



City of Joondalup

Climate Change Strategy
2014 – 2019

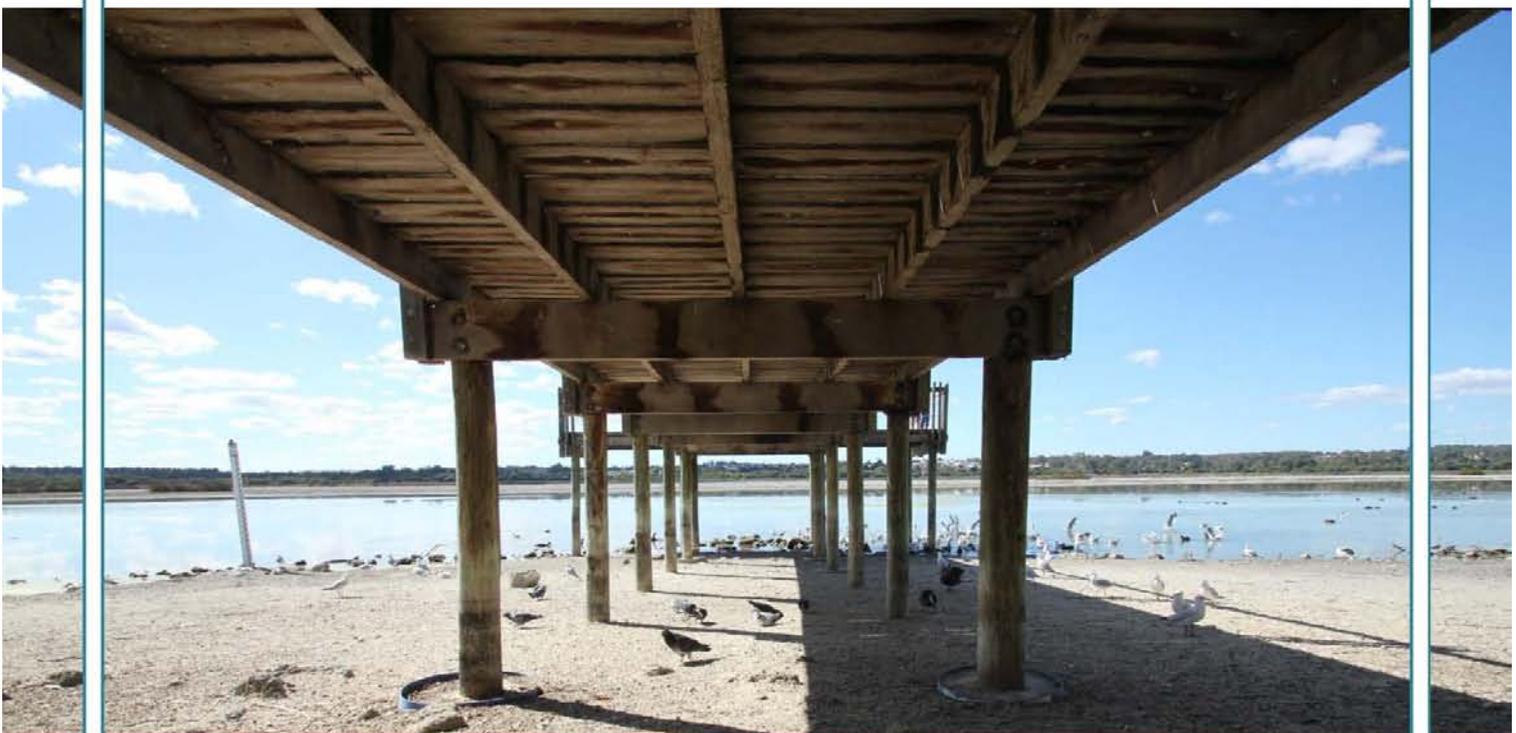


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Acronyms

ACCSP	Australian Climate Change Science Programme
AGO	Australian Greenhouse Office
BOM	Bureau of Meteorology
CBD	Central Business District
CCP	Cities for Climate Protection
CFCs	Chlorofluorocarbons
CO ₂	Carbon Dioxide
CO ₂ -e	Carbon dioxide equivalent
COJ	City of Joondalup
CSIRO	Commonwealth Science and Industry Research Organisation
DCC	Department of Climate Change
DPAW	Department of Parks and Wildlife
DPS2	District Planning Scheme 2
EEP	Environmental Education Program
GHG	Greenhouse Gas
GIS	Geographic Information System
GJ	Gigajoules
GL	Gigalitres
IOCI	Indian Ocean Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
KFA	Key Focus Area
kL	kilolitres
km	kilometres
kWh	Kilowatt hours
LED	Light emitting diode
LGEEP	Local Government Energy Efficiency Program
LPG	Liquefied Petroleum Gas
LPS	Local Planning Strategy
MWh	Mega watt hours
NCCARF	National Climate Change Adaptation Research Facility
NCOS	National Carbon Offset Standard
ppm	Parts per million
ppb	Parts per billion
PV	Photovoltaic
RCPs	Representative Concentration Pathways
SCA	Special Control Area
SLR	Sea level rise
t	Tonnes

WALGA
YICM

Western Australian Local Government Association
Yellagonga Integrated Catchment Management

Executive Summary

Climate Change is an important emerging issue for local government. Climate change will affect a number of areas that local government is responsible for including infrastructure, health services, water management, emergency management and the natural environment.

In 2070, it is expected that the City of Joondalup will have hotter, drier and windier summers with the number of days over 35°C nearly doubling. Winters will be drier, warmer and less windy as a result of fewer low pressure systems¹.

Responding effectively to climate change involves both reducing greenhouse gas emissions (mitigation) and being ready to adapt to climate change impacts as they occur (adaptation).

The City of Joondalup Climate Change Strategy 2014-2019 will provide guidance to the City's climate change activities over the next five years. The Strategy has a dual purpose:

- *Mitigation* – to continue to reduce greenhouse gas emissions to minimise the severity of climate change.
- *Adaptation* – to implement strategies to ensure the City is prepared and able to adapt to current and future impacts of climate change.

The City has identified a number of overarching objectives to guide implementation of the Strategy.

Mitigation Objectives	
M1	To reduce the City's greenhouse gas emissions through effective energy management and improved energy efficiency.
M2	To reduce the City's greenhouse gas emissions through the increased use of renewable energy and alternative fuels.
M3	To reduce the City's net greenhouse gas emissions through the strategic purchase of carbon offsets.
M4	To support and encourage the community to reduce their greenhouse gas emissions.
Adaptation Objectives	
A1	To improve the City's understanding of future climate scenarios and associated impacts for the City of Joondalup.
A2	To identify the likely risks to the City's environment, operations, infrastructure, activities and services as a result of climate change.
A3	To put in place strategies that will minimise the risk to the City's environment, operations, infrastructure, activities and services as a result of climate change.
A4	To support and encourage the community to prepare and adapt for climate change.

¹ CSIRO (2007)

The City's *Climate Change Strategy 2014-2019* sets a new direction for the City's mitigation activities and establishes an approach for the City to adapt to the impacts of climate change. The integration of climate change mitigation and adaptation into the one Strategy not only demonstrates the City's innovation and leadership but will also create both efficiencies and opportunities for the City's climate change management activities. The Strategy will have both a corporate and community focus.

The Strategy covers six key focus areas: infrastructure and assets, parks and reserves, land use planning and development, natural environment, corporate responsibility and good governance and community wellbeing. In developing the Strategy the City conducted a review of its energy use and emissions profile, assessed the risks posed to the City from climate change and developed climate change management projects for each of the key focus areas.

To enable the City to monitor and measure its progress towards achieving the objectives of the Strategy a number of targets have been set. Annual reporting against the targets will ensure both transparency and accountability to the community in the delivery of outcomes.

Corporate target	<p>Reduce net greenhouse gas emissions by 5 per cent per capita below 2012/13 emissions by 2018/19</p> <p>The City's net greenhouse gas emissions in 2012/13 were 100.6kg per capita. The City will need to reduce net emissions by 5.03kg per capita to reach this target.</p>
Community target	Implement a minimum of two community mitigation projects or events per year

Corporate target	Implement a minimum of 5 corporate adaptation projects per year
Community target	Implement a minimum of two community adaptation projects or events per year

Implementation of this Strategy demonstrates the City's commitment to continuing its climate change mitigation activities and its intent to become a leader in climate change adaption.

PART 1- INTRODUCTION

1.1 CLIMATE CHANGE STRATEGY

Planning for the future impacts of climate change is an important emerging issue for local government. Climate change affects a number of areas that local government is responsible for managing including infrastructure, health services, water management, emergency management and the natural environment.

Continuing to reduce greenhouse gas emissions to mitigate the effects of climate change is also an essential part of local government's role in managing the environment.

The effects of climate change will vary in scale and nature across the globe but will impact on temperature, rainfall, intensity and frequency of extreme weather events, wind strength and patterns, and ocean temperatures and currents. Predicting the exact scale and nature of climate change at a local level and the resulting impacts is challenging and will depend on the response of local climate systems and the level of future greenhouse gas emissions.

The City of Joondalup is situated within the south-west corner of Western Australia, a global biodiversity hotspot and an area particularly vulnerable to climate change. A considerable amount of climate-related research has focused on the south-west of WA and some key findings include:

- Rainfall has decreased by approximately 15% since the mid-1970's and is projected to continue decreasing throughout this century.
- Sea levels have been rising at a greater rate than the national average and more than double the global average.
- South-west WA has the highest concentration of rare and endangered species on the continent, and is already being impacted by habitat fragmentation. This will be exacerbated by climate change².

Expected climate change impacts within the region include (but are not limited to):

- coastal inundation and erosion as a result of sea level rise and increased storm surges;
- reduced water availability;
- increased flood risk;
- increased bushfire risk;
- increased spread of vector-borne diseases;
- Increased threats to habitats of flora and fauna;
- increased damage to infrastructure; and
- health impacts particularly for those considered vulnerable.

² Climate Commission, 2011

The climate change impacts will significantly affect the City’s operations, infrastructure, activities and services as well as its environment and community. The development and implementation of a Climate Change Strategy will assist the City to minimise and prepare for these impacts whilst increasing community resilience.

1.1.1 Purpose

The City of Joondalup Climate Change Strategy 2014-2019 will provide guidance to the City’s climate change activities over the next five years. The Strategy has a dual purpose:

- *Mitigation* – to continue to reduce greenhouse gas emissions to minimise the severity of climate change, and
- *Adaptation* – to implement strategies to ensure the City is prepared and able to adapt to current and future impacts of climate change.

The City has identified a number of overarching objectives to guide implementation of the Strategy, see Table 1.

Mitigation Objectives	
M1	To reduce the City’s greenhouse gas emissions through effective energy management and improved energy efficiency.
M2	To reduce the City’s greenhouse gas emissions through the increased use of renewable energy and alternative fuels.
M3	To reduce the City’s net greenhouse gas emissions through the strategic purchase of carbon offsets.
M4	To support and encourage the community to reduce their greenhouse gas emissions.
Adaptation Objectives	
A1	To improve the City’s understanding of future climate scenarios and associated impacts for the City of Joondalup.
A2	To identify the likely risks to the City’s environment, operations, infrastructure, activities and services as a result of climate change.
A3	To put in place strategies that will minimise the risk to the City’s environment, operations, infrastructure, activities and services as a result of climate change.
A4	To support and encourage the community to prepare and adapt for climate change.

Table 1: Overarching objectives of the Climate Change Strategy

1.1.2 Scope

Climate change is a global, national and local issue. Climate change adaptation and mitigation is the responsibility of all spheres of government as well as businesses, the community and individuals. While the City recognises that local government has an important role in both mitigation and adaptation, it is also important to recognise that many strategies for mitigation and adaptation are outside of the statutory responsibility or influence of local government.

The scope of this Strategy is limited firstly to the geographical boundary of the City, and secondly to the roles and responsibilities of the City as a local government authority.

In regard to mitigation, the City's responsibilities relate to reducing its own emissions and encouraging and supporting the community to reduce their emissions through education, behaviour change programs and planning and development processes. A more detailed summary of the City's role in climate change mitigation is provided in Table 2.

WITHIN SCOPE (Direct Influence)	
City facilities	The City aims to integrate principles of environmental sustainability into the design and construction of City owned buildings through the application of the <i>Environmentally Sustainable Design for City Buildings Policy</i> .
Energy use in City buildings	The City is responsible for and has direct control over the amount and source of energy used within its buildings.
City's fleet system	The City is responsible for and has direct control over the size and type of vehicles that comprise its vehicle fleet as well as the fuel sources used.
Urban Planning	The City has a limited direct regulatory role through the City's Local Planning Scheme. The Local Planning Scheme sets out the provisions for how the City is developed which may influence energy use within the community.
Local Coastal Vulnerability Assessment	The City has direct control over the identification of risks along the City managed areas of the coast and undertakes Studies to determine the vulnerability of infrastructure within this zone.
Lighting within Public Open Spaces	The City has direct control (i.e. design, installation, maintenance) over some public lighting within City owned or managed land such as in parks, recreations reserves and along paths.
Waste Management	The City is responsible (through Mindarie Regional Council) for collecting and managing waste produced by households. Effective waste management i.e. recycling and diversion from landfill can reduce greenhouse emissions.
WITHIN SCOPE (Indirect Influence)	
Street lighting	While the City pays for the electricity to power the streetlights the streetlight assets are owned by Western Power and therefore the City has limited ability to influence street lighting technology or maintenance schedules. The City's main role is likely to be an advocacy or partnership role.
Household energy use	The City can encourage and support energy savings and efficiency, use of renewable energy, and use of sustainable transport by individuals and households but cannot directly control it.
Building and development	The City can encourage and support energy efficient and climate sensitive building and development but cannot directly control it. Minimum energy requirements are set out by the Building Code of Australia.
Waste production	The City can support and encourage the community to reduce their waste production but cannot directly control it.
OUTSIDE SCOPE	
Carbon Pricing	Responsibility of the Federal Government.
Energy Regulation and Supply	Responsibility of the State Government.
Public Transport	Responsibility of the State Government.
Metropolitan Planning	Responsibility of the State Government.

Table 2: Scope of the City's Mitigation responsibilities

In regard to adaptation the City's responsibilities relate to preparing and adapting its own infrastructure, assets, operations and services for the impacts of climate change as well as managing the local environment. The City also has an indirect role in encouraging and supporting its community in becoming more resilient to the impacts of climate change.

There are a number of areas where local government and State Government have a shared role and/or overlapping responsibilities. This is particularly true for urban planning, where Local Planning Schemes are approved by the State Government and where planning and development decisions made by local government can be subject to review by the State Administrative Tribunal. There is also uncertainty in the extent to which local government or State government could be held responsible for planning and development decisions that are later impacted by climate change.

WITHIN SCOPE (Direct Influence)	
City infrastructure and assets.	Identifying risks to the City's infrastructure and assets as a result of climate change and planning for the protection and/or adaptation of these infrastructure and assets.
City owned land.	Identifying vulnerable City owned or managed land (particularly along the coast) and planning for its protection and/or adaptation.
Natural Areas	The City's environmental management activities in City owned and managed natural areas should be based on adaptive management principles to ensure its environmental management approach is responsive to a changing climate.
City's water use	Reducing the City's water use in preparation for a drying climate through effective water management, reduced consumption and use of alternative water sources.
Increased use in services and facilities	Ensuring the City has adequate planning and resources in place for increased use of facilities and service levels.
Stormwater management	Ensuring the City's stormwater management systems are adequate for future climate scenarios.
Urban Planning	Ensuring the City's Local Planning Scheme can adequately address future climate change impacts.
WITHIN SCOPE (Indirect Influence)	
Preparing individuals and communities for climate change impacts	The health and wellbeing of individuals may be affected by climate change; the City can support and encourage residents to become more resilient to climate change impacts.
Adaptation of private property	The City has a limited indirect role in advising individuals and communities about climate change risk and adaptation for private property.
Emergency Management	The City partners with the State Government in the delivery of emergency management services.
Natural Areas	The natural environment (habitats, flora and fauna) will respond and adapt to a changing climate. The City through its environmental management activities may be able to indirectly support or facilitate this adaptation of the natural environment.

OUTSIDE SCOPE	
Climate science research	There are many international, national and state based organisations that undertake climate science research.
Large scale coastal modelling	The Federal Government has undertaken some modelling of climate change impacts along Australia's coast. However gaps still remain in the availability of state wide coastal modelling data.
Adaptation of private property	Individuals are ultimately responsible for preparing and adapting their property for climate change.
Adaptation of State owned infrastructure and land	Responsibility of State Government.

Table 3: Scope of the City's Adaptation responsibilities

1.1.3 Why does the City need a Climate Change Strategy?

Developing a Climate Change Strategy will have a number of benefits for the City, including:

- Providing an informed and strategic direction for the City's climate change management activities.
- Building upon and continuing the City's significant achievements in greenhouse gas reduction.
- Recognising the adaptation activities the City is already undertaking and providing a strategic approach to their implementation.
- The City, its environment and its community will be more resilient, better prepared and better able to adapt to future climatic conditions.
- Early investment in preparation and adaptation planning will help the City avoid or minimise climate change impacts and reduce the costs of adaptation and impacts when they occur.
- Climate change mitigation and adaptation activities can create opportunities and provide benefits for the City not directly related to climate change i.e. reduced costs.
- Development and implementation of the Strategy will enable the City to become a leader in both climate change mitigation and adaptation.

