implications 2050+:** See Objective 6 and 7.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS -/0	**With CCAS -/--?**	

Sustainability objective	2020s	2050+	Comments
9. Biodiversity	Without CCAS **-/+**	Without CCAS **-/--?**	Reduced rainfall and increased abstraction associated with drought periods could have negative effects on biodiversity by changing habitat conditions. In addition, low flow levels could also reduce the dilution of any pollution or discharges entering a watercourse, therefore exacerbating the potential detrimental effects on flora and fauna. Although no policy elements or associated actions are directly seeking to protect or enhance biodiversity and habitats, if Policy 2 achieves its aim of reduced risk of drought in London this could mitigate some of the potential negative effects predicted on biodiversity. **Sustainability implications 2020s:** In the context of current and planned adaptation the effects predicted are not considered likely to influence the overall effects on biodiversity of the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Insignificant or minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS **-/+**	With CCAS **-/--?**	
10. Air Quality	Without CCAS **0/-**	Without CCAS **-?**	The repair and replacement of London's water mains (element 2.1) could cause localised dust and air pollution associated with roadworks / construction, although no specific action is proposed to deliver this element (however increased metering is a key objective of the Mayor's draft Water Strategy). Reduced flows associated with drought periods can lead to an increased concentration of pollutants, leading in turn to localised odour problems. If Policy 2 achieves its aim of reduced risk of drought in London, this could help mitigate these problems. However, only Action 8 is seeking to directly reduce water use, through efficiency measures. The effects of Actions 9 and 10 will depend on the implementation of the strategic planning they propose. As a result neutral or minor positive effects are predicted. **Sustainability implications 2020s:** The effects predicted are not considered likely to influence the overall effects on air quality of the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Neutral or minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **0/+**	CCAS **0/+?**	
	With CCAS **0/-**	With CCAS **-?**	
Climate change			
11. Climate change and energy[9] **11.1 Mitigation**	Without CCAS **-**	Without CCAS **-/--?**	Reducing leakage (policy element 2.1) and reducing demand through efficiency measures (key aim of policy and of Action 8) could have positive effects on climate change mitigation, as water treatment and pumping uses a considerable amount of energy, with associated greenhouse gas emissions. These potential positive effects may be relatively minor in comparison to London's overall greenhouse gas emissions, and new water demand likely to arise from the projected growth in London's population over the coming decades. Effects on climate change mitigation from Actions 9 and 10 will depend on

[9] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	2020s	2050+	Comments
11.2 Adaptation	CCAS **0/+**	CCAS **0/+?**	implementation of the strategic planning they propose. **Sustainability implications 2020s:** The effects predicted of the draft strategy are not considered likely to influence the impact of climate change on drought in London. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Insignificant or minor positive but uncertain effects are predicted, however these effects are not considered likely to influence the overall long-term effects predicted.
	With CCAS **-**	With CCAS **-/--?**	
	Without CCAS **-**	Without CCAS **--/+?**	Policy 2 and associated actions have the central aim of reducing the risk of drought in London. The Policy if implemented fully would have significant positive effects on adaptation, by reducing London's vulnerability to the impacts of drought on water resources. However the specific actions identified to deliver Policy 2 are predicted to have minor positive effects on climate change adaptation, as Action 8 is only addressing one aspect of resilience to drought (household water efficiency), and the effects of Actions 9 and 10 will depend on the implementation of the strategic plans they propose. The strategic water resources emergency plan (Action 9) could have positive effects on emergency planning in relation to droughts, and increasing the resilience of London, however these effects will depend on the exact nature of this plan, and its effective implementation. Minor positive effects on climate change adaptation are therefore predicted. **Sustainability implications 2020s:** The central aim of Policy 2 is to reduce and manage the risk of drought in London. In the medium-term only Action 8 is considered likely to have a direct impact on London's resilience to drought. As this action is seeking to directly promote water efficiency, it is predicted to have a minor positive influence on the sustainability implications of climate change on drought in London. This effect is predicted in the context of current and planned adaptation. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Minor positive effects are predicted, and these are considered to potentially have a minor positive influence on the overall effects predicted, although the overall effects remain uncertain in the long-term.
	CCAS **+**	CCAS **+**	
	With CCAS **0/-**	With CCAS **-/+?**	
Water management			
12. Water Quality and Water Resources[10] **12.1 Water quality**	Without CCAS **-/+**	Without CCAS **-?**	Prolonged drought periods, or consecutive drought years are likely to have negative effects on water quality. Less rainfall, and increased demand, is likely to lead to higher abstraction levels, low river flows and reduced water quality. The central aim of Policy 2 is to reduce and manage the risk of drought, which if successful would have positive effects on water quality. The policy elements promote water efficiency and leakage reduction, which would help to achieve the aim of reduced drought risk. Of the specific actions, only Action 8 is considered likely to have a direct impact on water demand

[10] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	2020s	2050+	Comments
12.2 Water resources	CCAS **0/+**	CCAS **0/+**	(through efficiency measures). The Water Strategy proposed by Action 10 is currently in draft, and when adopted could have significant positive effects on water quality. Policy 2 and associated actions are predicted to have minor positive or neutral effects on water quality. **Sustainability implications 2020s:** In the context of the scale of climate impacts predicted, and current and planned adaptation, the effects of Policy 2 and associated actions are not considered likely to influence the overall effects on water quality. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Insignificant or minor positive but uncertain effects are predicted, however, in the context of the likely scale of climate change impacts on water quality, and current and planned adaptation, these effects are not considered likely to influence the overall long-term effects predicted.
	With CCAS **-/+**	With CCAS **-?**	
	Without CCAS **-**	Without CCAS **--?**	Efficiency measures and reduced leakage could help reduce pressure on London's water resources, and help protect water resources from the effects of drought (for example reduced abstractions enabling increased winter recharge). However the direct effects of Policy 2 and associated actions are predicted to be minor, as only Action 8 proposes specific action to promote efficiency. Insignificant or minor positive effects are therefore predicted. The water strategy proposed by Action 10 is currently under public consultation, and when adopted could have significant positive effects on water resources. **Sustainability implications 2020s:** In the context of the scale of climate impacts predicted, and current and planned adaptation, the effects of Policy 2 and associated actions are not considered likely to influence the overall effects on water resources. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, however this will depend on the implementation of the strategic planning these actions propose. Neutral or minor positive but uncertain effects are predicted, however, in the context of the likely scale of climate change impacts on water resources, and current and planned adaptation, these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-**	Without CCAS **--?**	
Waste management and resource use			
13. Waste management	Without CCAS **0/-**	Without CCAS **-?**	Policy 2 and associated actions are predicted to have no significant effects on waste management in London. Policy element 2.1 which seeks the repair and replacement of London's water mains could have negative effects on materials use and construction waste, however no specific actions seek to deliver this action (leakage reduction is key objective of the Mayor's draft Water Strategy but it is not yet adopted, and as a result no significant effect is predicted. Drought conditions may increase localised dust problems associated with waste management facilities, however Policy 2 and associated actions are not expected to have any significant effect in relation to this. **Sustainability implications 2020s:** As no significant effects are predicted, the overall effects are likely to remain unchanged.
	CCAS **0**	CCAS **0**	
	With CCAS	With CCAS	