1.1.3 Precautionary Principle

The City's Sustainability Policy recognises the Precautionary Principle which states that avoidance of the risk of serious or irreversible environmental damage should not be postponed due to a lack of full, scientific knowledge. While it is clear that climate change will occur; the exact extent and nature of future climate change impacts is uncertain. The City recognises that while not all the information regarding specific impacts is currently available it is still necessary for the City to plan, adapt and act. Where there is a specific need for information to enable the City to act effectively this will be identified within the Strategy and projects developed to research or collect this information.

1.1.4 Structure of the Strategy

The Strategy is comprised of four parts.

Part 1 Introduction - provides an introduction to the Strategy, states the purpose and objectives of the Strategy, and describes the strategic context that the Strategy aligns to at a local, State and National level.

Part 2 Mitigation – provides an overview of the City's current and historical energy use and emissions profile. It also identifies a framework and priorities for the City's climate change mitigation activities into the future.

Part 3 Adaptation - provides the context to the climate change issues facing the City including a description of current and future changes to the climate as well as the associated impacts. An overview of the climate change risk identification and assessment process taken by the City to identify overarching risks is also included.

Part 4 Climate Change Strategy - utilises a project based implementation framework and presents specific climate change projects to be implemented over the life of the Strategy to achieve stated objectives. The projects include both new and existing projects.

1.2 MITIGATION AND ADAPTATION

This Strategy has the dual purpose of mitigation and adaptation. Combining mitigation and adaptation within the same Strategy is considered to be best-practice and will enable the City to:

- Demonstrate to the community that the City is committed to both climate change mitigation and adaptation;
- Identify projects that will have benefits for both mitigation and adaptation; and
- Maximise funding opportunities.

Climate change mitigation, climate change adaptation and the relationship between the two is described in more detail below.

1.2.1 Mitigation

Climate change is occurring on a global scale as a result of increasing concentrations of greenhouse gases in the atmosphere. Greenhouse gases are being emitted at an accelerated rate through human activities such as burning of fossil fuels, large-scale agriculture and land clearing. This increased concentration of greenhouse gases has resulted in a warming of the atmosphere which has and will continue to have a wide ranging effect on weather patterns and climate systems³.

Climate change mitigation refers to direct action to reduce emissions of greenhouse gases and decrease the severity of climate change. The more greenhouse gases that are emitted

³ CSIRO (2011)

(both presently and in the future) the greater the scale of future climate change and the associated impacts.

1.2.2 Adaptation

The concentration of carbon dioxide (one of the key greenhouse gases) in the atmosphere has increased by 40% since the beginning of the industrial revolution². This level of concentration is such that even if all emissions were to cease now, some climate change would still occur due to the level of past emissions.

The realisation that the world will be subject to a certain amount of unavoidable climate change has led to a focus on climate change adaptation. Climate change adaptation refers to changes in human or natural systems in response to actual or expected climate changes in order to minimise impacts or increase beneficial opportunities. Adaptation can be reactive or proactive. The greater the degree of proactive adaptation that occurs in expectation of specific climate changes, the less impact that climate change will have on human and/ or natural systems i.e. the expected climate change will still occur but the impact from it may be less⁴.

1.2.3 Relationship between Mitigation and Adaptation

While mitigation addresses the causes of climate change, adaptation addresses the effects of climate change. Mitigation and adaptation are inter-related. The more mitigation that occurs i.e. reduction of emissions, the less severe the climate change and the less adaptation will be required.

Therefore the City needs to adapt for unavoidable climate change while doing its part to reduce emissions to minimise the severity of climate change. This relationship between adaptation and mitigation is shown in Figure 1.

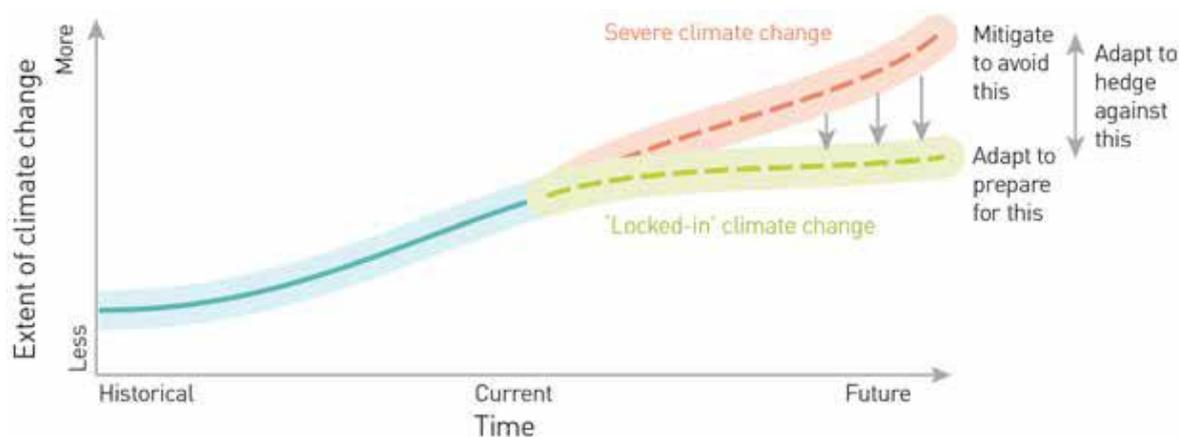


Figure 1: Diagram of the relationship between mitigation and adaptation⁵.

⁴ IPCC, 2007

⁵ Australian Government (2013) a

While adaptation and mitigation have two distinct purposes, single strategies can address both mitigation and adaptation. For example the installation of photovoltaic cells on City buildings is relevant for both mitigation and adaptation. The photovoltaic cells generate solar energy which does not emit greenhouse gases contributing to a reduction in the City's greenhouse gas emissions (i.e. mitigation). This also contributes to making the City more resilient to future energy price increases as the City is required to purchase less mains electricity for the building (i.e. adaptation).

1.2.4 Targets

By establishing targets, the City can monitor and measure progress towards achieving the objectives of the Climate Change Strategy. It also ensures both transparency and accountability in demonstrating the delivery outcomes.

Corporate mitigation target

The City's corporate mitigation target has been developed through a review of the City's energy use and emissions profile and giving consideration to the City's scope to make energy efficiency and energy reduction improvements (see Table 4). Given that the City has already achieved a greater than 20% reduction in emissions since 2002 many of the more easily achieved improvements have already been made. Whilst there is still scope for improvement, these initiatives are more challenging and often have larger budgets associated with implementation.

Under the Climate Change Strategy a Corporate mitigation target of a 5% per capita reduction in greenhouse gas emission has been established. 2012/13 is the City's most recent energy consumption data and will be used as the baseline year. The final implementation year of the Climate Change Strategy, 2018/19, is the target year. Per capita emission reduction targets have been proposed to account for new facilities and services for the City. The target relates to net emissions rather than total emissions and therefore includes any offsets that the City purchases (see section 2.3.4 for a more detailed discussion of net emissions and offsets).

Community mitigation target

The City does not have direct influence over the way that the community utilises energy, however the City can raise awareness of energy conservation and energy efficiency within the community. Furthermore it is not feasible for the City to obtain energy and greenhouse gas data for the community, therefore the City's community mitigation targets is based on implementing a minimum number of community mitigation projects/ events per year see Table 4.

Corporate target	Reduce net greenhouse gas emissions by 5 per cent per capita below 2012/13 emissions by 2018/19. The City's net greenhouse gas emissions in 2012/13 were 100.6kg per capita. The City will need to reduce its net emissions by 5.03kg per capita to reach this target.
Community target	Implement a minimum of two community mitigation initiatives per year.

Table 4: Corporate and community mitigation targets

Adaptation Targets

Corporate and community adaptation targets have also been based on a minimum number of projects implemented per year, see Table 5. Given the diversity of climate change impacts and the range of adaptation initiatives included within the *Climate Change Strategy*, the number of projects implemented per year is used as the overall measure for achieving climate adaptation.

Corporate target	Implement a minimum 5 corporate adaptation initiatives per year
Community target	Implement a minimum of two community adaptation initiatives or events per year

Table 5: Corporate and community adaptation targets

1.3 STRATEGIC CONTEXT

The City of Joondalup acknowledges that the Climate Change Strategy does not operate in isolation. Therefore the five year Strategy has been developed to align with the local, state and federal planning context.

1.3.1 Local

Integrated Planning Framework

The City operates under an *Integrated Planning Framework*; this Framework ensures that the City's strategic priorities align to its planned activities and resourcing requirements. The Framework also builds in reporting requirements to ensure transparency and the demonstration of planned achievements.

The nature of climate change mitigation and adaptation, and the wide scope of impacts expected from a changing climate, means that effective climate change management will need to be incorporated across the *Integrated Planning Framework*, see Figure 2.



Figure 2: City's Integrated Planning Framework

Joondalup 2022: Strategic Plan 2012 - 2022

Joondalup 2022: Strategic Plan 2012 – 2022 is the City's long-term strategic planning document; outlining its commitment to achieving the vision and aspirations of its community and regional stakeholders.

One of its key focus areas is the natural environment with contains the aspirational outcome;

The City is a global leader in adaptive environmental management. It works closely with the community to protect and enhance the natural environment, while celebrating and showcasing its natural assets to the world.

To achieve this aspirational outcome the City will:

- Continually adapt to changing local environmental conditions.
- Develop an appreciation for local natural assets by providing appropriate access to natural areas.
- Build a community that takes ownership of its natural assets and supports their ongoing preservation and conservation.
- Embrace learning opportunities on an international scale and continuously lead by example in our application of new knowledge.

Importantly, *Joondalup 2022* identifies the development of a City of Joondalup Climate Change Strategy as a priority project.

Environmental Framework

To facilitate the achievement of the outcomes for the natural environment identified in *Joondalup 2022*; an Environmental Framework has been developed (see Figure 3) to guide environmental management within the City of Joondalup



Figure 3: The City's environmental framework

Central to the Environmental Framework is the Environment Plan 2014 – 2019 (in development) which is one of the informing strategies under the City's Integrated Planning Framework and the key environmental document for the City. The Environment Plan provides strategic direction for broad environmental management across the City. The objective of the Environment Plan is *'To provide ongoing leadership in adaptive environmental management to ensure the sustainable use of natural resources and the conservation and enhancement of the City's natural assets for future generations'*.

Beneath the Environment Plan are a number of issue specific Plans, including the City's Climate Change Strategy.

1.3.2 Regional – Western Australian Local Government Association

The Western Australian Local Government Association (WALGA) develops climate change policy and projects, liaises with local governments to ascertain key climate change concerns and priorities and advocates to other spheres of government on behalf of the Local Government sector.

WALGA has developed a series of projects to assist local governments to mitigate greenhouse gas emissions and prepare for the impacts of climate change. The City of

Joondalup is involved in a number of these projects including the WALGA Climate Change Declaration.

At the September 2013 City of Joondalup Council Meeting, Council endorsed the City becoming a signatory to the Western Australian Local Government Climate Change Declaration.

The WALGA Climate Change Declaration recognises that a collaborative approach is required to adapt to the impacts of climate change. The declaration strengthens local government's advocacy position by articulating a shared political commitment across the sector. Currently 25 Western Australian local governments and two regional councils are signatories.

Signing the Declaration demonstrates the City's political commitment to climate change management and acknowledges the impacts of climate change and the importance of developing locally appropriate climate change management strategies.

The development of this *Climate Change Strategy* will ensure that the City meets its commitments under the WALGA Climate Change Declaration.

1.3.3 State

The State Government released its key climate change related strategy entitled '*Adapting to our Changing Climate*' in October 2012⁶. The Strategy outlines the key climate change challenges the State will face and provides a strategic approach to address them. The Strategy identifies the following areas where adaptation will be needed.

- Water supplies.
- The agricultural sector.
- Buildings, transport infrastructure and critical infrastructure that supply energy and water, health and communication services.
- Health, social and emergency management service systems.
- Industries.
- Communities.
- Management of our natural environment.

While the State Government does not have its own emissions reduction strategy or emissions reduction target, *Adapting to our Changing Climate* does reference the need for climate change mitigation. Other State Government policies that will influence climate change management activities are summarised in the table below.

⁶ Department of Environment and Conservation (2012)

Land Use Planning	<p><i>Directions 2031 (2010)</i>⁷ Provides a high level spatial framework and strategic plan that establishes a vision for future growth of the metropolitan Perth and Peel region; and guides the detailed planning and delivery of housing, infrastructure and services necessary to accommodate a range of growth scenarios.</p>
	<p><i>Draft State Planning Strategy 2012</i>⁸ The Strategy presents a vision for Western Australia to 2050 and beyond based on a framework of planning principles, strategic goals and State strategic directions. The Strategy is the Government's proposed response to the opportunities and challenges Western Australia is likely to face in the future.</p>
Coastal Planning	<p><i>State Coastal Planning Policy 2.6</i>⁹ Provides for the long term sustainability of WA's coast through guiding land use and development decision-making within the coastal zone including managing development and land use change; establishment of coastal foreshore reserves; and to protect, conserve and enhance coastal values.</p>
Water	<p><i>Draft Perth- Peel Regional Water Plan 2010-2030</i>¹⁰ Sets the strategic directions for the sustainable management of the region's water resources to the year 2030. It provides a blueprint for the next 20 years for the management, conservation and development of water resources in the region.</p>
	<p><i>Better Urban Water Management Framework (2008)</i>¹¹ Facilitates better management of urban water resources by ensuring an appropriate level of consideration is given to the total water cycle at each stage of the planning system and provides guidance on the implementation of <i>State Planning Policy 2.9 Water Resources</i>.</p>
	<p><i>Securing Western Australia's Water Future – A Position Paper (2013)</i>¹² Outlines policies which provide increased certainty to water users including key industry sectors such as mining, horticulture and agriculture, and local government, and drives new ways of effectively and efficiently managing water resources.</p>
Transport	<p><i>Draft Gnamangara Sustainability Strategy(2009)</i>¹³ A cross-government initiative working on an action plan that will ensure the sustainable use of water for drinking and commercial purposes and to protect the environment.</p>
	<p><i>Draft Public Transport for Perth in 2031 (2011)</i>¹⁴ This Plan outlines the State Government's vision for improved and expanded public transport in Perth and identifies the main public transport infrastructure needs and the links required between major activity centres.</p> <p><i>Draft WA Bicycle Network Plan 2012 - 2021</i>¹⁵ Provides a blueprint for metropolitan and regional cycle facilities to encourage and support bicycle trips. It identifies appropriate routes and supporting facilities that protect existing routes.</p>

⁷ Department of Planning (2010)

⁸ Department of Planning (2012)

⁹ Department of Planning (2013)

¹⁰ Department of Water (2009)

¹¹ Department for Planning and Infrastructure (2008)

¹² Department of Water (2013)

¹³ Gnamangara Coordinating Committee (2009)

¹⁴ Department of Transport (2011)

¹⁵ Department of Transport (2012)

Health	<i>Health impacts of Climate Change: Adaptation Strategies for Western Australia (2008)</i> ¹⁶ Provides an understanding of the potential health impacts and associated social implications of climate change that may affect the people of Western Australia in the future.
Energy	<i>Energy 2031 (2012)</i> ¹⁷ Outlines a vision and long-term plan for WA's energy sector, providing industry and the community with clarity about the sector's direction and its context for decision-making.
Waste	<i>Western Australian Waste Strategy: Creating the right environment (2012)</i> ¹⁸ Sets the long-term strategic directions and priorities for the way in which waste issues are managed in WA.

Table 6: State government policies relevant to climate change management

1.3.4 National

The Federal Government currently has a target of reducing Australia's greenhouse emissions by five per cent below 2000 levels by 2020.

To achieve this target the Federal Government has outlined a *Direct Action Plan* for emission reductions¹⁹. The central element to the *Direct Action Plan* is an Emissions Reduction Fund to source low-cost emissions reductions and provide incentives for emission reduction activities across the Australian economy. The Emissions Reduction Fund is currently in development.

The Federal Government also supports the National Climate Change Adaptation Research Facility (NCCARF) which is a national interdisciplinary program to generate the information needed by decision-makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts.

¹⁶ Department of Health (2008)

¹⁷ Department of Finance – Public Utilities Office (2012)

¹⁸ Waste Authority (2012)

¹⁹ Department of Environment (2013)

PART 2 - MITIGATION

2.1 GREENHOUSE EMISSIONS

Greenhouse gases occur naturally in the atmosphere where they absorb some of the sun's energy and re-radiate it back into the atmosphere (the remainder of the sun's energy is reflected back into space). This process keeps the earth at a temperature suitable for human life and is called the greenhouse effect. Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs). The enhanced greenhouse effect is where increasing concentrations of greenhouse gases in the atmosphere result in an increased warming of the atmosphere. See Figure 4 below.

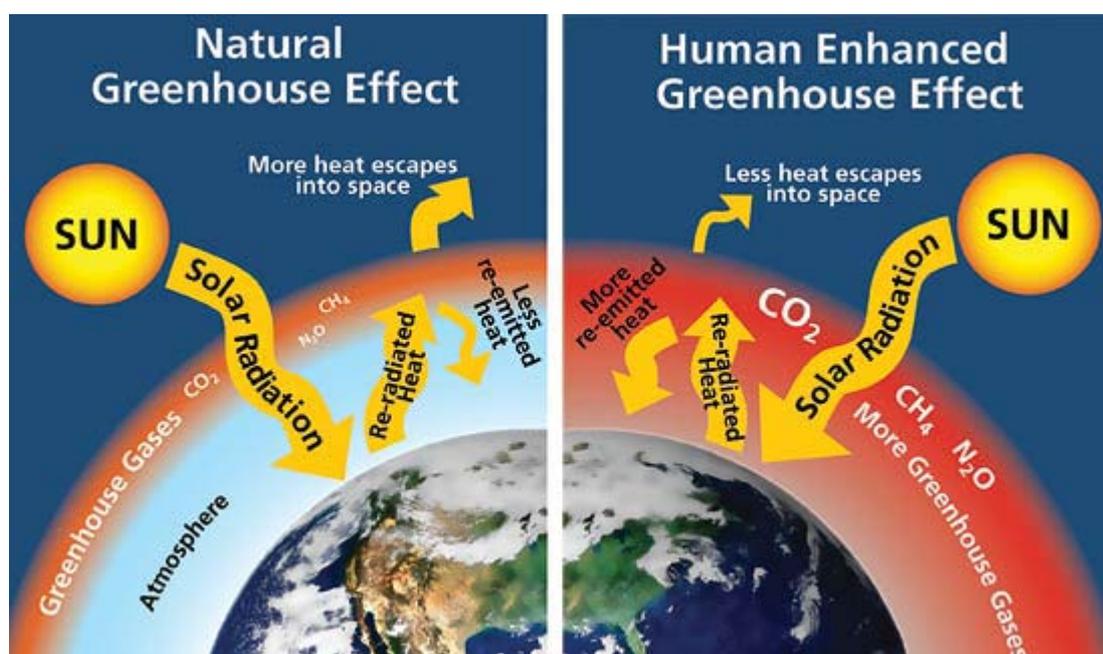


Figure 4: Diagram of the greenhouse effect and enhanced greenhouse effect.

Scientific research has established that this increased concentration of greenhouse gases is a result of human activities. The most recent report from the International Panel for Climate Change (IPCC)²⁰ states *'It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century'*²¹.

²⁰ The IPCC is a scientific body under the auspices of the United Nations (UN). It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change.

²¹ IPCC (2013)

The activities that contribute the most greenhouse gas emissions are:

- burning fossil fuels - such as coal, oil and natural gas in manufacturing processes and to create the energy to run homes, cars, business, industry etc,
- large scale agriculture – which creates methane, and
- land clearing – which releases the carbon dioxide stored in the trees and vegetation.

The IPCC states ‘*The atmospheric concentrations of carbon dioxide (CO₂), methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO₂ concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change*²¹.

	Atmospheric Concentration in 2011 ²²	Increase since preindustrial levels
Carbon Dioxide (CO ₂)	391ppm	40%
Methane (CH ₄)	1803ppb	150%
Nitrous Oxide (N ₂ O)	324ppb	20%

Table 7: Increasing concentrations of key greenhouse gases in the atmosphere²⁰.

Carbon dioxide (CO₂) is the main contributor to climate change, and accounts for about two thirds of greenhouse gases produced by human activities. Methane is not as abundant as CO₂, but is 21 times more effective at trapping heat making it an important greenhouse gas.

2.1.1 Emission Scenarios

The extent of future climate change is dependent upon the amount of greenhouse gases that continue to be emitted into the atmosphere. Government policy, technological development and population increases can all affect the amount of future greenhouse gas emissions. In order to account for this, emission scenarios are used to outline likely levels of greenhouse gas emissions under different assumptions of driving forces i.e. demographic and socioeconomic development, and technological change. These greenhouse concentrations are then used in climate modelling to predict different climate scenarios.

For the Fifth Assessment Report of IPCC, the scientific community has defined a set of four new emission scenarios, called Representative Concentration Pathways (RCPs). They include one mitigation scenario where significant action has been taken to reduce emissions, two different stabilisation scenarios where action is taken to stabilise emissions and one high emissions scenario where emissions continue to increase (see Table 8).

²² ppm (parts per million) or ppb (parts per billion, 1 billion = 1,000 million) is the ratio of the number of gas molecules to the total number of molecules of dry air.

	Concentration GHG's	Global Mean Surface Temperature Change (°C) 2081-2100		Global Mean Sea Level Rise (m) 2081-2100	
		mean	likely range	mean	likely range
RCP2.6 (mitigation)	475ppm	1.0	0.3 to 1.7	0.40	0.26 – 0.55
RCP4.5 (stabilisation)	630ppm	1.8	1.1 to 2.6	0.47	0.32 to 0.63
RCP6.0 (stabilisation)	800ppm	2.2	1.4 to 3.1	0.48	0.33 to 0.63
RCP8.5 (high emissions)	1313ppm	3.7	2.6 to 4.8	0.63	0.45 to 0.82

Table 8: Emission scenarios identified in the IPCC Fifth Assessment Report²⁰

The use of emission scenarios clearly demonstrates the impact that not mitigating future greenhouse emissions will have on temperature and sea level rise.

2.1.2 Reducing Greenhouse Emissions

It is widely agreed that if global temperatures were to rise by more than 2°C above pre-industrial levels the risks will be unacceptably high. If emissions continue to track at the top of the IPCC scenarios, mean global temperature could rise by up to 4.8°C by 2100. If global temperature rise is to be stabilised, substantial and sustained reductions in global carbon emissions will be required. The longer the delay in cutting emissions the greater the scale of change will be²³.

The IPCC reports that to have a *likely chance* of keeping temperature change below 2°C relative to pre-industrial levels then emissions will need to be reduced by 40-70% compared to 2010 by 2050 and to near zero by 2100²⁴.

Substantial and sustained reductions will require broad-based action across many sectors of the global economy. There is no single answer to reducing emissions; rather emissions need to be reduced from a variety of sources in a variety of ways. This may include:

- Using renewable energy (solar, wave and wind).
- Capturing and storing carbon to create 'clean' coal.
- Increasing energy efficiency in industry and manufacturing processes.
- Using alternative fuels for lower emission transport.
- Improving agricultural practices for lower emissions.

²³ Climate Council (2013)

²⁴ IPCC (2014)b

- Decreasing deforestation.
- Removing emissions from the atmosphere through carbon sinks - this is mostly through reforestation as trees absorb carbon dioxide from the atmosphere through the photosynthesis process.

Substantial and sustained reductions will require all spheres of government, business and individuals to contribute to mitigation. Local government alone will not be able to mitigate climate change; however it is important that local government takes action in mitigating its own emissions and supports its residents to mitigate their emissions.

2.2 LOCAL GOVERNMENT AND MITIGATION

2.2.1 Current and Past Achievements

Local government has a well-established record of climate change mitigation including the monitoring of greenhouse gas emissions and the implementation of initiatives to achieve emission reduction targets. The City of Joondalup has been working with the community to reduce energy and greenhouse gas emissions for over a decade and has implemented a number of projects and programs with a focus on energy efficiency and greenhouse gas reduction. Since 2002 the City's net emissions have decreased by 20% through the implementation of energy and greenhouse saving actions within City buildings and facilities and the purchase of greenhouse offsets, this including:

- Installation of geothermal heating to heat the swimming pools at Craigie Leisure Centre.
- Installation of photovoltaic cells on twelve of the City's community buildings.
- Repeated auditing of the City's high energy use buildings to identify energy efficiency improvements.
- The use of light emitting diodes (LED) lighting within public open spaces.
- Community and staff education programs on saving energy in the workplace.
- Diverting waste from landfill through improved resource and materials recovery.
- Purchasing hybrid vehicles and where possible replacing larger vehicles with four cylinder vehicles.
- Purchasing offsets for 100% of its vehicle fleet emissions and for 75% of the electricity consumed at Craigie Leisure Centre and the Joondalup Library, Administration and Civic Centre.

A key example of where the City has undertaken a targeted and effective energy reduction program is the City's flagship recreation facility, Craigie Leisure Centre. Craigie Leisure Centre includes two indoor swimming pools, an outdoor swimming pool, gymnasium, court facilities and meeting rooms. See Case Study Box 1 for information on how energy consumption and greenhouse gas emissions have been reduced at Craigie Leisure Centre.

CITY OF JOONDALUP CRAIGIE LEISURE CENTRE

An example of effective climate change mitigation

The City has significantly reduced the amount of energy consumption and greenhouse gas emissions at Craigie Leisure Centre: the City's largest community recreation facility. Key initiatives include:

- Installation of a geothermal heating system to heat the Centre's swimming pools.
- Installation of 32 kW solar photovoltaic system.
- Installation of a gas boosted solar hot water system to heat the swimming pool showers.
- Monitors have been installed at the Centre to enable Solar PV energy production to be tracked on an hourly, daily, weekly, monthly or annual basis.
- Regular energy audits and energy efficiency improvements.
- Installation of pool blankets on external pools to reduce water heating costs.
- Staff awareness and behaviour change programs.

Craigie Leisure Centre has consistently had the lowest emissions per patronage of all the local governments across Australia that subscribe to the Planet Footprint Service.

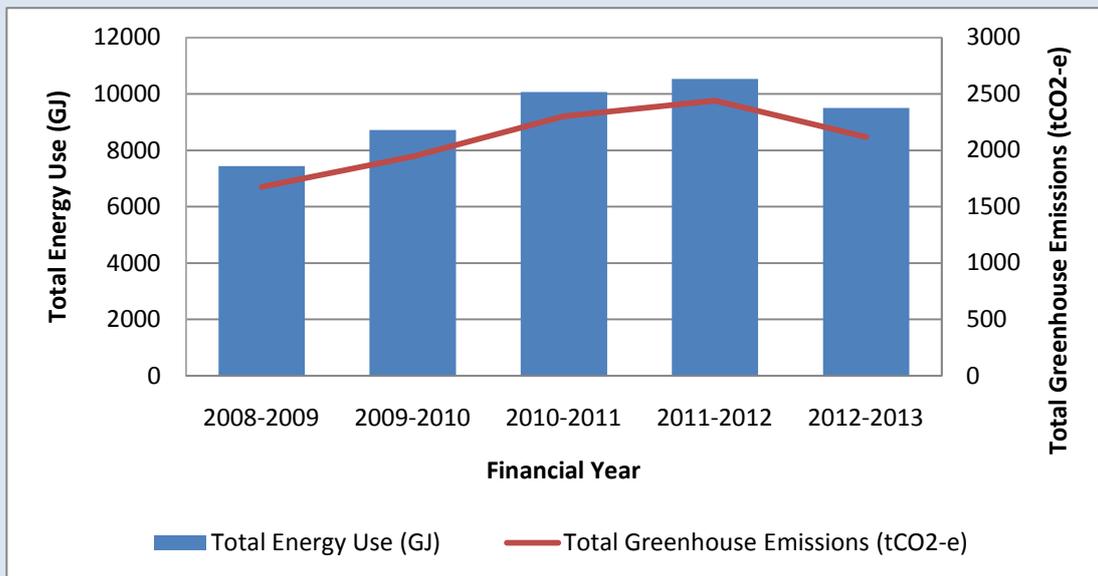


Figure 5: Case Study – Craigie Leisure Centre

2.3 CORPORATE ENERGY USE AND EMISSIONS PROFILE

The City uses energy to power its buildings, community facilities, street lights, public open space lighting, and light and heavy fleet vehicles.

The City uses traditional energy sources which produce greenhouse emissions such as electricity and natural gas, and petrol, liquefied petroleum gas (LPG) and diesel in its fleet vehicles. The City also uses energy from renewable sources (photovoltaic cells, solar hot water systems and geothermal heating) which produce no greenhouse emissions.

In addition, the City collects residential waste for the community which can create greenhouse emissions as a result of waste decomposing in landfill. The more waste that is

diverted from landfill, through reuse and recycling, the fewer the greenhouse emissions are emitted.

It is important for the City to monitor and understand its energy use and greenhouse gas emissions in order to manage and minimise the impact. The City currently monitors its energy use and greenhouse emissions through subscription to the Planet Footprint Program. Planet Footprint collects energy use data from the City's utility providers and uses it to provide the City with quarterly and annual reports. Reports are provided on greenhouse gas emissions, street lighting, fleet and energy (gas and electricity). Planet Footprint also provides individual property reports for the City's buildings. Data obtained through the program informs the delivery of the City's Capital Works Program and is utilised in the City's Annual Report to inform the community on the City's environmental performance.

A summary of the City's energy use and greenhouse gas emissions is provided below.

2.3.1 Energy Use by Sector

The City's total annual corporate energy use in 2012/13 was 101,571GJ. This energy was used across four main sectors:

- Electricity (Facilities) - Electricity is used to power the City's buildings and facilities as well as other items such as public open space lighting, water pumps etc.
- Electricity (Street lights) - Electricity is used to power the City's street lights. Although the City purchases the electricity to power the street lights the infrastructure is owned and operated by Western Power which means the City has limited opportunity to reduce or create efficiencies in the energy use of the street lights.
- Natural Gas - Is generally used in City buildings for hot water supply.
- Fuel (Fleet) - Is used to operate the City's heavy and light vehicle fleet. The City fleet uses a variety of fuel sources: diesel 81.49%, unleaded petrol 15.18% and LPG 3.33%.

Electricity (Facilities) is the largest energy user followed by Electricity (Street lighting), Fleet and then Natural Gas. See Figure 6 below.

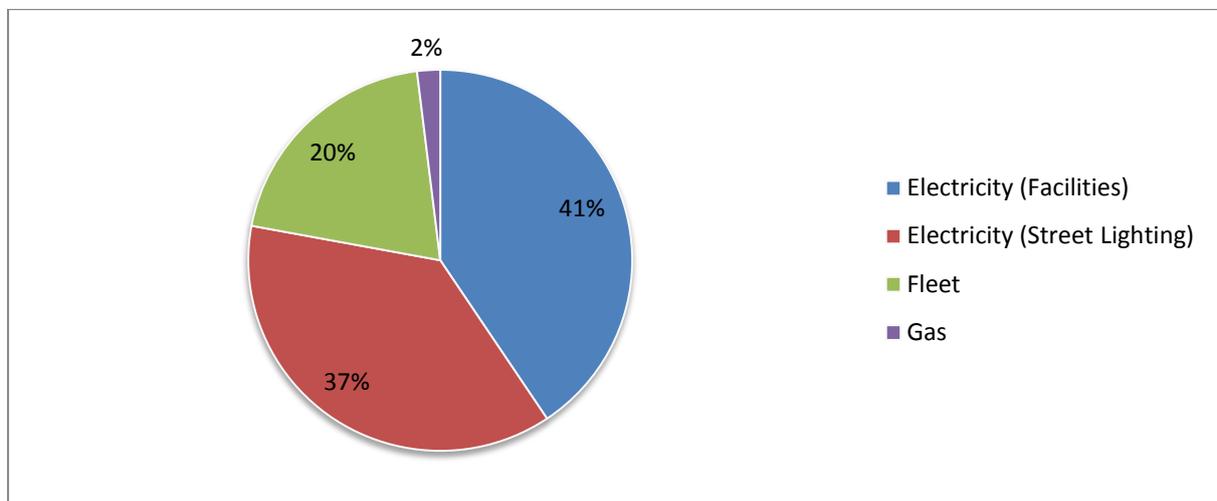


Figure 6: Percentage of Corporate Energy Use by Sector in 2012/13

The City’s energy use has remained relatively consistent since 2010. Energy use from Electricity (Facilities) has been decreasing slightly each year, which can be attributed to the implementation of energy efficiency initiatives. Electricity used for street lighting is calculated from the number of streetlights, type of street light, and hours of operation. In order to have great accuracy in reporting of corporate greenhouse gas emissions, a review of street lighting assets was undertaken. Following the review the City’s inventory of street lights has been updated which resulted in an increase in the calculated energy use from street lighting in 2011/12. Gas and Fleet have both remained consistent. See Figure 7.

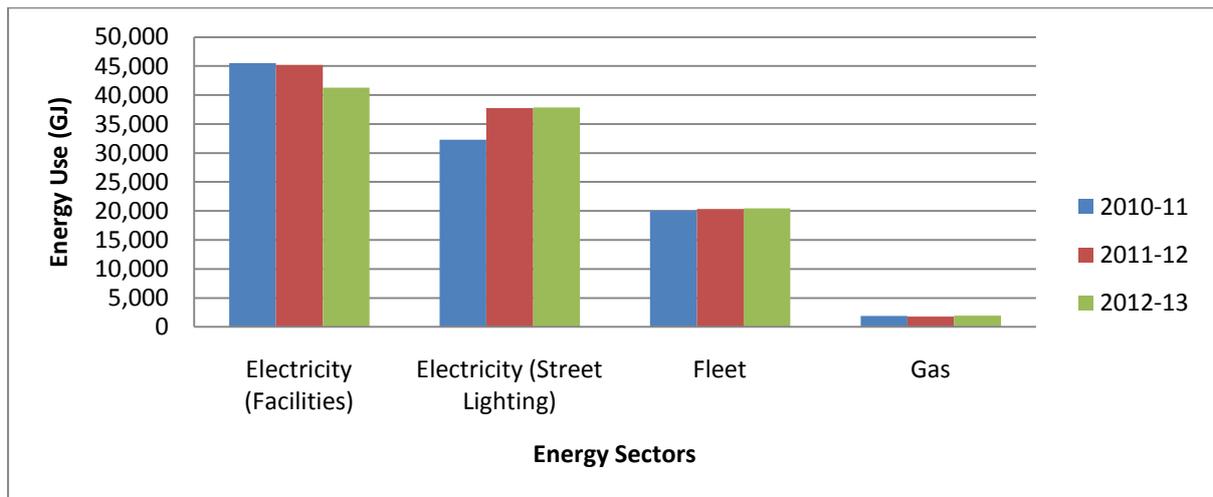


Figure 7: Annual Energy Use by Sector between 2010/11 and 2012/13

2.3.2 Waste Production

As the City is responsible for managing waste created by households, the emissions associated with residential waste are included within the City’s corporate greenhouse gas inventory. The total waste collected by the City from households has been steadily increasing since 2010/11 and in 2012/13 was 93,291 tonnes or 0.57 tonnes per capita. See Figure 8.