Sustainability objective	2020s	2050+	Comments
	0/-	**-?**	**Sustainability implications 2050+:** As no significant effects are predicted, the overall effects are likely to remain unchanged.
Economy			
14. Economy	Without CCAS **-**	Without CCAS **-?**	The effects of Policy 2 and associated actions on the economy of London are predicted to be minor positive and minor negative but uncertain. Minor effects are predicted as only Action 8 proposes direct action to promote efficiency, and Actions 9 and 10 will depend on the implementation of the strategic planning they propose. Reducing the risk of drought would have potentially positive economic effects, as it could reduce the negative impacts (and economic uncertainty) of non-essential use drought orders, which can impact upon the public and private companies which provide water based cleaning and leisure services. Reducing drought risk would also help mitigate other negative economic consequences of droughts, such as damage to buildings and infrastructure, and the attractiveness of London as a place to live and work. Replacing and repairing London's water mains could have negative short and medium-term economic costs, due to disruption caused by roadworks, and the potential for costs of these improvements being passed on to customers (although Ofwat's pricing powers should help reduce this potential effect). However such improvements could bring long-term economic benefits by reducing water loss, improving supply efficiency and reducing the need for abstractions, treatment and pumping. **Sustainability implications 2020s:** In the context current and planned adaptation, the effects of Policy 2 and associated actions are not considered likely to influence the overall effects on London's economy of the impacts of climate change on drought. **Sustainability implications 2050+:** Strategic planning as proposed in Actions 9 and 10 is likely to influence long-term management of drought risk, which could have significant positive economic effects. However this will depend on the implementation of the strategic planning these actions propose. Minor positive but uncertain effects are predicted, however, in the context of current and planned adaptation, these effects are not considered likely to influence the overall long-term effects predicted.
	CCAS **-/+?**	CCAS **+?**	
	With CCAS **-**	With CCAS **-?**	

Overall comments

Policy 2 and associated actions (8 – 10) are predicted to have generally non-significant and positive effects of minor significance in addressing the sustainability implications of climate change on drought, both in the medium term (2020s) and long term (2050+). No effects of major significance are predicted. A few potential negative effects, which are all uncertain and of minor significance are predicted, on equality, due to the potential for costs associated with repairing leakage / improving efficiency to impact on low income households, and on the economy due to the short and medium term costs associated with leakage reduction, and the potential disruption (e.g. congestion) caused by roadworks associated with replacing London's water mains.

The effects are in most cases predicted to be very similar in the medium and long-term. However there is a high level of uncertainty in predicting the long-term effects of Policy 2 and, in particular Actions 9 and 10, as these actions propose respectively the development of strategic plans: a water resources emergency plan; and, a water strategy for London. The Mayor's draft Water Strategy has recently been the subject of under public consultation. The long-term effects will therefore depend to a large extent on the implementation of these other plans, and attributing effects directly to Actions 9 and 10 as included in the draft CCAS is not possible or appropriate. The implementation of the Mayor's Water Strategy which seeks improved management of water in London, could lead to significant positive effects on some the sustainability objectives.

Although Policy 2 and associated actions are considered generally positive from a sustainability perspective, the influence they are predicted to have is not felt sufficient to alter the majority of predicted effects of the impact of climate change on drought in London, both in the medium and the long-term.

Sustainability objective	2020s	2050+	Comments
As the central aim of Policy 2 is to reduce and manage the risk of drought, and as Action 8 specifically targets water efficiency improvements in 1.8 million homes (by 2015), a positive influence on the overall effects predicted on education and awareness (in the medium-term) and climate change adaptation (in the medium and long-term) are predicted. The positive long-term effects predicted on climate change adaptation assumes that the strategic planning proposed in Actions 9 and 10 has a positive influence on drought risk reduction.			

3. Appraisal of the Overheating Policies and Actions Included in the Draft Strategy (September 2009 Version)

Policies and Actions included in the draft Strategy (September 2009)

Policy 3

The Mayor will seek to reduce and manage the impact of hot weather on Londoners through working with partners to:

3.1 Manage London's urban heat island through increasing the amount of greenspace and vegetation in the city

3.2 Creating an 'urban heat island action area' in the centre of London to incentivise urban greening and reduce waste heat emissions

3.3 Ensure new development and infrastructure is designed to minimise the risk of overheating and need for cooling as far as possible

3.4 Ensure that where cooling is still required, low carbon, energy efficient methods are used

3.5 Identify publicly accessible cool buildings that can be used for temporary refuge during heatwaves

3.6 Ensure robust implementation of the heatwave plan.

Policy 4

The Mayor believes that development should be designed and constructed to avoid the need for mechanical cooling. Developers should use the following 'cooling hierarchy' as guidance to reduce the need for cooling.

Actions:

11. Enhance 1,000ha of greenspace by 2012 to offset the urban heat island effect, manage flood risk, and provide biodiversity corridors through the city.
12. Increase greenspace cover in central London by 5% by 2030 and a further 5% by 2050.
13. Increase tree cover in the city by 5% (from 20%) by 2025.
14. Enable the delivery of 100,000m2 of green roofs by 2012.
15. Publish design guidance for developers that takes account of the urban heat island effect and rising temperatures due to climate change.
16. Retrofit a social housing development to reduce the risk of overheating using passive measures.
17. Every Borough in London has identifies a "heatwave refuge" (publically accessible building) that can be used to provide temporary shelter during heatwaves.
18. Encourage the market for 'Cool Roof' technology.
19. Publish a feasibility study into creating and maintaining a network of weather stations across London to improve our understanding of London's microclimate.

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

Without CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London, taking into account current and planned adaption to the 2020s and 2050+. This corresponds to the scores predicted in the appraisal matrix of predicted sustainability effects of climate change in London – Overheating. See Section 5 and Appendix 7 of the SA Report for a full description of these predicted effects.
CCAS	Predicted impacts of the Draft Strategy (Policy 1: Flooding, and associated Actions (1 – 7) to 2020s and 2050+) in isolation (i.e. predicted effects on sustainability of the draft Strategy as an initial framework for adaptation).
With CCAS	Predicted sustainability effects of the impacts of climate change on flooding in London to the 2020s and 2050+, taking into account current and planned adaption, and the predicted sustainability effects of Policies 3 and 4: Overheating, and associated Actions (11 – 19).

Sustainability objective	2020s	2050+	Comments
People and health			
1. Governance	Without CCAS **+?**	Without CCAS **+?**	Responding to the potentially significant effects on overheating and the impact of increased summer temperatures is likely to require a coordinated cross-sectoral response in London. Policy 3 states that the Mayor will work with partners to reduce and manage the impact of hot weather, and Actions 15 – 19 all propose joint or partnership working within their delivery mechanisms. Partnership and cross-sectoral working is predicted to have minor positive effects on governance. **Sustainability implications 2020s:** Current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 10). Thus the minor positive effects predicted on governance from Policy 3 and, in particular actions 15 – 19, are considered likely to have a positive influence on the effects of climate change on governance in London, over and above current and planned adaptation, in the medium term. **Sustainability implications 2050+:** The Roadmap to Resilience (Chapter 9 of the draft CCAS) indicates that all of the actions are intended to be delivered by 2011/12, with the exception of 11(C) which is ongoing. However effective partnerships and joint programmes may have a longer-term lifespan, especially where revisions to the CCAS support them. Long-term uncertain positive effects of minor significance are therefore predicted, however these are not considered likely to influence the overall effects.
	CCAS **+**	CCAS **+?**	
	With CCAS **+**	With CCAS **+?**	
2. Education and Awareness	Without CCAS **-/+**	Without CCAS **-**	Neutral or minor positive effects on education and awareness are predicted. If Policy 3 and 4, and associated actions achieve a reduction in the urban heat island effect, and ensure that schools and other education buildings are adapted to higher average temperatures, positive effects on education are possible. Actions which seek to promote partnership building or change practices (such as design guidance proposed by Action 15) may also have positive effects on awareness among stakeholders, developers and others involved in design and construction. **Sustainability implications 2020s:** Current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 9). As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on education and awareness in London, over and above current and planned adaptation, in the medium term. **Sustainability implications 2050+:** Although all of the actions (aside 11(C)) are to be delivered by 2011/12, the outcomes of these actions are intended to have long-term positive implications for overheating, by (for example) ensuring new building are designed accounting for higher temperatures, and increasing the amount of greenspace. Thus, in the long-term positive effects of minor significance are predicted, and these effects are considered likely to have a positive influence on the effects of climate change on education and awareness in London, over and above current and planned adaptation.
	CCAS **0/+**	CCAS **+**	
	With CCAS **0/+**	With CCAS **-/+**	
3. Health and Well Being	Without CCAS **--/+**	Without CCAS **--/+?**	Positive effects of minor significance are predicted on health and wellbeing. Measures to reduce the urban heat island effect may help reduce the negative health impacts of heatwaves in London (although they will not reduce the likelihood of heatwaves occurring). Evidence referred to in Chapter 4 of the draft CCAS indicates that increasing greenspaces by 10% (which is the aim of Action 13) could help maintain surface temperatures at or below the baseline 1960 – 1990 level for "most of the century". In addition providing greenspaces, trees and green roofs (Actions 11- 14) may have positive health and wellbeing effects,