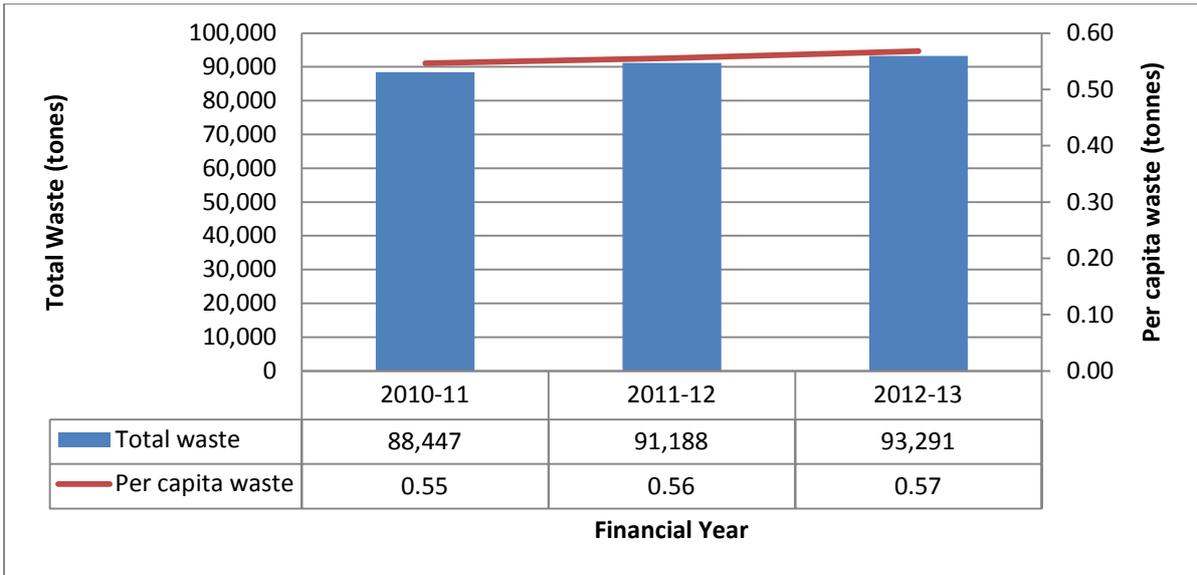


Figure 8: Total Waste and Per Capita Waste from 2010/11 to 2012/13

Over half (57%) of the waste collected by the City from residents is general household waste (green lid bin) while recyclables (yellow lid bin) account for 18%. The remaining 13% of waste is disposed through bulk rubbish collections.

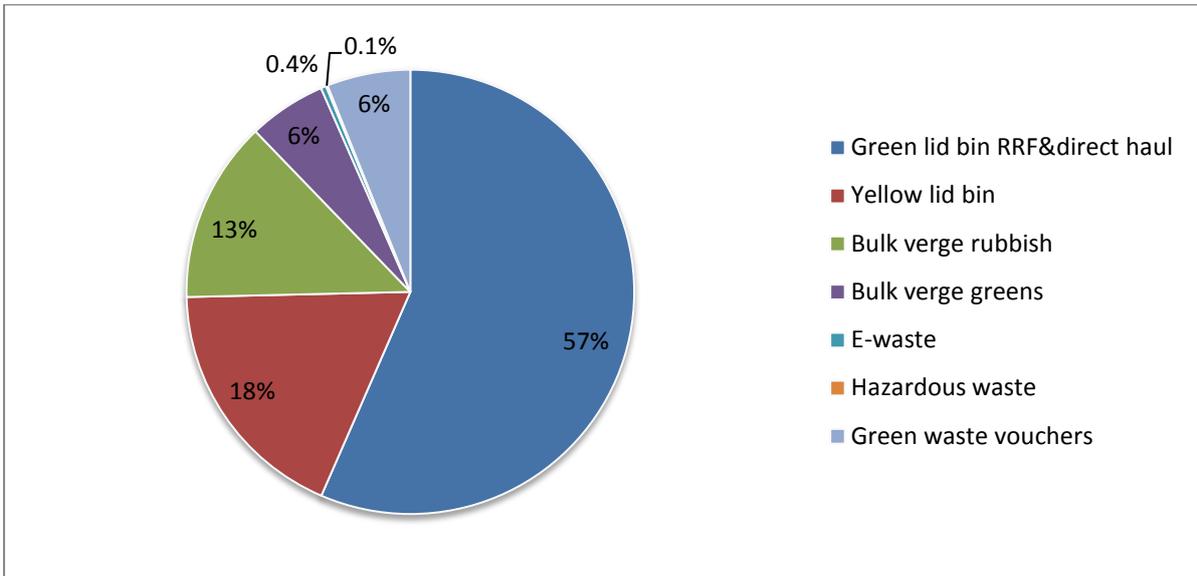


Figure 9: Sources of residential waste in 2012/13.

The City manages household waste to recover and recycle usable materials, this occurs through a number of methods and facilities:

- Materials Recovery – items from the yellow lidded bins are recycled at the Materials Recovery Facility.
- Resource Recovery Facility – organic items from the green lidded bins are recycled at the materials recovery facility, the remaining items are sent to landfill,

- Greens recycling – green waste (i.e. tree prunings etc) that is collected through the bulk verge greens collection or taken to the greens recycling facility are recycled into mulch.
- Landfill – the remaining waste that the City is unable to recycle or recover is sent to landfill.

As waste decomposes in landfill it produces greenhouse gas emissions, therefore it is important that the amount of waste going to landfill is minimised. The City has increased the amount of waste being diverted from landfill over recent years. Between 2010/11 and 2012/13, the amount of waste diverted increased by 3.86%, see Figure 10.

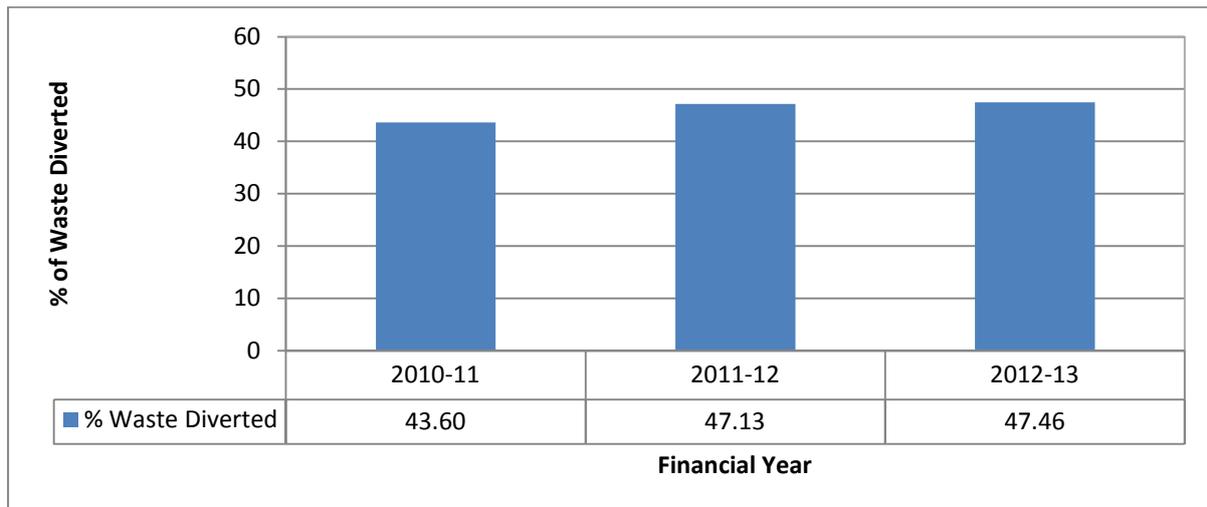


Figure 10: Percentage of waste diverted from landfill annually since 2010/11

2.3.3 Greenhouse Emissions by Sector

Various sources of energy produce different amounts of greenhouse gases therefore it is important to also look at greenhouse emissions by sector. Electricity has the highest emissions intensity and is also the City's largest source of emissions and therefore is an important focus for reducing energy consumption and increasing efficiency. Electricity used within City facilities is likely to offer the most opportunity to reduce emissions. Electricity (Street lighting) is likely to be more difficult to reduce or change as the infrastructure is owned by Western Power; however opportunities for improving efficiency and reducing emissions in this sector will be investigated.

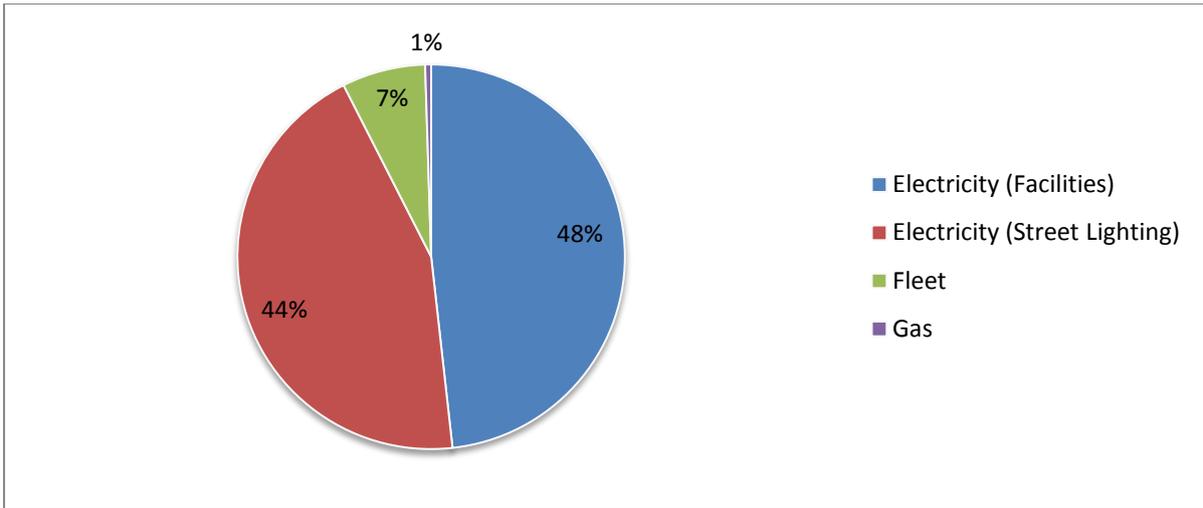


Figure 11: Percentage of Corporate greenhouse gas emissions by sector

The City's total annual Corporate emissions have remained consistent in recent years. The City's most recent emissions data 2012/13 will be used as the base year for future reporting and comparison of data for future years. The City's total GHG emissions in 2012/13 were 21,852 tonnes CO₂-e (equivalent) which equates to 133.1kg CO₂-e per capita.

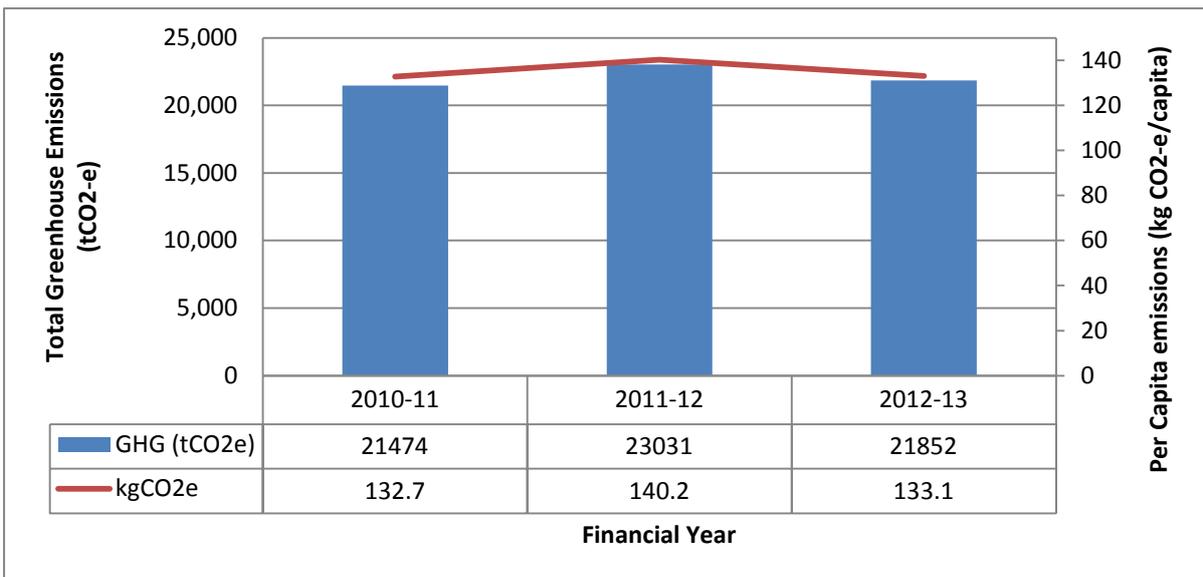


Figure 12: City of Joondalup total annual Corporate greenhouse gas emissions and per capita emissions since 2010/11

2.3.4 Renewable Energy

The City currently uses three types of renewable energy: solar energy, solar hot water and geothermal heating. While the total energy created from renewable energy accounts for a small proportion of the City's overall Corporate energy consumption (0.6%) renewable energy does not create greenhouse emissions and provides important public demonstration opportunities.

Solar Energy – The City has installed photovoltaic renewable energy systems on eleven of its community facilities. In 2012/13 the systems produced in total 493GJ (or 137067kWh) of electricity (note not all were online for the entire year). This is equivalent to powering 21 average Australian homes for an entire year.

Solar Hot Water – In 2012/13 the City installed a solar hot water system at Craigie Leisure Centre to provide hot water for the shower facilities at the Centre’s pool. Estimated average daily production from this system is calculated to be 89.4kWh equating to 117GJ annually; providing approximately 33% of the hot water demand with the remainder supplied by natural gas. In 2013/14 the City installed a further 15 solar hot water systems at seven locations. However, as these additional systems were installed in 2013/14 they are not included in the 2012/13 baseline year data.

Geothermal Heating - A geothermal bore and heat exchange pump is used to heat the pools at Craigie Leisure Centre. The energy provided per annum by this heat pump is calculated to be 3537GJ. An estimated 38,000 tonnes CO₂-e will be saved over the 30 year life expectancy of the system or 933 t CO₂-e per year.

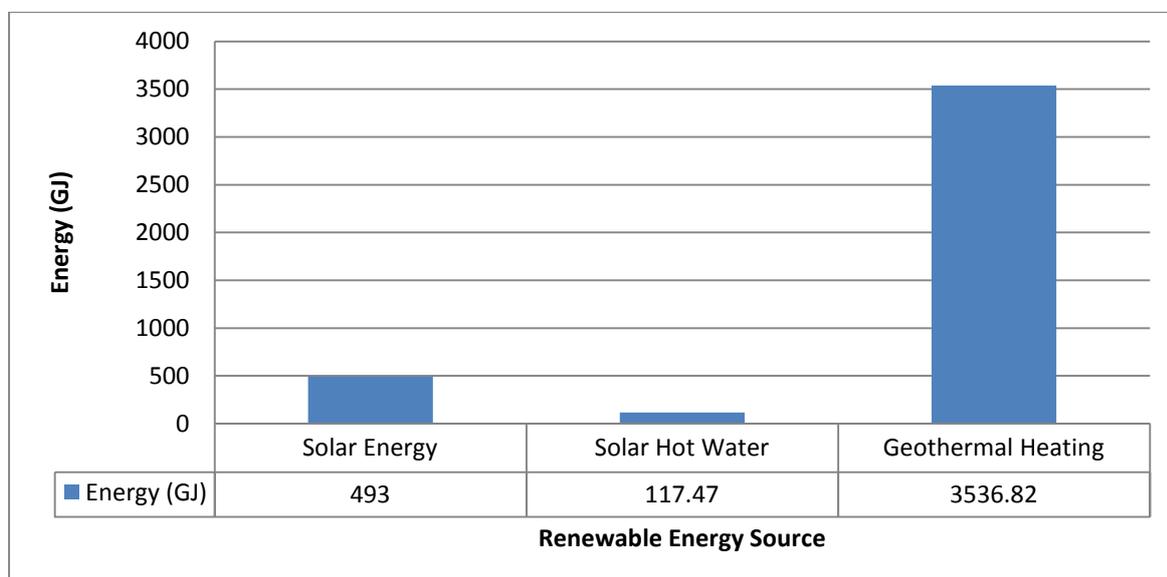


Figure 13: Total energy produced from renewable energy sources in 2012/13

2.3.5 Carbon Offsets and Net Emissions

The purchase of carbon offsets is an effective mitigation strategy and will reduce the City’s net emissions. Carbon offsets are credits for reductions in greenhouse gas emissions made at another location either through carbon sequestration or renewable energy projects. For carbon sequestration this usually involves the planting of trees or other methods that absorb emissions from the atmosphere. For renewable energy projects this involves the funding of renewable energy projects at another location such as wind farms which create renewable energy and reduce the need for fossil-fuel powered energy.

Using offsets does not mean the City is reducing its Total Emissions as those emissions are still being produced; however it does reduce the City’s net emissions as it mitigates the effect of the emissions that are unavoidable by reducing emissions elsewhere. It also has

the added benefit of either supporting re-forestation projects or supporting the renewable energy industry.

The City currently purchases offsets for 100% of its vehicle fleet emissions and for 75% of the electricity consumed at Craigie Leisure Centre and the Joondalup Library, Administration and Civic Centre. This purchase of offsets makes a significant contribution to reducing the City's net emissions.

In 2012/13 the City offset 5333 t CO₂-e which is equivalent to offsetting approximately 24% of the City's total emissions, resulting in net emissions of 16,519 t CO₂-e, see Figure 14. Per capita emissions in 2013 were 100.6 kg CO₂-e per capita.

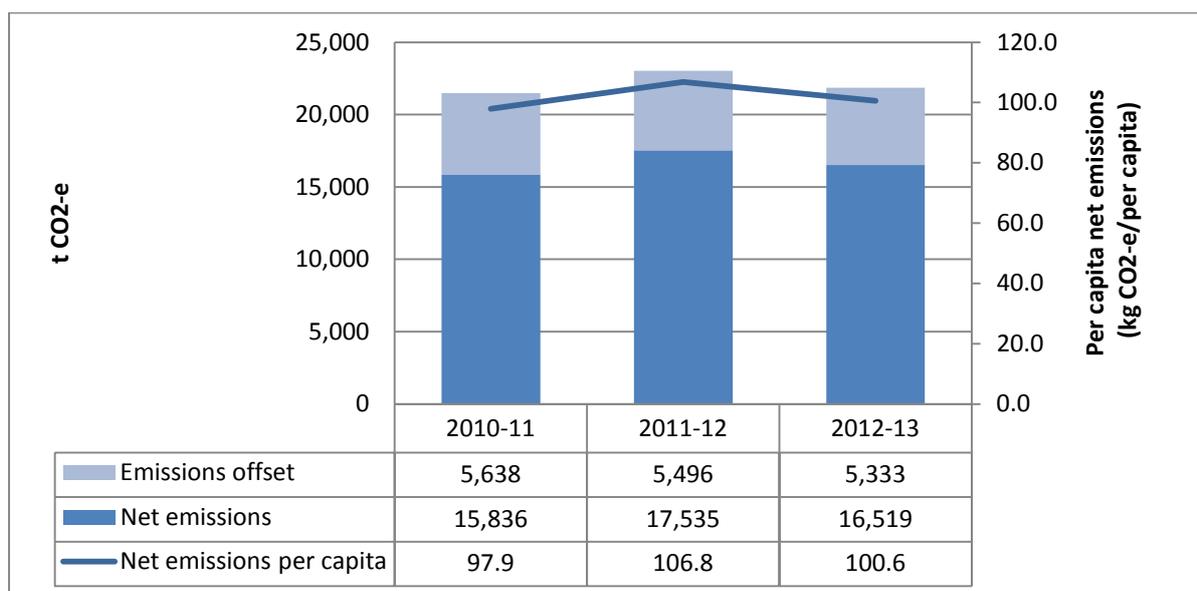


Figure 14: City of Joondalup net emissions and amount of emissions offset (note: net emissions + offsets = total emissions)

2.4 COMMUNITY ENERGY USE PROFILE

The City of Joondalup is located in the northern suburbs of Perth, between 15 and 30km north of the Perth CBD. The City is predominantly residential, with some commercial and industrial areas. The City encompasses a total land area of about 99 km², including substantial areas of coastline, parkland, foreshore reserves and bushland.

2.4.1 Community Profile

Population

The Estimated Resident Population (ERP) for the City of Joondalup in 2012 was 164,737²⁵

²⁵ Profile i.d (2013)

Compared to Greater Perth the City of Joondalup had a higher proportion of people in the younger age groups (0 to 17 years) and a lower proportion of people in the older age groups (60+ years) in 2011. Overall, 24.0% of the population was aged between 0 and 17, and 17.1% were aged 60 years and over, compared with 23.3% and 17.8% respectively for Greater Perth.

The largest changes in age structure for the City between 2006 and 2011 were in the age groups:

- Empty nesters and retirees (60 to 69) (+4,608 persons)
- Parents and homebuilders (35 to 49) (-1,952 persons)
- Secondary schoolers (12 to 17) (-1,625 persons)
- Seniors (70 to 84) (+1,060 persons)

Housing

There are 58,560 dwellings in the City and over 90% are described as a separate house and only 1.6% of dwellings considered as high density. Overall, 33.0% of the population owned their dwelling; 45.0% were purchasing, and 17.8% were renting, compared with 28.1%, 38.0% and 26.7% respectively for Greater Perth.

Compared with Greater Perth the City had a lower proportion of lone person households, and a higher proportion of larger households (those with 4 persons or more). Overall there were 16.7% of lone person households, and 31.6% of larger households, compared with 23.6% and 26.0% respectively for Greater Perth.

Journey to Work

In 2011, 26.6% of City of Joondalup's working residents were employed locally and this proportion has increased since 2006. In 2011, there were 11.3% people who caught public transport to work (train, bus, tram or ferry), compared with 69% who drove in private vehicles (car – as driver, car – as passenger, motorbike, or truck). Only 1.3% walked and 0.5% cycled.²⁶

Employment and Income

83,021 people living in the City of Joondalup are employed, of which 61% are working full time and 38% part time. Households in the City are relatively well off with a larger proportion of high income households (those earning \$2,500 per week or more) and a lower proportion of low income households (those earning less than \$600 per week), compared to Greater Perth.

2.4.2 Community Energy Use

Energy use data at a local government scale is difficult to obtain, however Synergy has provided the City with the average daily consumption data for each of the City's suburbs for

²⁶ Economy.id (2013)

2012. Average energy use within the City’s community is higher than the Perth average. Awareness of high energy consuming suburbs allows the City to target community education programs to encourage energy efficiency and energy conservation within these areas.

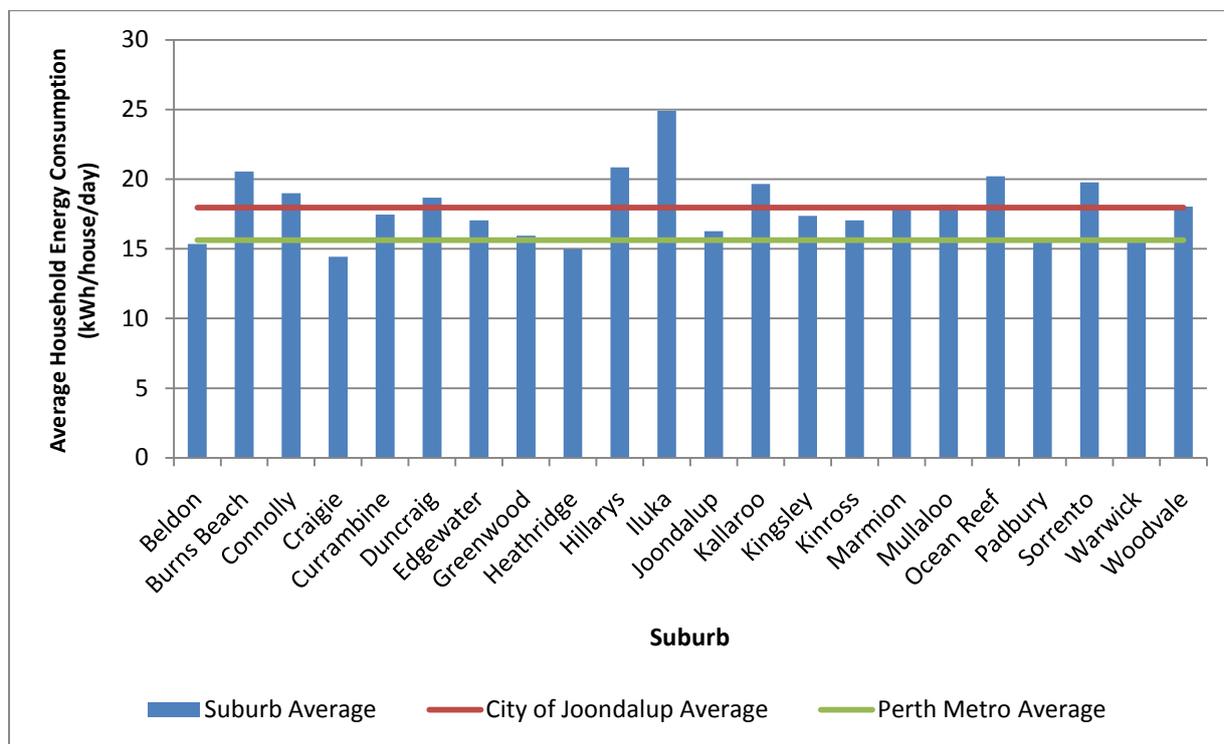


Figure 15: Average daily energy consumption by City of Joondalup suburb

2.5 AN APPROACH FOR CONTINUED MITIGATION

The City has been undertaking energy reduction and efficiency improvements for some time and has made significant progress in reducing corporate energy consumption and greenhouse gas emissions. This means that many of the ‘easier’ low-cost energy management options have already been implemented.

However there are still significant opportunities for the City to continue to undertake effective energy management actions and continue to contribute to the mitigation of climate change. A Climate Change Mitigation Framework has been developed to provide direction for the City’s climate change mitigation activities to ensure a strategic, cost effective approach is taken that achieves the maximum amount of emission reduction.

2.5.1 Climate Change Mitigation Framework

The Climate Change Mitigation Framework outlines three approaches for reducing emissions: reducing energy use, using lower emission energy sources and purchasing offsets. The Framework is outlined in Table 9. For each approach a number of priorities have been identified based on an assessment of the City’s corporate energy use profile.

Approach	Description	Priorities
Reducing Energy Use	Reducing energy use through energy efficiency and energy reduction activities.	<p>Target electricity use as it has the highest emission intensity.</p> <p>Target highest energy using buildings.</p> <p>Retrofit energy efficient technologies.</p> <p>Reduce standby power and overnight electricity use.</p> <p>Improve staff energy use behaviours.</p>
Using Lower Emission Energy Sources	Using lower emission energy sources preferably renewable energy.	<p>Use of renewable energy within community buildings and facilities to maximise education and awareness raising opportunities.</p> <p>Fleet vehicles (i.e. alternative fuels).</p> <p>Sustainable lighting (lighting that creates lower emissions i.e. LED, solar etc.).</p>
Purchasing Offsets	Offsetting the City's emissions through the purchase of carbon offsets.	Purchase offsets to reduce net emissions when 1 st tier and 2 nd tier options are not viable.

Table 9: City of Joondalup Climate Change Mitigation Framework

This Framework formalises the City's existing approach to mitigation and will also provide guidance when planning the City's future mitigation activities. Benefits and disadvantages of each approach are summarised in the table below.

Approach	Benefits	Disadvantages
Reducing Energy Use	<p>Can have lower upfront costs</p> <p>Reduces energy consumption and ongoing energy costs.</p>	May only result in smaller emission reductions.
Using Lower Emission Energy Sources	<p>Reduces consumption from mains electricity and ongoing energy costs.</p> <p>Protects the City against rising energy costs.</p>	<p>Higher upfront costs.</p> <p>Not financially viable for all buildings.</p>
Purchasing Offsets	<p>Can provide large reductions in net emissions.</p> <p>Lower upfront costs.</p>	<p>Does not reduce energy consumption or energy costs.</p> <p>Costs to purchase offsets can be significant and needs to be purchased annually.</p>

Table 10: Benefits and disadvantages of three climate change mitigation approaches

While a combination of all three approaches is likely to result in the greatest emission reductions, where possible the City should consider reductions initially through reducing energy use, as this is the most cost effective approach.

PART 3 – ADAPTATION

In order to minimise the risk to the City from climate change the City must first understand how the City’s climate is likely to change and second how that change will impact on the City’s infrastructure, operations activities and services as well as its environment and community.

3.1 A CHANGING CLIMATE

Climate change science and research is a constantly evolving field with ongoing improvements in climate change modelling and projections. Research is being conducted on a local, national and international level. Local scale research is the most relevant for informing and guiding the City’s climate change management activities. However the City still needs to be cognisant of global scale research as the nature of climate change means that global changes may still impact at the local level. Key research initiatives that have informed the development of this Strategy and that will continue to guide the City’s climate change activities are summarised in the table below.

Intergovernmental Panel on Climate Change (IPCC)	The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. www.ipcc.ch
CSIRO Climate Change Program	The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia’s leading research organisation. Its climate change program provides comprehensive, rigorous science to help Australia understand, respond to, and plan for, a changing climate. www.csiro.au/outcomes/climate
Australian Climate Change Science Program	The Australian Climate Change Science Programme (ACCSP) is a key driver of Australia’s climate change research effort and plays a significant role in informing the development of Australia’s climate change policies. www.cawcr.gov.au/projects/climatechange
National Climate Change Adaptation Research Facility (NCCARF)	National Climate Change Adaptation Research Facility (NCCARF) is a national interdisciplinary effort to generate the information needed by decision-makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts. www.nccarf.edu.au
Indian Ocean Climate Initiative (IOCI)	Indian Ocean Climate Initiative (IOCI) is a partnership of the State, CSIRO, and the Bureau of Meteorology (BOM), formed by the Western Australian Government to support informed decision-making, on climate variability and change in Western Australia. www.ioci.org.au

Table 11: Key Climate Change Research Initiatives

Climate change research has largely been focused on four different themes: current climate change, current climate change impacts, future climate change, and future climate change impacts. A description of these research areas and key documents are outlined in Table 12.

	Research Theme	Key documents
Current climate change	How is the climate changing now?	CSIRO and BOM (2014) State of the Climate 2014. ²⁷ CSIRO (2007) Climate Change in Australia- Technical Report. ²⁸ IPCC (2013) Climate Change 2013: The Physical Science Basis. Summary for Policymakers. Fifth Assessment Report. ²⁰
Current climate change impacts	How are current climate changes impacting the environment and society?	IPCC (2014) Climate Change 2014: Impacts, Adaptation and Vulnerability. Summary for Policymakers. Fifth Assessment Report. ²⁹ Climate Commission (2011) The Critical Decade: Western Australian Climate Change Impacts. ³⁰ Steffen W et al (2009) Australia's Biodiversity and Climate Change. A strategic assessment of the vulnerability of Australia's biodiversity to climate change. ³¹
Future climate change	What changes in climate can be expected in the future?	IPCC (2014) Climate Change 2014: Impacts, Adaptation and Vulnerability. Summary for Policymakers. Fifth Assessment Report. ²⁹ CSIRO (2007) Climate Change in Australia- Technical Report. ²³ Indian Ocean Climate Initiative (2012) Western Australia's Weather and Climate: A Synthesis of Indian Ocean Climate Initiative Stage 3 Research. CSIRO and BoM, Australia. ³²
Future climate change impacts	How will these future climate changes impact the environment and society?	IPCC (2014) Climate Change 2014: Impacts, Adaptation and Vulnerability. Summary for Policymakers. Fifth Assessment Report. ²⁹ IPCC (2014) Climate Change 2014: Mitigation of Climate Change. Summary for Policymakers. Fifth Assessment Report. ³³ National Climate Change Adaptation Research Facility (2013) Supporting evidence-based adaptation decision-making in Western Australia. A synthesis of climate change adaptation research. ³⁴ Australian Government (2009) Australia's Biodiversity

²⁷ CSIRO and BOM (2014)

²⁸ CSIRO (2007)

²⁹ IPCC (2014)a

³⁰ Climate Commission (2011)

³¹ Steffen W et al (2009)

³² IOCI (2012)

³³ IPCC (2014)b

³⁴ NCCARF (2013)

Adaptation		<p>and Climate Change. A strategic assessment of the vulnerability of Australia's biodiversity to climate change.</p> <p>Department of Climate Change (2009) Climate Change Risks to Australia's Coast - A first pass national assessment.³⁵</p> <p>Department of Climate Change and Energy Efficiency (2011) Climate Change Risks to Coastal Buildings and Infrastructure - A Supplement to the First Pass National Assessment.³⁶</p>
	How can environment and society adapt to these impacts?	<p>IPCC (2014) Climate Change 2014: Mitigation of Climate Change. Summary for Policymakers. Fifth Assessment Report.³³</p> <p>National Climate Change Adaptation Research Facility (2013) Supporting evidence-based adaptation decision-making in Western Australia. A synthesis of climate change adaptation research.²⁶</p> <p>Department of Climate Change and Energy Efficiency (2011) Coastal Climate Change Risk-- Legal and Policy Responses in Australia.³⁷</p> <p>Engineers Australia (2012) Climate Change adaptation guidelines in coastal management and planning.³⁸</p> <p>Department of Health (2008) Health Impacts of Climate Change: Adaptation Strategies for Western Australia.³⁹</p>

Table 12: Climate change research themes and key documents

3.1.1 Current Climate Change

It is clear that the climate is already changing. Understanding current climate change will help the City to prepare for future climate change and will also provide examples of best management practice in adaptation planning and implementation.

The IPCC states that *'Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased (IPCC, 2013).'*

At a global scale the IPCC report⁴⁰ found:

- Global average temperature has increased by 0.85 (0.65 to 1.06) °C between 1880 and 2012,

³⁵ Department of Climate Change (2009)

³⁶ Department of Climate Change and Energy Efficiency (2011)

³⁷ Department of Climate Change and Energy Efficiency (2011)

³⁸ Engineers Australia (2012)

³⁹ Department of Health (2008)

⁴⁰ IPCC (2013)

- It is *very likely* that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale,
- There are *likely* more land regions where the number of heavy precipitation events has increased than where it has decreased,
- It is *likely* that the frequency of heat waves has increased in large parts of Europe, Asia and Australia.
- There is high confidence that over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent.
- Over the period 1901–2010, global mean sea level rose by 0.19 [0.17 to 0.21] m.

At a local scale the south-west of Western Australia (which includes the City of Joondalup) has been the focus of research by the Indian Ocean Climate Initiative (IOCI) which has identified significant climate change occurring in the region. These changes include increased temperatures, increase in sea levels, decrease in rainfall, more intense storm events and increased storm surge. See Table 13.