Sustainability objective	2020s	2050+	Comments
	CCAS **+**	CCAS **+**	through improved amenity, positive effects on air quality, and potentially opportunities for exercise. Identifying cool spaces / buildings: "heatwave refuges", (Action 17) may also reduce the risk of negative health impacts during heatwaves. Policies 3 and 4 and Action 15 seek also to ensure that new development is designed to minimise the risk of overheating. As new development represents a small proportion of London's building stock limited health effects are predicted. **Sustainability implications 2020s:** Current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 9). As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on health and wellbeing in London, over and above current and planned adaptation, in the medium term. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4, although intended to be delivered by 2011/12 will have long-term implications. The establishment of green roofs, enhancing greenspaces, planting trees and developing design guidance, may all have long-term positive effects. As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on health and wellbeing in London, over and above current and planned adaptation, in the long-term. Some negative, but uncertain effects are still considered likely.
	With CCAS **-/+**	With CCAS **--/+?**	
4. Equality and Diversity	Without CCAS **-/+**	Without CCAS **--/+?**	Insignificant or minor positive effects on equality are predicted. No significant effects are predicted on diversity. Policy elements and actions which seek to increase greenspace, and provide refuge from heatwaves may have minor positive effects on equality, as they will help reduce the impacts of heatwaves and provide spaces for vulnerable people to go to remain cool during such events. The focus of the actions is predominantly on central London, and on ensuring new development is adapted to higher temperatures, thus the effects on deprived communities, especially living outside of central London may be limited. **Sustainability implications 2020s:** Although current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 9), the significance of the predicted effects of Policies 3 and 4 and associated actions are not considered likely to influence the overall impacts of climate change on equality in London in the medium-term. **Sustainability implications 2050+:** See Objective 3. Long-term positive effects of minor significance on equality are predicted, these effects are not considered likely to influence the overall impacts of climate change on equality in London in the long-term.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-/+**	With CCAS **--/+?**	
5. Safety and Security	Without CCAS **-?**	Without CCAS **-?**	The measures proposed by Policies 3 and 4 and associated actions are do not address directly the potential (but uncertain) negative effects of overheating on safety and security (see appraisal of climate change impacts on overheating in Appendix 9). As a result no significant effects are predicted in either the medium or long-term. **Sustainability implications 2020s:** As no significant effects are predicted, the overall effects are likely to remain unchanged. **Sustainability implications 2050+:** As no significant effects are predicted, the overall effects are likely to remain
	CCAS **0**	CCAS **0**	

Sustainability objective	2020s	2050+	Comments
	With CCAS **-?**	With CCAS **-?**	unchanged.
Place			
6. Liveability and Place	Without CCAS **-/+**	Without CCAS **-?**	Minor positive effects are predicted on liveability and place. Measures to reduce the impact of hot weather are intended to make London a more liveable city during heatwaves and hotter average temperatures. Policy 3 (elements 3.1 and 3.2) and Actions 11 -14 seek increased greenspace in London which could have positive effects on liveability and place, by improving amenity of existing public spaces and, potentially creating new greenspaces (e.g. the implementation of the Green Grid Programme). A greener London may also be a more attractive place to live and work, and these actions could enhance peoples' sense of place, and positivity about living in London. **Sustainability implications 2020s:** Current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 9). As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on liveability and place in London, over and above current and planned adaptation, in the medium term. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4, although intended to be delivered by 2011/12 will have long-term implications. The establishment of green roofs, enhancing greenspaces, planting trees and developing design guidance, may all have long-term positive effects on liveability and place. As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on liveability and place in London, over and above current and planned adaptation, in the long-term. Some negative, but uncertain effects are still considered likely.
	CCAS **+**	CCAS **+**	
	With CCAS **0/+**	With CCAS **-/+?**	
7. Accessibility and Availability	Without CCAS **-/+**	Without CCAS **--/+?**	Insignificant or minor positive effects are predicted on accessibility. Policy element 3.3 seeks to ensure new infrastructure is designed to minimise the risk of overheating, however as new transport infrastructure is likely to represent a small proportion of London's total transport network, this is predicted to have limited effects. Policy 3 and Actions 11 – 14 are seeking to increase the amount of greenspace in London. If this is achieved and the potential negative impacts of higher temperatures on transport infrastructure reduced, there could be positive effects on accessibility. **Sustainability implications 2020s:** Although current and planned adaptation to overheating is relatively limited, there are specific existing measures seeking to improve the resilience of London's transport infrastructure to higher temperatures (see appraisal of climate change impacts on overheating in Appendix 9). As a result, the significance of the predicted effects of Policies 3 and 4 and associated actions are not considered likely to influence the overall impacts of climate change on accessibility in London in the medium-term. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4, although intended to be delivered by 2011/12 will have long-term implications. Long-term neutral or positive effects of minor significance on equality are predicted, however these effects are not considered likely to influence the overall impacts of climate change on equality in London in the long-term.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-/+**	With CCAS **--/+?**	

Sustainability objective	2020s	2050+	Comments
8. Landscape, Historic and Cultural Environment	**Without CCAS -/0**	**Without CCAS -?**	Insignificant or minor positive effects are predicted on landscape and the historic and cultural environment. Actions 11 – 14 which seek to increase the amount of greenspace in the capital could improve visual amenity of the public realm / landscapes in the city, and if successful in reducing the impact of higher temperatures greening could also protect historic buildings and their settings, as well as reducing the negative impacts of higher temperatures (especially combined with droughts) on archaeological remains. **Sustainability implications 2020s:** Current and planned adaptation to overheating is relatively limited (see appraisal of climate change impacts on overheating in Appendix 9), and although the significance of the predicted effects of Policies 3 and 4 and associated actions are considered to be minor, greening actions could in particular have significant positive effects on visual amenity and the quality of the public realm (e.g. planting of street trees), and these are therefore considered to have a potentially positive influence on the overall impacts of climate change on landscape, historic and cultural environment in London in the medium-term. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4, although intended to be delivered by 2011/12 will have long-term implications. The establishment of green roofs, enhancing greenspaces, planting trees and developing design guidance, may all have long-term positive effects on visual amenity, the quality of the public realm, and in mitigating the negative impacts of higher temperatures on the historic and cultural environment. As a result the minor positive effects predicted are considered likely to have a positive influence on the effects of climate change on landscape, historic and cultural environment in London, over and above current and planned adaptation, in the long-term. Some negative, but uncertain effects are still considered likely.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS -/+	**With CCAS -/+?**	
9. Biodiversity	Without CCAS **-**	Without CCAS **--?**	Positive effects of minor, or major significance are predicted on biodiversity. The key measure proposed by Policy 3 to reduce and manage the impact of hot weather is through increasing the amount of greenspace and vegetation in the city. Action 11 (for example) seek to enhance 1000ha of greenspace by 2012 and provide biodiversity corridors through the city. Other actions to plant street trees and promote green roofs are also likely to have positive effects on biodiversity, but creating new habitats and protecting existing habitats / species from the impacts of overheating. Specific targets are included, e.g.: increasing greenspace cover by 10% by 2050 (Action 12) and increasing tree cover by 5% by 2025. **Sustainability implications 2020s:** The effects of Policy 3 and associated actions on biodiversity are considered likely to have a positive influence on the overall effects on biodiversity of the impacts of climate change in the medium-term. However some negative effects are still considered likely, as higher average temperatures would still put pressure on some species / habitats, such as through higher temperatures in aquatic environments, and on native fauna. Due to the uncertain nature of the effects of climate change on biodiversity the overall effects remain uncertain. **Sustainability implications 2050+:** Many of the actions proposed to deliver increased greenspace in the capital, although intended to be delivered by 2011/12 will have long-term implications. This is particularly the case as some of the targets (e.g. in Action 12) are to be met over the period to 2050. As a result long-term positive effects on biodiversity are predicted, and these effects are considered likely to have a potentially positive influence on the impacts of climate change on biodiversity in London. However as noted above, some, potentially major negative effects on biodiversity from overheating remain likely, and the uncertainty about the long-term impact of overheating remains.
	CCAS **+/++**	CCAS **+/++**	
	With CCAS **-/+?**	With CCAS **--/+?**	