↑ TEMPERATURE	The long term trend in WA's average temperature has been steadily increasing since the 1950's. Overall temperature has risen approximately 0.8°C in this time ⁴¹ .
↑ SEA LEVEL	Sea level along the west coast of Australia has been rising at more than double the global average. In Perth it is estimated that sea-level rose 7.4mm /yr between the early 1990's and 2010 ³⁴ .
↓ RAINFALL	The south-west of WA has had a 15% reduction in rainfall since the mid-1970s. This is a result of fewer winter low pressure systems, more prevalent high pressure systems and, since 2000, a decrease in the rainfall associated with each system ⁴² .
STORM SURGE	Current research suggests that storminess and therefore storm surge have increased for the south-west Western Australian coastline in the past forty to sixty years ⁴³⁴⁴ .

Table 13: Summary of current climate change in the south-west of Western Australia

3.1.2 Current Climate Change Impacts

The changing climate is already impacting on the environment, communities and government practices. The impacts being experienced are varied but the most significant current impacts for the south-west of WA (including the City of Joondalup) are; reduced water availability, impacts on biodiversity and coastal erosion.

⁴¹ Climate Commission (2011)

⁴² IOCI (2010)

⁴³ Bosserelle, Pattiaratchi and Haigh (2012)

⁴⁴ Haigh (2009)

Reduced water availability

One of the key issues for the south-west of Western Australia is water availability. Reduced rainfall has resulted in a significant decrease in the annual stream flow into Perth dams. Between 1911 and 1974 average annual stream inflow into Perth's dams was 338 Gigalitres (GL); between 2006 and 2012 it was only 65.8GL, representing approximately an 80% decrease, see Figure 16.

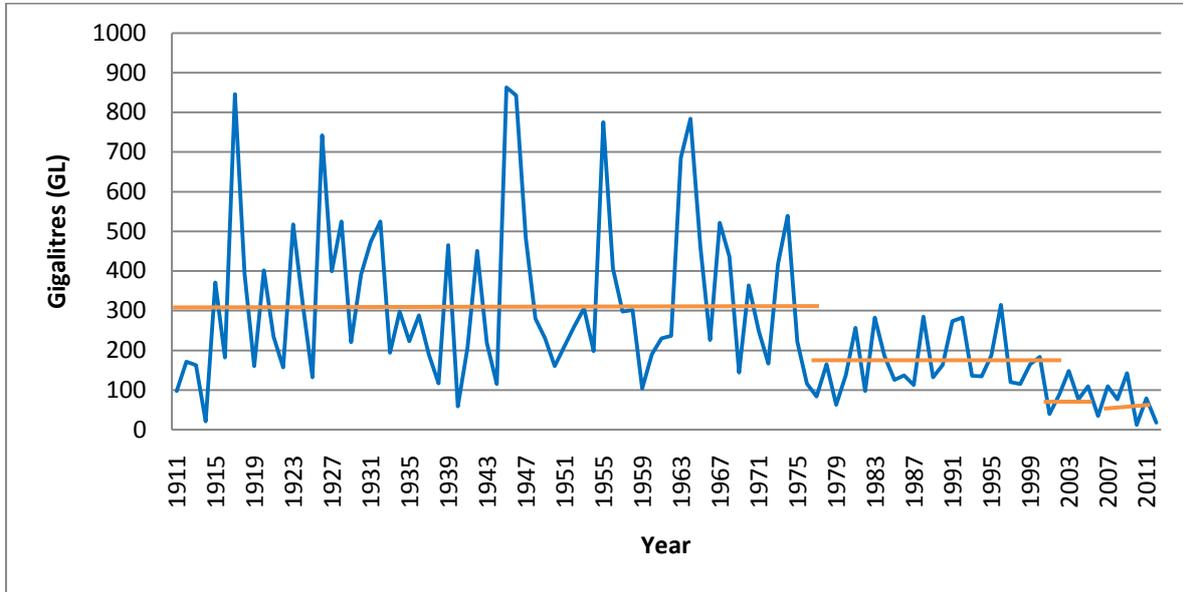


Figure 16: Annual stream inflow (GL) into Perth dams⁴⁵.

Reduced stream inflow affects water availability for the Perth Metropolitan Area and increases pressure on groundwater resources. The resulting reliance on groundwater extraction has resulted in more stringent management and monitoring of groundwater use by the State Government which has meant large users such as the local government sector have had to adapt and significantly reduce groundwater use.

The Department of Water is facilitating reform of water resources legislation to ensure a more equitable, transparent and sustainable approach to groundwater allocations and management. Local governments will need to prepare for the possibility of changes to the amount of groundwater that is available for use for irrigation purposes.

The City's groundwater management program is an important example of how the City is already being impacted by a changing climate and how the City can successfully adapt. See the Case Study in Figure 17, for more information.

⁴⁵ Water Corporation (2013)

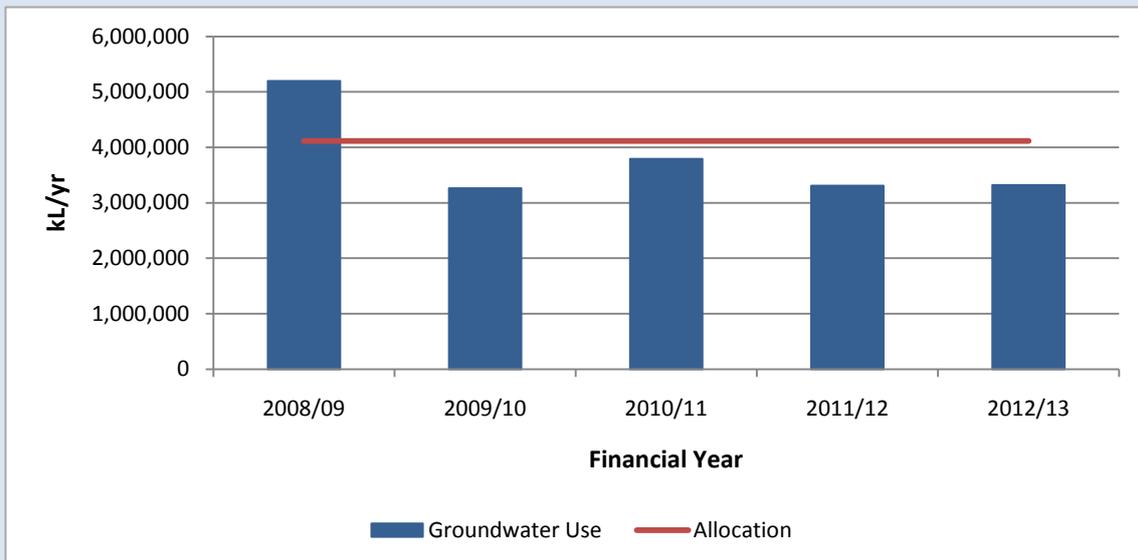
CITY OF JOONDALUP GROUNDWATER MANAGEMENT PROGRAM

An example of adaptation already in action

During the past 5 years the City has made significant progress in monitoring and management of groundwater use resulting in significant reductions in consumption. Key developments include:

- Installation of monitors on all bores and ongoing monthly data collection.
- Establishment of a bore maintenance and replacement program.
- Use of iPads to access evaporation rates and rainfall in order to determine watering regimes.
- Soil moisture sensors have been installed at key parks to monitor moisture at four depths in the soil profile to inform watering regimes and prevent over watering.
- Use of hydrozoning¹ and ecozoning² in parks and open spaces to reduce watering requirements. This approach has been successful in reducing groundwater use by up to 50% in some parks.

The Groundwater Management Program has resulted in a reduction of groundwater consumption of 37% since 2008/09. This has meant the City has remained well under its Department of Water allocation targets every year since 2009/10.



¹ Hydrozoning involves establishing separate zones within a park to receive different amounts of irrigation.

² Ecozoning relates to a grouping of plants with similar watering requirements.

Figure 17: Case Study – City of Joondalup Groundwater Management Program

Impacts on Biodiversity

The south-west of Western Australia is Australia's only international biodiversity hotspot and has the highest concentration of rare and endangered species on the continent. The concentration of endemic species⁴⁶ is particularly high⁴⁷.

There is evidence that biodiversity in south-west Western Australia is already responding to climate change⁴⁸. Bird migration is, amongst other factors, cued by temperature change. In the south-west of Western Australia the arrival and departure times of certain migratory birds has significantly altered in a manner that is consistent with current climatic changes⁴⁹.

Carnaby's black cockatoo is endemic to south-west Western Australia and has undergone a rapid decline over the last century, largely due to habitat destruction and land clearing. Climate change is also starting to impact on this already endangered species. Between October 2009 and March 2010 the species was subjected to a possible outbreak of disease in one of its major breeding areas and exposed to an extremely hot day and a severe localised hail storm leading to fatalities⁵⁰.

Coastal Erosion and Inundation

Coastal erosion and inundation can occur along a coastline due to increased sea levels as a result of mean sea level rise.⁵¹ Severe storm events have the potential to cause increased erosion to a shoreline, through the combination of higher, steeper waves generated by sustained strong winds, and increased water levels. While there is currently limited scientific evidence to suggest that extreme sea levels above the mean sea level (i.e. storm surge) are being impacted by climate change^{52,53}: there is anecdotal evidence that increased incidences of coastal erosion and flooding is occurring and is associated with storm events along the south-west of Western Australia. Coastal erosion along the City of Joondalup coastline, is evidenced in the below photos. Coastal erosion affects not just sandy areas but also dunal vegetation and infrastructure such as fencing and paths.

In order to determine the level of risk from climate change to the City's coastal zone and to provide information to assist the City in planning future coastal protection measures, a series of Coastal Vulnerability Studies are being undertaken.

⁴⁶ Endemic species are those that evolved in the region and are generally found nowhere else.

⁴⁷ Conservation International (2013)

⁴⁸ Climate Commission (2011)

⁴⁹ Chambers LE (2008)

⁵⁰ Saunders et al (2011)

⁵¹ Department of Climate Change (2009)

⁵² Haigh (2009)

⁵³ Bosserelle, Pattiaratchi and Haigh (2012)

Coastal Vulnerability Studies have been completed between Marmion and Sorrento, and Hillarys to Ocean Reef. The final stage, Ocean Reef to Burns Beach will be completed in 2013/14.

Outcomes of the Coastal Vulnerability Studies will be incorporated into the Coastal Adaptation Planning and Implementation Project, see Appendix A for more information.



Figure 18: Coastal erosion and dune movement at Whitfords Nodes South

3.1.3 Future Climate Change

The scientific community has undertaken extensive research to predict how the climate will change on a global, national and local scale. The extent of change is dependent on both the amount of greenhouse gases that continue to be emitted and how the environment responds to changing temperatures.

For the purposes of the City's Climate Change Strategy, and to aid future planning, the City has adopted the most likely climate change scenario based on the best available science and a number of assumptions regarding future levels of greenhouse gases and responses on a global and local scale. This scenario is consistent with those used by other local

governments in Western Australia who have undertaken climate change adaptation planning and is consistent with current research that demonstrates emissions are currently tracking most closely to the A1FI⁵⁴ emissions scenario⁵⁵.

The climate change scenario used provides a picture of what the climate will be like in the City of Joondalup in 2070 compared to 1990. Generally it can be expected that in 2070 the City of Joondalup will have hotter, drier and windier summers with the number of days over 35°C nearly doubling. Winters will be drier, warmer and less windy as a result of fewer low pressure systems. See Figure 19 for more detail.

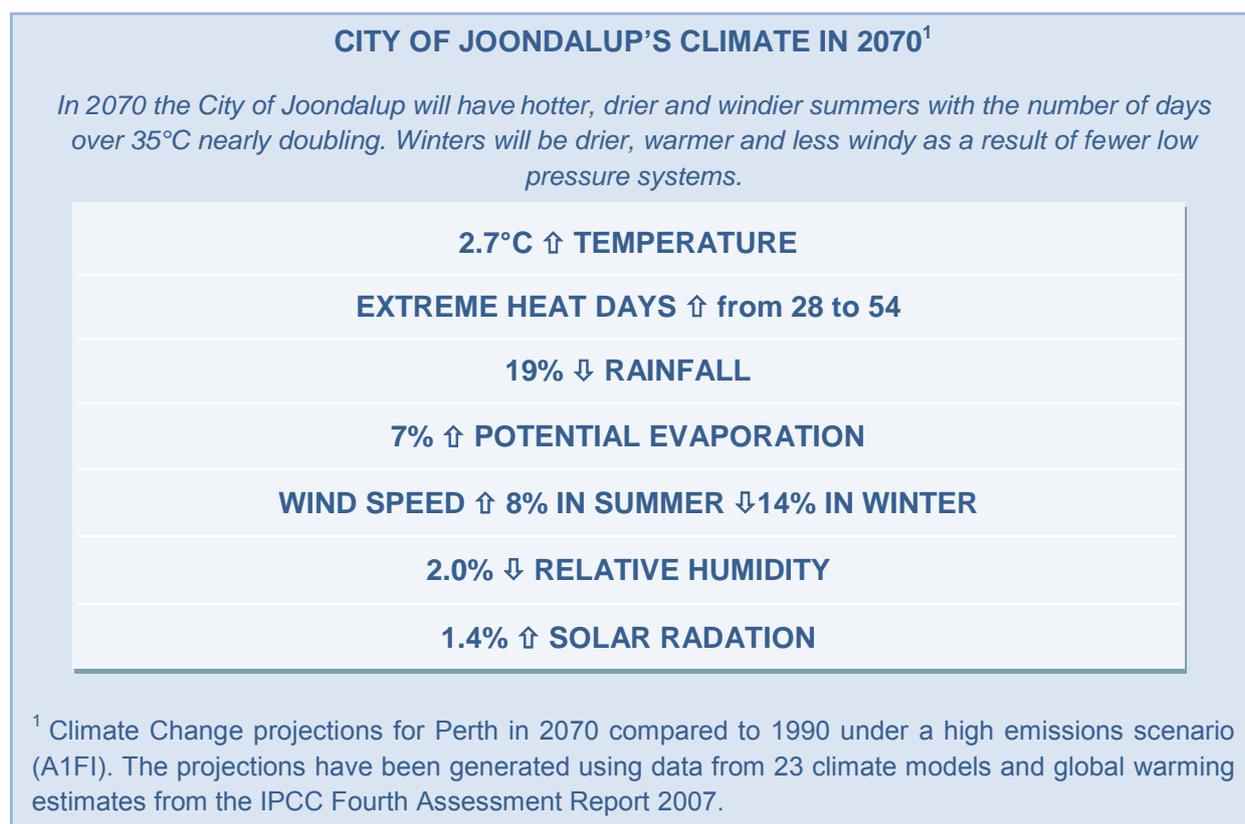


Figure 19: Climate Change Scenario for the City of Joondalup in 2070⁵⁶

3.1.4 Future climate change impacts

Identifying future climate change impacts is an important area of research being undertaken by a variety of organisations and includes topics such as bushfire risk, coastal erosion and vulnerability, impacts on biodiversity and the natural environment, impacts on buildings and infrastructure, and impact on community health and wellbeing. Outcomes of the research

⁵⁴ A1FI emissions scenario is a high emissions scenario defined in IPCC Fourth Assessment Report. Note more recent emission scenarios have been released in the IPCC Fifth assessment report; however corresponding climate projections have not yet been released.

⁵⁵ IOCI (2012)

⁵⁶ CSIRO (2007)

can provide the City with useful tools for managing climate change activities and adaptation planning.

As a result of the climatic changes described above, a number of climate change impacts can be expected. These include rising sea levels and increased storm inundation, increased numbers and intensity of bushfires, and increased number of drought months and reduced water availability, see Figure 20.

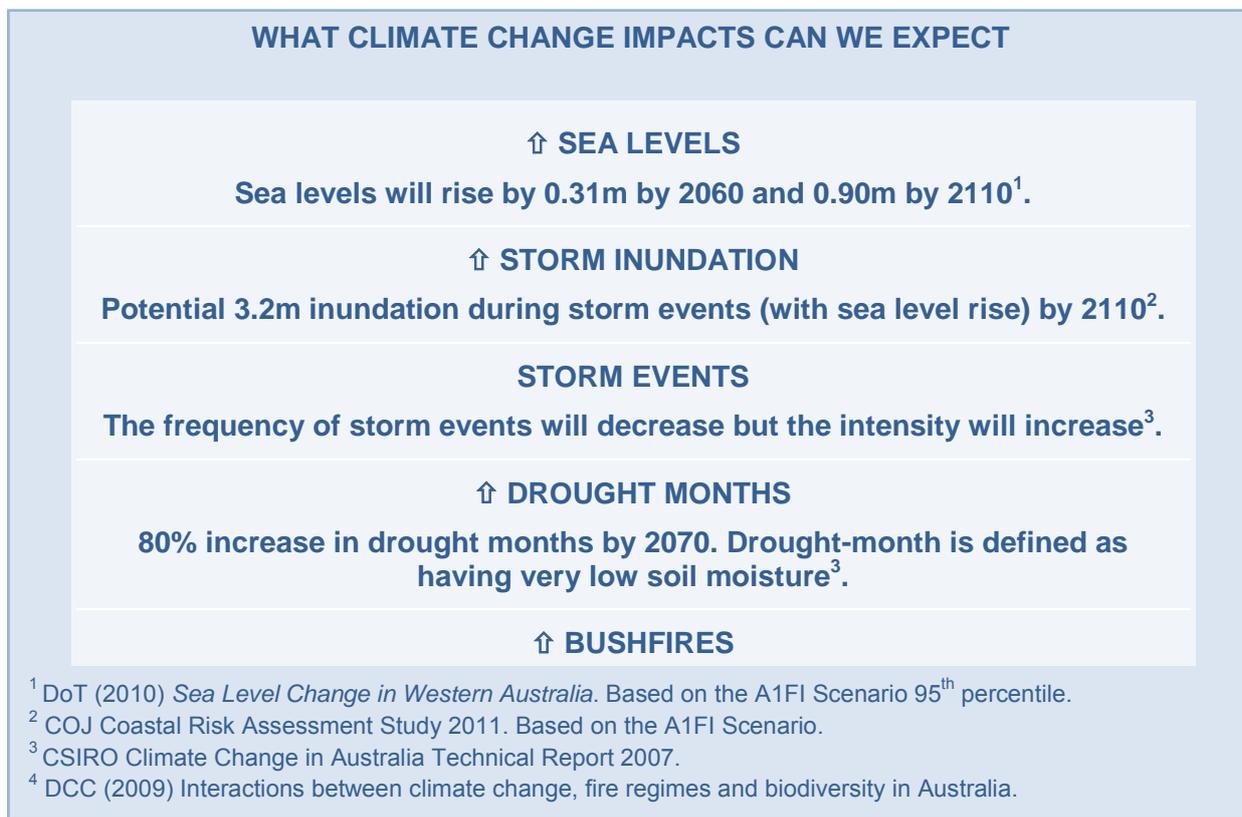


Figure 20: Expected Climate Change Impacts for the City of Joondalup

The expected climate change impacts will affect key areas of local government operations and responsibilities including infrastructure and assets, parks and reserves, natural environment, land use planning and community wellbeing. General impacts expected for the local government sector are outlined below. Specific risks for the City of Joondalup, identified through a risk assessment process are outlined in section 3.4.