Sustainability objective	2020s	2050+	Comments
10. Air Quality	Without CCAS **--**	Without CCAS **--?**	Policy 3 and associated actions are predicted to have minor positive effects on air quality. If targets included in Actions 11 – 14 are met, the increased amount of greenspace and foliage could have direct positive effects on air quality. In addition as greening is predicted to help reduce the urban heat island effect (see objective 3) this will also help mitigate poor air quality. **Sustainability implications 2020s:** Although Policy 3 and Actions 11 – 14 are predicted to have positive effects on air quality, many of the underlying causes of air quality will remain unchanged, and the influence of higher average temperatures and decreased cloud cover remain likely to exacerbate poor air quality in the capital. As a result the positive effects predicted are not considered likely to influence the overall effects of climate change on air quality in London in the medium term. **Sustainability implications 2050+:** See objective 9 – long-term positive effects on air quality are predicted. However, for the reasons noted above these effects are not considered likely to influence the overall effects of climate change on air quality in London in the long-term.
	CCAS **+**	CCAS **+**	
	With CCAS **--**	With CCAS **--?**	
Climate change			
11. Climate change and energy[11] **11.1 Mitigation**	Without CCAS **-/+**	Without CCAS **--/+?**	Insignificant or minor positive effects are predicted on climate change mitigation. Policies 3 and 4 and associated actions are predicted to have positive effects on climate change mitigation as increasing the amount of greenspace (Actions 11 – 14) could reduce the need for cooling, and actions to manage overheating in buildings (Actions 15 – 18) seek to reduce the need for mechanical cooling (through improved design) and where cooling is required, help ensure that energy efficient methods are used. These effects are considered likely to be of minor significance as cooling is only one aspect of London's energy use and greenhouse gas emissions generation, and also the focus of Policies 3 and 4 is predominantly on new development, which represents only a small proportion of London's built environment. In addition even where the level of emissions generated by cooling in new development is minimised, overall emissions are likely to rise given the scale of new development proposed. **Sustainability implications 2020s:** Although Policies 3 and 4 and associated actions are predicted to have potentially minor positive effects on climate change mitigation, in the context of current and planned adaptation, and the relatively limited focus of the actions in relation to greenhouse gas emissions, these effects are not considered likely to significantly influence climate mitigation in London in the medium term. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4 are likely to have long-term effects, given the effective lifespan of many new buildings, and the long-term benefits of increased greenspace. However, in the context of current and planned adaptation, and the scale of emissions from existing building stock and other sectors, these effects are not considered likely to have a significant influence on climate change mitigation in London in the long-term.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-/+**	With CCAS **--/+?**	

[11] Note – the scores for Climate Change is split to reflect effects on mitigation and adaptation separately.

Sustainability objective	2020s	2050+	Comments
11.2 Adaptation	Without CCAS **0/+**	Without CCAS **-?**	Positive effects of minor or major significance are predicted on climate change adaptation. The central aim of Policies 3 and 4 is reducing and managing the impact of higher temperatures in London. Increasing the amount of greenspace (Actions 11 – 14) and seeking to ensure new buildings and infrastructure are designed for higher average temperatures, and providing refuge spaces from heatwaves (Actions 15 – 18) will help to facilitate adaptation. Potential major positive effects are predicted in relation to increased greenspace, as this could provide multiple adaptation benefits, for example in relation to reducing flood risks, and protecting biodiversity from higher temperatures. **Sustainability implications 2020s:** The positive effects of Policies 3 and 4 and associated actions, are considered likely to have a positive influence on adaptation to climate change in London. **Sustainability implications 2050+:** Many of the actions proposed to deliver Policies 3 and 4 are likely to have long-term positive effects, given the effective lifespan of many new buildings, and the long-term benefits of increased greenspace coverage. As a result long-term positive effects are predicted, and these effects are considered likely to have a potentially positive influence on climate change adaptation in London. However some, potentially negative effects on adaptation remain likely, due to the potential significance of climate change impacts on average temperatures in the long-term, and the uncertainty about the long-term impact of overheating remains.
	CCAS **+/++**	CCAS **+/++**	
	With CCAS **+**	With CCAS **-/+?**	
Water management			
12. Water Quality and Water Resources[12] **12.1 Water quality**	Without CCAS **-**	Without CCAS **-?**	Insignificant or positive effects of minor significance are predicted on water quality. None of the policy elements or actions directly address the potential impacts of overheating on water quality (see appraisal of climate change impacts on overheating in Appendix 9), however increasing the amount of greenspace in the capital may have water quality benefits, for example by reducing rates of evapo-transpiration, by increasing shading and improving water attenuation, reducing run-off. **Sustainability implications 2020s:** Insignificant or minor positive effects are predicted on water quality, however these are not these effects are not considered likely to significantly influence the overall effects of the climate change impacts on water quality in London in the medium term. **Sustainability implications 2050+:** Although many of the actions proposed to deliver Policies 3 and 4 are likely to have long-term positive effects on water quality, these effects are not considered likely to significantly influence the overall effects of the climate change impacts on water quality in London in the long-term.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-**	With CCAS **-?**	
12.2 Water	Without CCAS **-**	Without CCAS **-?**	See 12.1. **Sustainability implications 2020s:** See 12.1. **Sustainability implications 2050+:** See 12.1.

[12] Note – the scores for Water Quality and Water Resources is split to reflect effects on each of these separately.

Sustainability objective	2020s	2050+	Comments
resources	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-**	Without CCAS **-?**	
Waste management and resource use			
13. Waste management	**Without CCAS 0/-**	**Without CCAS -?**	Although Policies 3 and 4 may address some of the potential negative effects of overheating on waste management, (see appraisal of climate change impacts on overheating in Appendix 9), no significant effects are predicted. **Sustainability implications 2020s:** As no significant effects are predicted, the overall effects are likely to remain unchanged. **Sustainability implications 2050+:** As no significant effects are predicted, the overall effects are likely to remain unchanged.
	CCAS **0**	CCAS **0**	
	With CCAS 0/-	**With CCAS -?**	
Economy			
14. Economy	Without CCAS **-?**	Without CCAS **-?**	Insignificant or minor positive effects are predicted on London's economy. Action 18 seeks to encourage the market for "cool roof" technologies, which could have quite specific economic benefits for those working in this sector, although the net effect on the economy as a whole is likely to be limited. Overheating is predicted to have potentially negative effects on London's economy (see appraisal of climate change impacts on overheating in Appendix 9), and as Policies 3 and 4 and associated actions seek to minimise the impact of overheating, minor positive effects are possible. **Sustainability implications 2020s:** Insignificant or minor positive effects are predicted on water quality, however these are not these effects are not considered likely to significantly influence the overall effects of climate change impacts on London's economy in the medium term. **Sustainability implications 2050+:** Although many of the actions proposed to deliver Policies 3 and 4 are likely to have long-term positive effects, these effects are not considered likely to significantly influence the overall effects of climate change impacts London's economy in the long-term.
	CCAS **0/+**	CCAS **0/+**	
	With CCAS **-?**	With CCAS **-?**	
Overall comments Policies 3 and 4 and associated actions (11 – 19) are predicted to have generally positive effects of minor significance in addressing the sustainability implications of climate change on overheating in both the medium-term (2020s) and long-term (2050+). Two potentially major positive effects are predicted, in relation to biodiversity and climate			

Sustainability objective	2020s	2050+	Comments
change adaptation. The effects predicted on biodiversity reflect the focus of Policy 3 and Actions 11 – 14 on increasing the amount of greenspace, the proposed provision of biodiversity corridors, planting of street trees etc. Major positive effects are predicted as these actions contain specific targets. Major positive effects are predicted on adaptation, as this is the central focus of Policies 3 and 4 and Actions 11 – 19. No potentially negative effects are predicted. The effects are in most cases predicted to be the same in the medium and long-term. This reflects the fact that although most of the actions are intended to be implemented by 2011/12, many are likely in practice to have long-term benefits, for example due to the long-term value of increased greenspace, and the likely lifespan of many buildings. Due to the inclusion of specific targets within the overheating actions, and as there is limited current and planned adaptation in relation to overheating (see Section 4, and the appraisal of climate change impacts on overheating in Appendix 9), the positive effects predicted are considered potentially significant enough to have a positive influence on the overall sustainability effects of the impacts of climate change on overheating in London. However in most cases some significant negative effects are predicted to remain, due to the potential significance of climate impacts, especially in the long-term, and the mayor's limited powers. A potential positive influence on the overall effects is predicted on: governance; education and awareness; health and wellbeing; liveability and place; landscape, historic and cultural environment; biodiversity; and, climate change adaptation.			

APPENDIX 9

REVISIONS TO THE APPRAISAL IN THE LIGHT OF THE CHANGES IN THE LATEST DRAFT STRATEGY (FEBRUARY 2010)

Revisions to the Appraisal in the Light of the Changes in the Latest Draft Strategy (February 2010)

The detailed appraisal presented in the matrices in Appendix 8 was based on the Policies and Actions as included in the draft Strategy dated 10 September 2009, as made available to CEP 25 September 2009. Rather than re-appraise these policies it was decided that a more proportionate approach would be to analyse the changes in the Policies and Actions between the two versions of the draft Strategy (some of which we made due to comments provided by the SA in a sustainability commentary to GLA in October 2009). This analysis is presented below, together with comments on the sustainability implications of these changes. Where a change is considered likely to modify the scale or direction of effects predicted this is also noted, and these revised scores have been carried over into the summary appraisal matrices (key changes are highlighted in the text in yellow) and the appraisal discussion in Sections 5 and 6.

Implications for the appraisal of the changes in the current Draft Strategy (February 2010 Version) - flooding

Flooding Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**
Policy 1 The Mayor will work with partners to reduce and manage flood risk in London through : • Improving the standard of flood defence • Increasing permeability and flood storage capacity • Encouraging Boroughs at shared flood risk to work collaboratively on flood risk management measures • Ensuring that Borough development plans consider emergency flood risk management measures • Requiring that development built at flood risk is flood resilient and can remain safe and operational during a flood • Encouraging critical infrastructure (transport, utilities and health services)	**Policy 1.** The Mayor will work with partners to reduce and manage current and future flood risk in London by: • Improving the understanding of flood risk in London and how climate change will alter the risks to improve our ability to manage flood risk. • Reducing flood risk to the most critical assets and vulnerable communities to target the greatest effort on London's most vulnerable assets. • Raising public awareness of flooding and individual and community capacity to cope and recover from a flood to improve London's resilience to flood events.	**Key changes to the policy:** • Policy has been restructured to provide a higher-level framework for the flooding Actions. • Many of the more specific Policy bullets have been deleted, but are generally reflected in the new or existing Actions. • The new Policy broadly covers all aspects of the PPRR framework of adaptation: the first bullet representing "prepare"; the second bullet representing "prevent"; and, the third bullet "respond" and "recover" • The following bullets from the previous Policy have been removed, but do not appear to be represented in the new Policy or Actions: ○ Improving the standard of flood defence ○ Increasing permeability and flood

Flooding Policies and Actions

September 2009 Version	February 2010 Version	Comments
owners and managers to assess and manage their climate risks. • Raising public awareness of flood risk and their capacity to respond to a flood		storage capacity ○ Requiring that development built at flood risk is flood resilient and can remain safe and operational during a flood. • Recommend specific mention of flood defences be re-introduced?? Or is this covered by 2nd bullet in new Policy? **Sustainability implications and changes to the appraisal:** • No changes predicted: although much of the detail included in the previous Policy has been removed, as the Policy is Appraised together with its Actions, and it is through the implementation of the Actions that sustainability effects are likely.
Actions – The Mayor will work with partners to: 11. Update the map of areas at flood risk for tidal, fluvial and surface water flooding today and assess how climate change will increase this risk in the future (extent, depth and frequency) in the future. 12. Update the map of the critical infrastructure and vulnerable communities at risk now and in the future (note that some of this information will be subject to security restrictions). 13. Develop a London-wide surface water management plan, identifying areas at risk and develop more detailed plans for priority	**From policy to action** There is a good understanding of current tidal and fluvial flood risk in London, but a poor understanding of surface water flood risk. **To improve our ability to predict and manage flood risk**, **further work is required to understand surface water flood risk and how climate change will increase all forms of flood risk.** **Action 1** - The Mayor will work with the Environment Agency, Boroughs and other partners to improve the mapping of who and what is at flood risk from all sources of flooding today, and to predict future flood risk for all flood sources.	**Key changes to the actions:** • Previous Actions are all included, with minor wording differences, with exception of previous Action 6 which has been deleted. • There are three new Actions: Action 5; Action 8; and, Action 9. • Of these three, Actions 5 and 8 broadly overlap with bullets in the previous Policy 1. Only Action 9 is entirely new. • The Actions predominantly address the "prepare" aspect of the PPRR adaptation framework. Only Action 7 is felt to address the "prevent" aspect. No Actions address the "respond" or "recover" aspects.

Flooding Policies and Actions

September 2009 Version	February 2010 Version	Comments
areas. 14. Create a web-based portal for collating and sharing information on surface water flood risk management. 15. Create a single data capture form for recording flood incidents that is adopted and by Drain London members. 16. Implement flood risk management policies with particular attention to flood risk mitigation and resilience measures. 17. Reduce the probability of surface water flood risk in high-risk areas.	**Action 2 -** The Drain London Forum will develop a surface water management plan for London which identifies and prioritises areas at risk and develops more detailed plans for the priority areas. **Action 3 -** The Drain London Forum will create an online data portal to allow flood risk management partners to more effectively share information and data analysis. **Action 4 -** The Drain London Forum will create a flood incident reporting system that is adopted throughout London to improve our understanding of flood risk today. **Action 5 -** The Mayor will work with boroughs through the Association of London Borough Planning Officers and the Local Resilience Forums to ensure that flood risk management is integrated across borough boundaries and within borough teams. **In order to prioritise flood risk management actions we need to identify the most vulnerable communities and critical assets.** **Action 6** - The Mayor will work with the Environment Agency, London Resilience and the London Climate Change Partnership to identify and prioritise critical infrastructure and vulnerable communities at flood risk. **Action 7 -** To reduce the risk of local surface water flooding, the Mayor will work with TfL, London Boroughs and Thames Water to review their drain and gully maintenance programme, particularly in high-risk areas.	**Sustainability implications and changes to the appraisal:** • Potentially more positive effect regarding governance (especially surface water flooding). This may have additional positive effects on governance, and change previous score to +/++ (2020s). • Potentially more positive effects regarding education and awareness, although this is not felt significant enough to change the overall effects predicted (no change in score). • Cross cutting actions which may have positive sustainability effects through their influence on better flood management / risk reduction include: ○ Action 30 which could have a positive effect regarding biodiversity through the restoration of rivers (environment chapter). ○ Actions 31 and 32 which may have positive economic effects where business and buildings are more resilient to climate risks, including flooding (economy chapter). • These actions are not, however, predicted to influence the overall sustainability effects in relation to biodiversity and the economy.