Infrastructure and Assets

- Built assets, such as roads, stormwater drains and buildings may not be able to withstand future extreme events, such as flooding, fire and intense storms.
- Built assets, such as roads, stormwater drains and buildings may not be suitable for future hotter and drier climates and have reduced life spans and increased maintenance costs.
- Infrastructure and assets in coastal areas may become at risk from rising sea levels and increased storm surges.

Parks and Reserves

- Current landscaping and plantings may not be suitable for a future drier climate.
- There is likely to be less water availability for irrigation of parks and public open spaces.
- Park equipment and assets may not be suitable for future climatic conditions and may have reduced life span and increased maintenance costs.
- Parks and reserves may require increased facilities such as shading and water fountains to improve amenity for park users in a hotter climate.
- Increased vegetation cover may be required to combat rising temperatures and the urban heat island effect throughout the City's public open, space, verges and medians.

Natural Environment

- Future climatic conditions may increase threats to the natural environment such as weeds, fire and disease.
- A changing climate will change habitats and distribution patterns of species. A drier climate will mean reduced water availability for ecosystems and fauna and flora species.
- Extreme weather events such as heat-waves and intense storms will threaten fauna and flora species.

Land Use Planning

- Land-use patterns may change, with implications for zoning and planning decisions.
- Infill development and increased housing density may exacerbate increasing temperatures by contributing to an urban heat island effect whereby heat is stored and reflected from urban construction materials.
- Uncertainty over development and building approvals, particularly in areas considered to be at risk from climate changes i.e. coastal erosion and flooding.

Community Wellbeing

- An increase in public safety issues caused by extreme weather events and temperatures. For example an increase in accidents caused by bushfires/floods and an increased risk of heat stress and disease from vectors.
- Communities and households may come under stress from increased cost of utilities and services such as energy costs.
- There may be an increased demand for local government services, such as aquatic facilities, financial planning, or community support for the elderly.
- Residential houses and property may be at risk from extreme weather events and/or coastal erosion.

Governance

- Increased public liability exposure as a result of risks exacerbated by climate change impacts.
- Higher cost of utilities and services.
- Higher insurance costs as a result of increased claims.

3.2 A RISK ASSESSMENT APPROACH

Due to the complexity and uncertainty in predicting the extent of climate change, a risk assessment approach is considered best practice for climate change adaptation planning. A risk assessment is a systematic process of evaluating the potential risks that may be involved in a projected activity or undertaking. Undertaking a risk assessment enables the City to:

- identify and assess the risks that climate change poses to the City's assets, operations and services.
- prioritise risks that require further action as a basis for decision-making and planning.
- invest early in preparation and adaptation planning to help avoid or minimise climate change impacts and reduce the costs of adaptation and impacts when they occur.

The City's risk assessment approach is based on the risk assessment methodology outlined by the Australian Government in '*Climate Change and Risk Management: a guide for business and government*⁵⁷. This approach is considered best practice and has been used by the majority of other local governments who have under taken climate adaptation planning. The City applied the risk assessment methodology through a risk assessment workshop, post workshop survey and follow up meetings, see Table 14 below.

	DESCRIPTION	APPROACH
ESTABLISH THE CONTEXT ↓	Establish the context for the Strategy by defining the climate scenario and evaluation framework.	Literature Review
IDENTIFY THE RISKS ↓	Identify potential risks to the City as a result of climate change.	Risk Assessment Workshop
ANALYSE THE RISKS ↓	Identify what controls the City already has in place which will help to minimise the risks identified. Assess the likelihood, consequence and risk priority of the risks identified.	Risk Assessment Workshop Post workshop Survey
EVALUATE THE RISKS ↓	Review the risks and their risk priority and make any adjustments necessary.	Follow up meetings
TREAT THE RISKS	Identify actions and projects to minimise the identified risks.	Follow up meetings

Table 14: Summary of the risk assessment methodology used in the City's climate change adaptation planning

⁵⁷ Australian Greenhouse Office (2006)

3.2.1 Evaluation Framework

An evaluation framework for assessing climate change risk in the City of Joondalup was developed. The evaluation framework sets out four components (risk category, consequence scale, likelihood scale, risk priority matrix) that provide the basis for assessing the risk. The four components are summarised in Table 15. The evaluation framework will ensure that risks are evaluated in a transparent and consistent manner that can be easily replicated.

The evaluation framework used in this Strategy for assessing climate change risk is based on the:

- *City of Joondalup Risk Management Framework 2013*⁵⁸ which provides the foundations and organisational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organisation, and the
- Australian Greenhouse Office's evaluation framework presented in '*Climate Change in Australia: a guide for business and government*'.⁵⁹

Both the City's Risk Management Framework 2013 and the AGO's evaluation framework are based on the risk management guidelines and principles of AS/NZS ISO 31000:2009, and therefore have many similarities. Where possible the City's Risk Management Framework has been used to ensure consistency with the City's other documents, however in some instances the AGO evaluation framework was used as it was more relevant for climate change risk, particularly with the longer time scales over which climate change risk is being assessed.

	DESCRIPTION
RISK CATEGORY	The areas of risk relevant to the City are summarised into five risk categories. ⁴⁶
CONSEQUENCE SCALE (Catastrophic, Major, Medium, Minor, Insignificant)	Describes a range of possible consequences of a risk. Qualitative measures of risk consequence are described for each risk category to provide better understanding of the level of consequence for the City. ⁴⁶
LIKELIHOOD SCALE (Almost Certain, Likely, Possible, Unlikely, Rare)	Describes the likelihood of suffering a level of consequence. Likelihood refers to the likelihood of a risk under the chosen climate change scenario: that is, when considering the likelihood of the risk, it must be assumed that the scenario is certain to occur ⁴⁷ . (Note the AGO scale was used because it had a longer timeframe more relevant to climate change).
RISK PRIORITY (Extreme, High, Moderate, Low)	A priority rating is assigned, as a function of the consequence and likelihood, using a risk priority rating table. For example, risks that have a likelihood rating of 'rare' and a consequence rating of 'insignificant' will be given a low risk priority. ⁴⁶

⁵⁸ City of Joondalup (2013)

⁵⁹ Australian Greenhouse Office (2006)

Table 15: Summary of the evaluation framework used during the risk assessment

The risk priority matrix is used to identify the level of risk to the City and is a function of both the consequence of the risk and the likelihood of the risk occurring. The risk priority matrix used in the risk assessment is shown in Table 16.

Likelihood	Consequences				
	Catastrophic	Major	Moderate	Minor	Insignificant
Almost Certain	Extreme	Extreme	High	Moderate	Low
Likely	Extreme	High	Moderate	Moderate	Low
Possible	High	High	Moderate	Moderate	Low
Unlikely	Moderate	Moderate	Moderate	Low	Low
Rare	Low	Low	Low	Low	Low

Table 16: Risk priority matrix used to assess climate change risk

3.2.2 Risk Assessment Methodology

The following table summarises each of the methods used to undertake the risk assessment, these included a risk assessment workshop, post workshop survey and follow-up meeting and project development.

Method	Description	Outcome
Risk Assessment Workshop	<p>The risk assessment workshop included:</p> <ul style="list-style-type: none"> ▪ Presentation on the background to climate change, the chosen climate change scenario and the evaluation framework. ▪ Brainstorming and identification of potential risks to the organisation as a result of climate change. ▪ Identification of the controls, management regimes and responses that the City already has in place that would help minimise the risks identified. 	During the workshop 78 climate change risks and their controls were identified.
Post Workshop Survey	A post workshop survey was used to analyse the risks. This involved assessing the consequence and likelihood for each risk identified in the workshop while taking into consideration the context of existing controls.	An 'average' consequence and likelihood was calculated for each risk and a priority rating was used generated using the priority matrix.
Follow-up meetings and project development	Follow up meetings were then held to review the identified risks and their priority. Consideration was given to the existing controls, and the potential for the City to mitigate or manage the risk. Potential project ideas were then identified that could assist the City in helping to prepare and adapt to these risks. These meetings were also used to identify potential mitigation projects for the City.	Potential project ideas were identified and further developed for inclusion in the Strategy.

Table 17: Summary of risk assessment methodology used to undertake the risk assessment.

3.3 OVERARCHING RISKS

The City has identified 11 overarching climate risks. For each of these risks a Risk Priority has been assigned as well as an assessment of the City's level of influence to mitigate or manage the risk. The Risk Priority was generated taking into account both the likelihood of the risk occurring and the consequence, see Table 18. The level of influence is considered to be either direct or indirect; direct means that the City has direct control over the outcomes rather than only able to influence or encourage certain outcomes.

		RISK PRIORITY	LEVEL OF INFLUENCE
RISK 1	Increased damage to or loss of City buildings, infrastructure and assets due to climate change impacts (sea level rise, storm level surge, flooding, bushfire, extreme winds etc).	Moderate	Direct
RISK 2	Future climatic changes may make it difficult to maintain the amenity of and service level to the City's parks, reserves, leisure facilities, landscaped areas and natural areas.	Moderate	Direct
RISK 3	The City's natural landscapes, habitats and biodiversity may become under increasing pressure from climate change impacts (decreased rainfall, increased temperatures, bushfires etc).	Moderate	Indirect
RISK 4	The health and safety of residents and communities may be at risk from more intense extreme weather events, vector diseases, food safety and water quality issues.	Moderate	Indirect
RISK 5	The City's design, maintenance and replacement practices for City buildings, infrastructure and assets may not be suitable for future climatic conditions.	Moderate	Direct
RISK 6	The City may not have the necessary knowledge, planning or resources in place to adequately respond to future climate change impacts.	Moderate	Indirect
RISK 7	Future climate changes may result in a decrease in the wellbeing, safety and productivity of City of Joondalup staff.	Moderate	Direct
RISK 8	Future climate changes may lead to an increased need for service delivery as well as an increased cost to deliver services (in particular cost of utilities, resources and waste management).	Moderate	Indirect
RISK 9	The City's statutory land use planning documents may be unable to adequately address future climate change impacts.	Moderate	Direct
RISK 10	The wellbeing of residents and communities may decrease due to increased cost of living, more uncomfortable climates and a lack of readiness and resilience to adapt to future climatic conditions.	Moderate	Indirect
RISK 11	The expected or legislated role of local government in climate change adaption may be unclear or may change leading to increased regulatory and compliance requirements and increased potential for liability.	Moderate	Indirect

Table 18: Overarching risks of climate change for the City of Joondalup

PART 4 - CITY OF JOONDALUP CLIMATE CHANGE STRATEGY

4.1 CLIMATE CHANGE FOCUS AREAS AND OBJECTIVES

Key Focus Areas have been developed to address key climate change issues and opportunities. Implementation of projects within these key focus areas will ensure a multi-pronged approach to climate change mitigation and adaptation. Objectives to improve climate change mitigation and climate change adaptation in the City have been developed for each key focus area and are provided below.

KEY FOCUS AREA	Overarching Risk	Key Issues	Objectives
Infrastructure and Assets	Risk 1 Risk 5	Coastal erosion and inundation.	To protect and/or adapt the City's existing infrastructure and assets against future climate change impacts.
		Existing infrastructure not built for future climates. Reducing electricity use in City buildings.	To design and construct future buildings and facilities to ensure suitability for future climates. Reduce energy use and greenhouse gases emitted from the City's infrastructure and assets.
Land Use Planning and Development	Risk 9	Implementation of new State Coastal Planning Policy 2.6. Uncertainty in the role and responsibilities between local and State government.	To ensure the City's planning documents and processes support climate change adaptation. To ensure the City's planning documents and processes support climate change mitigation.
Parks and Reserves	Risk 2	Reduced water availability and a drying climate. Protection of infrastructure and park users against hotter temperatures.	To reduce water consumption at the City's parks and reserves. To ensure that the amenity, useability and safety of the City's parks and reserves are maintained in future climates.
Natural Environment	Risk 3	Impact of drying climate on Yellagonga Wetlands. Impacts on local biodiversity, flora and fauna species.	To ensure the City's integrated catchment management planning for the Yellagonga wetlands takes into account future climates. To ensure the City's management of natural areas takes into account the impacts of future climates.

Corporate Responsibility and Good Governance	Risk 6 Risk 7	Ensuring that existing strategic planning adequately address future climate change impacts	To demonstrate responsible leadership and governance practices in the City's climate change management activities. To incorporate climate change management into the City's strategic and corporate planning.
	Risk 4 Risk 10	Increasing financial burden (increased energy, water and insurance costs) on the community. Limited ability to directly influence the impact of future climates on the community.	To increase awareness in the community about climate change and its impacts. To assist the City's residents and communities to become more resilient to the impacts of climate change.
Monitoring and Review	Risk 6 Risk 11	Remaining up to date of current climate change research and contemporary best practice approaches to adaptation planning.	To ensure the City continues to improve its knowledge and understanding of future climate change scenarios for the City. To ensure the City continues to improve its knowledge and understanding of how climate change will impact on the City's operations and services.

Table 19: Key Focus Areas and their overarching risks, key issues and objectives

4.2 CLIMATE CHANGE STRATEGY PROJECTS

In order to achieve the objectives of the Climate Change Strategy 2014 – 2019 projects have been identified within each of the six Key Focus Areas. These projects will be implemented over the life of the Strategy and will be subject to regular monitoring and review. A list of the projects is provided in Table 22. A full description of each of the projects is provided in Appendix A.

CLIMATE CHANGE STRATEGY PROJECTS				
Key Focus Area: INFRASTRUCTURE AND ASSETS				
Project No	Title	Mitigation	Adaptation	Related Risk
1.1	Coastal Adaptation Planning and Implementation Project		✓	R1, R5
1.2	Coastal Monitoring Program		✓	R1, R6
1.3	City of Joondalup Strategic Asset Management Framework		✓	R1, R2, R5
1.4	Rainfall Monitoring and Stormwater Management		✓	R1, R5
1.5	Review of the Stormwater Management Policy		✓	R1, R5
1.6	City of Joondalup Renewable Energy	✓	✓	R8

	Project			
1.7	City of Joondalup Solar Hot Water Project	✓	✓	R8
1.8	Environmental Building Audits	✓	✓	R5, R8
1.9	ECOSTAR	✓	✓	R8, R10
1.10	City Fleet Project	✓		
1.11	Street Lighting Research Project	✓		
1.12	City of Joondalup Walkability Plan	✓		
1.13	City of Joondalup Bike Plan	✓		
1.14	City of Joondalup Integrated Transport Management Plan	✓		
Key Focus Area: LAND USE PLANNING AND DEVELOPMENT				
Project No	Title	Mitigation	Adaptation	Related Risk
2.1	Review of the City's Local Planning Strategy and Local Planning Scheme		✓	R9
2.2	Review of Local Planning Policies to include climate change impacts		✓	R9
2.3	Implementation of State Coastal Planning Policy 2.6		✓	R9, R11
Key Focus Area: PARKS AND RESERVES				
Project No	Title	Mitigation	Adaptation	Related Risk
3.1	Water Recycling Feasibility Study		✓	R2, R8
3.2	Rain Sensor Program		✓	R2
3.3	Parks Redevelopment Program		✓	R2
3.4	Urban Planting Program	✓	✓	R2, R3
Key Focus Area: NATURAL ENVIRONMENT				
Project No	Title	Mitigation	Adaptation	Related Risk
4.1	Yellagonga Integrated Catchment Management Plan Review		✓	R3
4.2	City of Joondalup Natural Area Management Plans		✓	R3
4.3	City of Joondalup Pathogen Management Plan		✓	R3
4.4	City of Joondalup Fire Management Plan		✓	R3
4.5	City of Joondalup Coastal Foreshore Natural Areas Management Plan		✓	R3
4.6	City of Joondalup Waste Management Plan	✓		

Key Focus Area: CORPORATE RESPONSIBILITY AND GOOD GOVERNANCE				
Project No	Title	Mitigation	Adaptation	Related Risk
5.1	City of Joondalup Project Management Framework		✓	R1, R2, R5, R6
5.2	Review of City of Joondalup Workforce Plan		✓	R6, R8
5.3	City of Joondalup Corporate Risk Register		✓	R6, R11
5.4	Annual Policy Manual Review	✓	✓	R6
5.5	Planet Footprint	✓		
5.6	City of Joondalup Carbon Offset Program	✓		
5.7	Green Purchasing Protocol	✓		
5.8	Green Office 'Think Green' Program	✓		
5.9	City Water Plan		✓	R2, R3, R8
5.10	Strategic Partnerships	✓	✓	R11
Key Focus Area: COMMUNITY WELLBEING				
Project No	Title	Mitigation	Adaptation	Related Risk
6.1	Mosquito Monitoring Program		✓	R4
6.2	Community Development Plan		✓	R10
6.3	Think Green - Energy Program	✓	✓	R10
6.4	Think Green – Environmental Education Program	✓	✓	R10
6.5	Lessee Environmental Education Program	✓	✓	R8
6.6	Emergency Management Planning		✓	R4

Table 20: List of Climate Change Strategy Projects

4.3 IMPLEMENTATION

Effective and coordinated implementation of the Climate Change Strategy is critical to achieving the objectives of the Strategy. Implementation of the Strategy will be coordinated by setting up processes for monitoring and review, improving knowledge and understanding and training and development.