Flooding Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**
	We will seek to raise individual and community level awareness of flooding and the capacity to cope and recover from a flood: **Action 8 -** The Mayor will work with the Environment Agency to increase the number of Londoners signing up to the Floodline Warning Direct scheme and to raise awareness the of the measures that individuals and communities can undertake to reduce the risks and manage the consequences of flooding. **Action 9** – The Drain London Forum will identify 2 communities at significant flood risk and work with them to develop bespoke community flood plans to build their capacity to manage flood risk.	
See also urban greening actions in Chapter 4.	See also Actions17-20 in Chapter 5 and Action 32 in Chapter 8.	

Summary of the appraisal of business as usual, the draft Strategy (Sept 2009) and draft Strategy (Feb 2010) - Flooding

Climate change headline impacts and timeframe	Sustainability Objectives													
	1. Governance	2. Education and Awareness	3. Health and Well-being	4. Equality and Diversity	5. Safety and Security	6. Liveability and Place	7. Accessibility and Availability	8. Landscape, Historic and Cultural Environment	9. Biodiversity	10. Air Quality	11. Climate Change[13]	12. Water Quality and Water Resources[14]	13 Waste Management	14 Economy
Flooding														
Business as usual[15]														
Medium-term (2020s)	+	+/++	-	-	-/0	-/0	-	-/0	-?	0?	- -/+	-? -?	-	-
Long-term (2050+)	+	++?	--?	-/--?	--?	-/--?	--?	-/--?	--?	-?	--? -?	--? --?	-?	--?
Draft Strategy (Sept 2009)														
Medium-term (2020s)	+	+/++	-	-	0/+	-/0	-	-/0	-?	0?	- +/0	-? -?	-	-
Long-term (2050+)	+	++?	--?	-/--?	--?	-/--?	--?	-/--?	--?	-?	--? -/0	--? --?	-?	--?
Draft Strategy (Feb 2010)											-?			
Medium-term (2020s)	+/++	+/++	-	-	0/+	-/0	-	-/0	-?	0?	- +/0	-? -?	-	-
Long-term (2050+)	+/++?	++?	--?	-/--?	--?	-/--?	--?	-/--?	--?	-?	--? -/0	--? --?	-?	--?

[13] Objective split between (11.1) mitigation and (11.2) adaptation to Climate Change.
[14] Objective split between (12.1) water quality and (12.2) water resources.
[15] This corresponds to the appraisal of future climatic conditions in London taking into account current and planned adaptation, as presented in Section 4.

Implications for the appraisal of the changes in the current Draft Strategy (February 2010 Version) - Drought

Drought Policies and Actions

September 2009 Version	February 2010 Version	Comments
POLICY 2 The Mayor will work with partners to manage and reduce the risk of drought through: • Encouraging the water companies to repair and replace London's water mains • Rolling out a domestic water and energy efficiency improvement programme for existing homes • Ensuring that Borough development plans promote water efficiency in new development • Communicating water efficiency measures and benefits to Londoners • Supporting the development of a water resources emergency plan • Exploring the concept of 'water neutrality' and how it can be implemented	**From vision to policy** **Policy 2:** The Mayor will work with partners to improve the sustainability of London's water supply and demand balance and make London more robust to drought by : • Taking a strategic view on London's water resources • Reducing the demand for water in London • Improving our response to drought	• **Key changes to the policy:** • Policy has been restructured to provide a higher-level framework for the drought Actions. • Many of the more specific Policy bullets have been deleted, but are generally reflected in the new or existing Actions. • In terms of the PPRR framework of adaptation, the new Policy broadly addresses the "prepare" and "respond" elements. This reflects the assertion in the draft CCAS that droughts cannot be prevented, and that recovery occurs naturally once a drought period is over. • However the impacts of drought can be prevented or mitigated, for example by reducing loss of existing supplies or ensuring adequate water resources, and as a result the Policy also addresses the "prevent" aspect. • From a sustainability perspective, it is recommended that recovery of biodiversity, in particular trees and parks, could be addressed by the Policy / Actions. • Previous Policy bullets now deleted and apparently not included in new Policy or Actions: o Encouraging water companies to repair and replace water mains

Drought Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**
		○ Ensuring that borough development plans promote water efficiency in new development ○ Communicating water efficiency measures and benefits to Londoners • These aspects of water management are included in the Mayors draft Water Strategy (Action 10). **Sustainability implications and changes to the appraisal:** • The deletion of a Policy bullet addressing efficiency of water supply (repairing and replacing mains) may reduce potential positive effects in relation to water resources.
Actions - The Mayor will work with partners to: 18. Improve the energy and water efficiency of 1.8million homes across London by 2015, (saving on average £62 on household utility bills and equates to 46,000 litres of water and 0.48 tonnes of CO2 per home per year) 19. Publish a strategic water resources emergency plan for London that sets out how responsible agencies will manage water shortages for up to 200,000 people. 20. Publish a water strategy for London that presents a London-specific view of managing water resources, with the goal of improved water management – both the water we want (such as drinking water) and the water we don't (such as sewage and	**From policy to action** In an average year, London has enough water for its needs, but only by withdrawing more water from the environment that it can sustain. Climate change and London's growth will put further pressure on London's water supplies. **We need to take a strategic view on London's water resources :** **Action 10.** The Mayor will publish and regularly review a London Water Strategy that presents a London-specific view of managing water resources, with the goal of improved water management – both the water we want (such as drinking water) and the water we don't (such as sewage and floodwater in the wrong place). **Action 11.** The London Water Group will	**Key changes to the actions:** • Previous Actions all included with minor wording differences. However, the target for improved energy and water efficiency (Action 13) has been reduced from 1.8 million homes by 2015 to 1.2 million homes by 2015. • New Action 14 seeks to publish a "London specific Drought Plan" – this seems to correspond with previous Action 9, although this referred to a "strategic water resources emergency plan". • Action 11 and Action 12 are new. • The Actions predominantly address the "prepare" and "prevent" aspects of the PPRR

Drought Policies and Actions

September 2009 Version	February 2010 Version	Comments
floodwater in the wrong place).	undertake a study to define 'water neutrality' in London and explore how strategic scale water efficiency measures could make London more resilient to drought and long-term changes in water resources. **Action 12.** The Mayor will lobby the water utility regulator (OfWat) to encourage and enable the water companies to deliver greater household water efficiency savings and greater investment in London's water infrastructure. **London must reduce the amount of water it consumes, both to reduce our impact on the environment of our demands for water and to improve our resilience to drought :** **Action 13.** The Mayor will work with the Boroughs (through the Home Energy Efficiency Programme) to improve the energy and water efficiency of up to 1.2 million homes across London by 2015 and with businesses and the GLA estate managers to improve the energy and water efficiency of public and commercial buildings in London (through the Green 500, Building Energy Efficiency Programme and the Mayor's Green Procurement Code). There are national and water company responses to drought, but there is no London-specific emergency drought plan. **In order to improve our response to droughts :** **Action 14.** The Mayor recommends that the London Resilience Partnership should review the need for a London-specific Drought Plan.	adaptation framework. No Actions address the "respond" or "recover" aspects. **Sustainability implications and changes to the appraisal:** • The reduction in the target for water efficiency measures may reduce the significance of positive effects predicted on education and awareness. • Cross cutting actions which may have positive sustainability effects through their influence on drought resilience include: ○ Action 30 which could have a positive effect regarding biodiversity through the restoration of rivers / flood plains (environment chapter). ○ Actions 31 and 32 which may have positive economic effects where business and buildings (and their settings) are more resilient to climate risks, including drought (economy chapter). ○ Action 33 which may have a positive influence on the understanding and management of the risks of drought to infrastructure (e.g. subsidence / heave). • These actions are not, however, predicted to influence the overall sustainability effects in relation to biodiversity, the economy or access and availability.

Summary of the appraisal of business as usual, the draft Strategy (Sept 2009) and draft Strategy (Feb 2010) - Drought

Climate change headline impacts and timeframe	Sustainability Objectives													
	1. Governance	2. Education and Awareness	3. Health and Well-being	4. Equality and Diversity	5. Safety and Security	6. Liveability and Place	7. Accessibility and Availability	8. Landscape, Historic and Cultural Environment	9. Biodiversity	10. Air Quality	11. Climate Change[16]	12. Water Quality and Water Resources[17]	13 Waste Management	14 Economy
Drought														
Business as usual														
Medium-term (2020s)	+	+/++	-	-	-/0	-/0	-	-/0	-/+	-/0	- -	-/+ -	-/0	-
Long-term (2050+)	+?	++?	-?	-/--?	-?	-?	-?	-/--?	-/--?	-?	-/--? --/+?	-? --?	-?	-?
Draft Strategy (Sept 2009)														
Medium-term (2020s)	+	++	-	-	-/0	-/0	-	-/0	-/+	-/0	- 0/-	-/+ -	-/0	-
Long-term (2050+)	+?	++?	-?	-/--?	-?	-?	-?	-/--?	-/--?	-?	-/--? -/+?	-? --?	-?	-?
Draft Strategy (Feb 2010)														
Medium-term (2020s)	+	++	-	-	-/0	-/0	-	-/0	-/+	-/0	- 0/-	-/+ -	-/0	-
Long-term (2050+)	+?	++?	-?	-/--?	-?	-?	-/0?	-/--?	-/--?	-?	-/--? -/+?	-? --?	-?	-?

[16] Objective split between (11.1) mitigation and (11.2) adaptation to Climate Change.
[17] Objective split between (12.1) water quality and (12.2) water resources.

Implications for the appraisal of the changes in the current Draft Strategy (February 2010 Version) - Overheating

Overheating Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**

POLICY 3
The Mayor will seek to reduce and manage the impact of hot weather on Londoners through working with partners to :
• Manage London's urban heat island through increasing the amount of greenspace and vegetation in the city
• Creating an 'urban heat island action area' in the centre of London to incentivise urban greening and reduce waste heat emissions.
• Ensure new development and infrastructure is designed to minimise the risk of overheating and need for cooling as far as possible
• Ensure that where cooling is still required, low carbon, energy efficient methods are used
• identify publicly accessible cool buildings that can be used for temporary refuge during heatwaves
• ensure robust implementation of the heatwave plan
 	
POLICY 4
• The Mayor believes that development should be designed and constructed to avoid the need for mechanical cooling. Developers should use the following
	From vision to policy
	POLICY 3 : The Mayor will seek to reduce and manage the impact of hot weather on Londoners through working with partners to :
	• Improve the understanding of overheating risk in London by identifying who and what is affected and where is most at risk
	• Manage rising temperatures in London by increasing the amount of greenspace and vegetation in the city
	• Reduce the risk of overheating and the need for mechanical cooling in new and existing development and infrastructure
	• Ensure London has a robust heatwave plan
		Key changes to the policy:
		• Policy has been restructured to provide a higher-level framework for the overheating Actions.
		• Many of the more specific Policy bullets have been deleted, but are generally reflected in the new or existing Actions.
		• In terms of the PPRR framework of adaptation, the new Policy broadly addresses the "prevent", "prepare" and "respond" elements. No bullets specifically address the "recover" aspect. This reflects the statement made in the draft CCAS that "once a heatwave is over, there is little need to recover as there are few lasting effects" (chapter 2).
		• Previous Policy elements now deleted and apparently not included in new Policy or Actions:
		  ○ Specific reference to the urban heat island effect has now been removed from the Policy, as has the proposed creation of an "urban heat island action area".
		  ○ Ensuring that where cooling is required, low carbon, energy efficient methods are used. This is considered a potentially important omission from a sustainability perspective.

Overheating Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**
'cooling hierarchy' as guidance to reduce the need for cooling.		• In relation to the London heatwave plan, the emphasis of this Policy bullet has changed from ensuring "implementation" of a heatwave plan (old Policy) to just ensuring such a plan exists (new Policy). This change in wording is felt to reduce the strength of the Policy in this regard. **Sustainability implications and changes to the appraisal:** • Although no changes to the overall sustainability effects are predicted, the following deletions are likely to reduce the significance of positive effects predicted: ○ Removal of reference to low-carbon cooling, where mechanical cooling cannot be avoided. Potential effect on the score in relation to climate change mitigation – though not considered significant in the context of London's overall emissions, this represented an opportunity to provide a "joined-up" policy approach (adaptation and mitigation), and its deletion is regretted. ○ Removal of reference to the need of robust *implementation* of the London heatwave plan.
Actions – The Mayor will work with partners to : 11. Enhance 1,000ha of greenspace by 2012 to offset the urban heat island effect, manage flood risk, and provide biodiversity corridors	**From policy to action** We currently have a poor understanding of how temperatures vary across London, how the city's microclimate will intensify the rising temperatures in the future and who and what are vulnerable to	**Key changes to the actions:** • All previous Actions included with some wording differences. Notably: ○ Previous Action 17 (new Action 26)

Overheating Policies and Actions

September 2009 Version	February 2010 Version	Comments
through the city. 12. Increase greenspace cover in central London by 5% by 2030 and a further 5% by 2050. 13. Increase tree cover in the city by 5% (from 20%) by 2025. 14. Enable the delivery of 100,000m^2 of green roofs by 2012. 15. Publish design guidance for developers that takes account of the urban heat island effect and rising temperatures due to climate change. 16. Retrofit a social housing development to reduce the risk of overheating using passive measures. 17. Every Borough in London has identifies a "heatwave refuge" (publically accessible building) that can be used to provide temporary shelter during heatwaves. 18. Encourage the market for 'Cool Roof' technology. 19. Publish a feasibility study into creating and maintaining a network of weather stations across London to improve our understanding of London's microclimate.	high temperatures. **To improve the understanding of overheating risk and target priority areas ;** **Action 15** : The Mayor will work with partners to undertake a feasibility study into creating and maintaining a network of weather stations across London to improve our understanding of London's microclimate and the impact of urban greening measures on managing temperatures. **Action 16** : The Mayor will work with the SCORCHIO and LUCID projects to improve our understanding of how climate change will affect summer temperatures in the future and to identify and prioritise areas of overheating risk and risk management options. **We believe that by increasing greenspace and vegetation cover in the city we can manage and offset rising temperatures (and manage flood risk) :** **Action 17.** The Mayor will work with partners to enhance 1,000ha of green space by 2012 to offset the urban heat island effect, manage flood risk and provide biodiversity corridors through the city. **Action 18.** The Mayor will work with partners to increase green cover in central London by 5% by 2030 and a further 5% by 2050 to manage temperatures in the hottest part of London. **Action 19**. The Mayor will work with partners to increase tree cover across London by 5% (from 20 to 25%) by 2025. **Action 20.** The Mayor will work with partners to enable the delivery of 100,000m^2 of new green	addresses the same issue (heatwave refuges) in a different way – the new Action seeks an assessment of the benefits of these refuges rather than their identification. ○ Previous Action 18 (new Action 25) reference to the European Cool Roofs project removed. • Four entirely new Actions are included: 16, 22, 23 and 27. • New Action 22 refers to the "cooling hierarchy" previously included in the now deleted Policy 4. This was a recommendation in the October 2009 SA commentary. • New Action 23 is entirely new and refers to "mapping opportunities for decentralised energy (power, heat and cooling)". This perhaps relates to London Policy 4A.6 – Decentralised energy: heating, cooling and power. It is recommended this cross reference is clearly made. • Although introductory text to Actions 26 and 27 refers to the proposed London heatwave plan, there is no specific Action seeking its development / implementation. This seems a strange omission. **Sustainability implications and changes to the appraisal:** • No significant changes to the sustainability effects are predicted as a result of the

Overheating Policies and Actions

September 2009 Version	February 2010 Version	Comments
	roofs by 2012 (from 2008-09 baseline).	changes to existing / new actions included in the new draft CCAS.
	To reduce the risk of overheating and the need for mechanical cooling in new and existing development and infrastructure : **Action 21.** The Mayor and the Chartered Institution of Building Services Engineers will publish design guidance for architects and developers to reduce the risk of overheating, and encourage its use through the revised London Plan. **Action 22.** The Mayor has proposed a new 'cooling hierarchy' policy in the draft replacement London Plan to require developers to reduce potential overheating and the need for mechanical cooling **Action 23.** The London Development Agency will work with the Boroughs to map the opportunities for decentralised energy (power, heat and cooling) and with business through a range of energy efficiency programmes. **Action 24.** The London Climate Change Partnership will work with a social housing landlord to undertake a demonstration project to retrofit a social housing development to reduce risk of overheating using passive measures. **Action 25**. The Mayor will work with partners to assess and promote 'cool roof technology' (highly reflective, well insulated roofs) in London to reduce demand for mechanical cooling.	• Cross cutting actions which may have positive sustainability effects through their influence on the management of overheating include: ○ Actions 28 and 29 which could have positive health effects, where health buildings and health services are better able to manage the effects of overheating (health chapter). ○ Actions 31 and 32 which may have positive economic effects where businesses and buildings (are more resilient to climate risks, including overheating (economy chapter). ○ Action 33 which may have a positive influence on the understanding and management of the risks of extreme temperatures to infrastructure (e.g. melting of road surfaces, buckling to rail-tracks, discomfort on buses / tube etc.). • These actions are not, however, predicted to influence the overall sustainability effects in relation to health, the economy or access and availability.
	We want to ensure London has a robust heatwave plan and that Londoners know what to do during a heatwave to stay cool	

Overheating Policies and Actions		
September 2009 Version	**February 2010 Version**	**Comments**
	and save energy: **Action 26.** The Mayor recommends that London Resilience Partnership should assess the benefits of having 'heatwave refuges' (publicly accessible cooled building) that can be used to provide temporary shelter during heatwaves. **Action 27.** The Mayor will review the lessons learned from developing the community flood plans (see Action 9) to determine how best to encourage and enable a community level response to heatwaves.	

Summary of the appraisal of business as usual, the draft Strategy (Sept 2009) and draft Strategy (Feb 2010) - Overheating

Climate change headline impacts and timeframe	Sustainability Objectives													
	1. Governance	2. Education and Awareness	3. Health and Well-being	4. Equality and Diversity	5. Safety and Security	6. Liveability and Place	7. Accessibility and Availability	8. Landscape, Historic and Cultural Environment	9. Biodiversity	10. Air Quality	11. Climate Change[18]	12. Water Quality and Water Resources[19]	13 Waste Management	14 Economy
Overheating														
Business as usual														
Medium-term (2020s)	+	-/+	--/+	-/+	-?	-/+	-/+	-/0	-	--	-/+ 0/+	- -	-/0	-?
Long-term (2050+)	+?	-	--/+?	--/+?	-?	-?	--/+?	-?	--?	--?	--/+? -?	-? -?	-?	-?
Draft Strategy (Sept 2009)														
Medium-term (2020s)	+	0/+	-/+	-/+	-?	0/+	-/+	-/+	-/+?	--	-/+ +	- -	-/0	-?
Long-term (2050+)	+?	-/+	--/+?	--/+?	-?	-/+?	--/+?	-/+?	--/+?	--?	--/+? -/+?	-? -?	-?	-?
Draft Strategy (Feb 2010)														
Medium-term (2020s)	+	0/+	-/+	-/+	-?	0/+	-/+	-/+	-/+	--	-/+ +	- -	-/0	-?
Long-term (2050+)	+?	-/+	--/+?	--/+?	-?	-/+?	--/+?	-/+?	--/+?	--?	--/+? -/+?	-? -?	-?	-?

Key:

Major positive: ++ Minor positive: + Neutral: 0 Minor negative: - Major negative: -- Uncertain:? Mixed: -/+

[18] Objective split between (11.1) mitigation and (11.2) adaptation to Climate Change.
[19] Objective split between (12.1) water quality and (12.2) water resources.

Mainstreaming adaptation across the GLA group and key sectors in London

Cross cutting / sectors		
September 2009 Version	**February 2010 Version**	**Comments**
Health		•
• none	*As health is a cross-cutting issue, actions in Chapters 3-5 generally apply to this chapter, but there are two specific actions.* **Action 28**. The London Climate Change Partnership will work with the London Regional Public Health Group to undertake a London-specific assessment of the impacts and opportunities of climate change on London's health services. The study will provide recommendations to the health sector on the priority risks and opportunities. **Action 29.** The Mayor will work with the London Regional Public Health Group, NHS London and the London Primary Care Trusts to ensure that climate risks are addressed in their refurbishment programmes and the commissioning of health services.	**Key changes to the actions:** • Actions 28 and 29 are both new Actions, not included in the previous draft CCAS. **Sustainability implications and changes to the appraisal:** • Generally these Actions are predicted to have positive effects on health, by helping ensure health services and buildings are resilient to climate risks and able to exploit climate opportunities. • These effects are not predicted to be of significance to alter the overall health effects predicted in the appraisal.
London's environment		•
• none	*As this is a cross-cutting issue, actions proposed in Chapters 3-5 apply to this chapter, particularly Actions 17-20 and the following action*. **Action 30**. The Mayor will work with the Environment Agency and other partners to restore 15kms of London's rivers by 2015 through the London Rivers Action Plan.	**Key changes to the actions:** • Action 30 is a new Action, not included in the previous draft CCAS. **Sustainability implications and changes to the appraisal:** • Action 30 is predicted to have potentially positive effects on biodiversity. Positive effects are also possible in relation to health and wellbeing and liveability and place (e.g. due to improvements in local amenity,

Cross cutting / sectors		
September 2009 Version	**February 2010 Version**	**Comments**
		access to riverside walks etc.). • These effects are likely to be limited to local areas (due to the specific nature of the Actions), and not considered significant enough to alter the overall effects predicted in relation to these SA objectives.
London's economy		•
• none	*The actions identified in this strategy will help to improve the resilience of London's economy to climate change.* **Action 31.** The Mayor will engage with business organisations and other key stakeholders to consider how to raise awareness of the need to integrate climate risks and opportunities into their routine risk management and planning, and whether there is further practical assistance that can be given to London's businesses, including its SMEs. **Action 32.** The Mayor will work with the insurance sector in calling for the government to amend building regulations to require buildings being rebuilt or renovated to be climate resilient.	**Key changes to the actions:** • Actions 31 and 32 are new Actions, not included in the previous draft CCAS. **Sustainability implications and changes to the appraisal:** • These new Actions are predicted to have potentially positive effects on the economy. • If building regulations are changed, this could have a significant effect on the resilience of new development, although this will depend on the lobbying proposed being successful. • The potential positive effects predicted are not considered to be significant enough to alter the overall effects predicted in relation to the economy.
Infrastructure		•
• none	*The actions identified in this strategy will help to improve the resilience of London's infrastructure to climate change.* **Action 33**. TfL will undertake a climate risk assessment of their assets and operations and develop prioritised action plans for key climate risks.	**Key changes to the actions:** • Actions 33 and 34 are new Actions, not included in the previous draft CCAS. **Sustainability implications and changes to the appraisal:** • These new Actions are predicted to have

Cross cutting / sectors		
September 2009 Version	**February 2010 Version**	**Comments**
	Action 34. The Mayor believes that London should have a resilient energy supply and will work with the Distribution Network Operator and the energy retailers to ensure that the distribution infrastructure is resilient to climate impacts and that energy suppliers can meet seasonal variations in demand.	potentially positive effects on the resilience of transport infrastructure (accessibility and availability objective), and the economy. • The potential positive effects predicted are not considered to be significant enough to alter the overall effects predicted in relation to these SA objectives.