4.3.1 Monitoring and Review

In line with the City's Project Management Framework, the Climate Change Strategy 2014 – 2019 will be reviewed on an annual basis. The review will include an:

- Assessment of the progress and status of each climate change management project,
- Assessment of progress towards the City's targets and indicators, and
- Identification of any implementation issues or significant lack in progress.

Climate Indicators

Climate targets have been developed to allow for appropriate reporting and evaluation of the Climate Change Strategy 2014 – 2019. These targets will be reported on during the annual review process.

TARGET	
Corporate Mitigation	- Reduce net greenhouse gas emissions by 5 per cent per capita below 2012/13 consumption by 2018/19 The City's net greenhouse gas emissions in 2012/13 were 100.6kg per capita. The City will need to reduce its net emissions by 5.03kg per capita to reach this target.
Community Mitigation	- Implement a minimum of two community mitigation projects or events per year
Corporate Adaptation	- Implement minimum 5 corporate adaptation projects per year
Community Adaptation	- Implement a minimum of two community adaptation projects or events per year

Table 21: Climate targets for the Climate Change Strategy 2014 – 19.

4.3.2 Improving Climate Change Knowledge and Understanding

Climate change science, research, policy and regulation are constantly evolving fields with ongoing improvements in climate change modelling and projections and evolving responses from both science and government. To ensure the City's climate change management activities continue to be best-practice it is important that the City remains abreast of the latest developments in this field. In particular the City should monitor the below topics:

- Climate change science and research,
- Climate change legislation, policy and regulation, and
- Local government exposure to liability.

REFERENCES

- Australian Bureau of Statistics (2013) *Household energy consumption survey, Australia: Summary of Results 2012*. Australian Bureau of Statistics.
- Australian Government (2009) *Australia's Biodiversity and Climate Change. A strategic assessment of the vulnerability of Australia's biodiversity to climate change*.
- Australian Government (2013)a *Climate Adaptation Outlook: A Proposed National Adaptation Assessment Framework*.
- Australian Government (2013)b *Weeds in Australia*.
<http://www.environment.gov.au/biodiversity/invasive/weeds/index.html> Last updated 12 August 2013.
- Australian Greenhouse Office (2006) *Climate Change and Risk Management: A Guide for Business and Government*. Australian Greenhouse Office
- Bosserelle, C, Pattiaratchi, C & Haigh, I (2012) *Inter-annual variability and longer term change in the wave climate of Western Australia*. *Ocean Dynamics*, **62**, 1, p63-76.
- Chambers LE (2008) Trends in timing and migration of south-western Australian birds and their relationship to climate. *Emu* 108: 1-14
- City of Joondalup (2013) *City of Joondalup Risk Management Framework 2013*.
- Climate Commission (2011) *The Critical Decade: Western Australia climate change impacts*. Climate Commission
- Climate Council (2013) *Unpacking the IPCC Fifth Assessment Report*.
www.climatecouncil.org.au
- Conservation International (2013) *International Biodiversity Hotspots: Southwest Australia*.
http://www.conservation.org/where/priority_areas/hotspots/asia-pacific/Southwest-Australia/Pages/default.aspx
- CSIRO (2007) *Climate Change in Australia – Technical Report*. CSIRO
- CSIRO (2011) *Climate Change: Science and Solutions for Australia*. CSIRO
- CSIRO and BOM (2014) *State of the Climate 2014*. CSIRO
- Department of Climate Change (2009) *Climate Change Risks to Australia's Coast - A first pass national assessment*. Department of Climate Change
- Department of Climate Change and Energy Efficiency (2011) *Climate Change Risks to Coastal Buildings and Infrastructure - A Supplement to the First Pass National Assessment*. Department of Climate Change and Energy Efficiency.

Department of Climate Change and Energy Efficiency (2011) *Coastal Climate Change Risk-- Legal and Policy Responses in Australia*. Department of Climate Change and Energy Efficiency.

Department of Environment (2013) *Cleaner Environment Plan: Clean Air*. <http://www.environment.gov.au/cleaner-environment/clean-air.html> Australian Government.

Department of Environment and Conservation (2012) *Adapting to our changing climate*. Western Australian Government.

Department of Finance – Public Utilities Office (2012) *Strategic Energy Initiative: Energy 2031*. Government of Western Australia.

Department of Health (2008) *Health impacts of Climate Change: Adaptation Strategies for Western Australia*. Government of Western Australia.

Department of Planning (2010) *Directions 2031 and Beyond: Metropolitan planning beyond the horizon*. Western Australian Planning Commission

Department of Planning (2012) *State Planning Strategy (Draft)*. Western Australian Planning Commission

Department of Planning (2012) *State Coastal Planning Policy* 2.6. Western Australian Planning Commission

Department of Planning and Infrastructure (2008) *Better Urban Water Management*. Western Australian Planning Commission.

Department of Transport (2011) *Draft Public Transport for Perth in 2031: Mapping out the future for Perth's public transport network*. Government of Western Australia.

Department of Transport (2012) *Draft WA Bicycle Network Plan 2012 - 2021*. Government of Western Australia.

Department of Water (2009) *Draft Perth – Peel Regional Water Plan 2010 – 2030: Responding to our drying climate*. Government of Western Australia

Department of Water (2013) *Securing Western Australia's Water Future: Position Paper – reforming water resource management*. Government of Western Australia

Engineers Australia (2012) *Climate Change adaptation guidelines in coastal management and planning*. Engineers Australia

Gnangara Coordinating Committee (2009) *Draft Gnangara Sustainability Strategy*. Government of Western Australia

Haigh, ID & Pattiaratchi, C (2009) *21st Century Changes in Extreme Sea Levels around Western Australia*. Proceedings of the 17th National Australian Meteorological and oceanographic Society Conference, Canberra, Australia.

.id, the population experts (2013) *Profile.id: City of Joondalup*. www.profile.id.com.au/joondalup

.id, the population experts (2013) *Economy.id: City of Joondalup*.

<http://economy.id.com.au/joondalup>

IOCI (2010) *WA Rainfall – What the past can tell us, and what the future may hold*. IOCI

IOCI (2012) *Western Australia's Weather and Climate: A Synthesis of Indian Ocean Climate Initiative Stage 3 Research*. IOCI.

IPCC (2007) *Climate Change 2007: IPCC Fourth Assessment Report, Working Group III: Mitigation of Climate Change*. IPCC

IPCC (2013) *Climate Change 2013: The Physical Science Basis. Summary for Policymakers. IPCC Fifth Assessment Report*. IPCC

IPCC (2014)a *Climate Change 2014: Impacts, Adaptation and Vulnerability. Summary for Policymakers. IPCC Fifth Assessment Report*. IPCC

IPCC (2014)b *Climate Change 2014: Mitigation of Climate Change. Summary for Policymakers. IPCC Fifth Assessment Report*. IPCC

MP Rogers and Associates (2012) *Hillarys to Ocean Reef Coastal Vulnerability*. Report for City of Joondalup.

NCCARF (2013) *Supporting evidence-based adaptation decision-making in Western Australia. A synthesis of climate change adaptation research*. NCCARF

Saunders DA, Mawson P, and Dawson R (2011) The Impact of Two Extreme Weather Events and Other Causes of Death on Carnaby's Black Cockatoo: A Promise of Things to Come for a Threatened Species? *Pacific Conservation Biology* Vol 17, No 2, 2011: 141-148.

Steffen W, Burbidge AA, Hughes L, Kitching R, Lindemayer D, Musgrave W, Stafford Smith M and Werner PA (2009) *Australia's biodiversity and climate change: a strategic assessment of the vulnerability of Australia's biodiversity to climate change*. A report to the Natural Resource Management Ministerial Council commissioned by the Australian Government. CSIRO Publishing

Waste Authority (2012) *Western Australian Waste Strategy: Creating the right environment*. Government of Western Australia.

Water Corporation (2013) *Annual stream inflow data*. www.watercorporation.com.au/water-supply-and-services/rainfall-and-dams/streamflow/streamflowhistorical Downloaded August 2013.

Appendix A – Project Descriptions

Key Focus Area Infrastructure and Assets

Objective 1: To protect and/or adapt the City's existing infrastructure and assets against future climate change impacts.

Objective 2: To design and construct future buildings and facilities to ensure suitability for future climates.

Objective 3: Reduce energy use and greenhouse gases emitted from the City's infrastructure and assets.

Project 1.1 Coastal Adaptation Planning and Implementation Project
<p>Project Status New Project</p>
<p>Mitigation Adaptation ✓ Risks addressed R1, R5</p>
<p>Project Description</p> <p>In order to determine the level of risk from climate change to the City's coastal zone and to provide information to assist the City in planning future coastal protection measures, a series of Coastal Vulnerability Studies are being undertaken.</p> <p>Coastal Vulnerability Studies have been completed between Marmion and Sorrento, and Hillarys to Ocean Reef. The final stage, Ocean Reef to Burns Beach will be completed in 2013/14. Outcomes of the Coastal Vulnerability Studies will be utilised to inform the City's coastal adaptation activities.</p> <p>The Coastal Adaptation Planning and Implementation Project aims to ensure that the outcomes of the Studies are integrated into City policies, planning and maintenance schedules and capital works programs where relevant.</p>
<p>Project Objectives</p> <ul style="list-style-type: none"> ▪ To ensure that the outcomes of scientific research and studies inform the City's approach to coastal adaptation activities. ▪ To ensure future coastal vulnerability is taken into account when planning and developing new coastal infrastructure and land use planning decisions within the coastal zone.
<p>Deliverables</p> <ul style="list-style-type: none"> ▪ A Coastal Adaptation Plan outlining activities to be implemented along the City's coastal zone to adapt to the future impacts of climate change. ▪ A Coastal Vulnerability and Adaptation Policy (or similar) to guide the planning, development and protection of coastal infrastructure.

Project 1.2 Coastal Monitoring Program

Project Status

New project

Mitigation

Adaptation ✓

Risks addressed R1, R6

Project Description

Coastal Monitoring provides valuable information that can be utilised to inform planning decisions, maintenance schedules and the implementation of coastal adaptation works. Coastal Monitoring assesses shoreline movements over time and involves monitoring of the shoreline through the use of beach and nearshore profiles and mapping of the coastal vegetation line to establish seasonal and annual beach movements over a period of time.

Initially the monitoring program should be established for the entire coastline to enable the collection of baseline data. It is recommended that the monitoring program be repeated at 5 year intervals and subsequent data sets be compared to the baseline data set.

Project Objectives

- To improve understanding of the City's coastal shoreline movements over time.
- To enable localised information to be used to inform Capital Works Programs, future coastal studies and coastal management planning.

Deliverables

- Establishment of a monitoring schedule for a 5-year interval monitoring program.
- Baseline data set on shoreline movement for the City of Joondalup coastline.

Project 1.3 Asset Management Planning Framework

Project Status
Existing Project

Mitigation
Adaptation ✓
Risks addressed R1, R2, R5

Project Description

The City is currently developing a Strategic Asset Management Improvement Plan to determine how the City's asset portfolio will meet the service delivery needs of the community into the future, enable the City's Asset Management Policy to be achieved and ensure that asset management is established as part of the City's integrated planning.

This Plan has been developed for the short term, to lead the process of developing a longer term *Strategic Asset Management Plan* for the future. In addition an Asset Management Plan will be developed for each major asset class and will define current levels of service and the processes used to manage that asset class.

It is important that future climates are taken into account within the City's Asset Management Planning Framework to ensure more accurate current and future forecasted demands for assets and funding, this includes (but is not limited to):

- Increase in intensity of storm events potentially leading to a need for increased drainage capacity;
- Effects of increased temperatures and increased intensity of storm events on the City's road network;
- Increased temperatures potentially increasing need for shade and drinking water facilities in the City's parks and public open spaces;
- Increased temperatures impacting on the life span of assets and materials;
- Increased intensity of storm events leading to damage and/or loss to City's landscaping;
- Sea level rise and increased storm surge leading to damage and loss to the City's coastal infrastructure; buildings, roads, car parks, fences, paths, park infrastructure etc; and
- Reduced water availability for irrigation of parks and open space.

Project Objectives

- To ensure the City's asset management framework takes into account future climate change impacts.
- To identify any areas of research required to facilitate improved accuracy in forecasting the impact of future climates in asset management planning.

Deliverables

- Future climate change impacts incorporated into the City's asset management planning.
- Gaps identified and prioritised and a schedule determined for obtaining research needed to quantify the impacts of climate change on the City's assets.
- Updated Strategic Asset Management Plan and Individual Asset Management Plans that consider climate change impacts and risk.

Project 1.4 Rainfall Monitoring and Stormwater Management

Project Status

Existing Project

Mitigation

Adaptation ✓

Risks addressed R1, R5

Project Description

Climate change projections indicate that while overall rainfall will decline the intensity of individual storm events is likely to increase; compounded with increased population and infill developments this will place pressure on the City's stormwater management system and may result in localised flooding.

The City has installed four rain gauges across the City at Boas Ave, Cook Ave (Hillarys), Coolibah Park (Duncraig) and Ellersdale Park (Warwick) to capture detailed rainfall data. A number of pressure sensors have also been installed to record water depths at various sites. This will assist the City in understanding localised rainfall patterns and will enable the City to tailor its stormwater management design accordingly. In order to inform the re-design of stormwater infrastructure such as sumps, additional rainfall monitoring will be undertaken at sites where drainage upgrades are scheduled for commencement.

The City also maintains a record of localised stormwater flooding incidents to assist in identifying and prioritising locations where the stormwater system needs upgrading. This will ensure that the City has the necessary information and processes in place to adapt to any increased pressure on the stormwater management system as it becomes required.

Project Objectives

- To improve the City's understanding of localised rainfall patterns.
- To respond to and reduce the incidence of localised stormwater flooding.

Deliverables

- A record of monthly rainfall data at key locations within the City.
- A record of the number and location of localised stormwater flooding.
- Installation of additional rainfall monitoring sites to inform drainage infrastructure upgrades.
- Stormwater infrastructure upgrades and design that takes into account climate change impacts and risk.

Project 1.5 Review of the City's Stormwater Management Policy

Project Status

Existing Project

Mitigation

Adaptation ✓

Risks addressed R1, R5

Project Description

Climate change projections indicate that while overall rainfall will decline the intensity of individual storm events is likely to increase; compounded with increased population and infill developments this will place pressure on the City's stormwater management system and may result in localised flooding where drainage capacity is exceeded.

The City has adopted a Stormwater Management Policy to provide guidance on matters relating to stormwater planning and maintenance. The objectives of the Policy are:

- To ensure stormwater is managed to protect environmental, social and economic values, and
- To facilitate the integration of water sensitive design principles into planning and development within the City of Joondalup.

The City's Stormwater Management Policy should give due consideration to future climate changes and the potential impact on the City's stormwater management system.

Project Objectives

- To ensure the City's Stormwater Management Policy recognises future climate change impacts.

Deliverables

- A review of the City's Stormwater Management Policy.
- An updated Stormwater Management Policy.

Project 1.6 City of Joondalup Renewable Energy Project

Project Status

Existing project

Mitigation ✓

Adaptation ✓

Risks addressed R8

Project Description

The City has demonstrated its commitment to renewable energy technology through the implementation of the Renewable Energy Program. The Program has included the purchase and installation of solar PV (photovoltaic) systems at community facilities, as well as an extensive community education program to promote renewable energy and its benefits to the wider community. To date the City has installed 12 PV systems at community facilities. Ongoing monitoring of the solar PV systems has been achieved through the development of a live energy monitoring Dashboard, which is displayed on the City's website and at key facilities.

In order to reduce reliance on traditional forms of energy and to reduce greenhouse gas emissions, the Renewable Energy Project should be continued where funding opportunities arise and as part of new or significant redevelopments of the City's community facilities. Consideration where appropriate should also be given to other forms of renewable energy (i.e. wind power). The installation of renewable energy systems will help the City reduce its greenhouse gas emissions and will also enable the City (and any community groups using the community facilities) to become more resilient to increasing energy costs.

Project Objectives

- To reduce greenhouse gas emissions and increase the City's resilience to rising energy costs, through the generation of renewable energy.
- To raise community awareness of renewable sources of energy through the promotion of the City's renewable energy technologies.

Deliverables

- Identification of suitable facilities for the installation of renewable energy systems.
- Further installations to be undertaken as opportunities and funding arise.
- Continuation of community awareness initiatives to promote renewable energy.

Project 1.7 City of Joondalup Solar Hot Water Project**Project Status**

Existing project

Mitigation ✓**Adaptation** ✓**Risks addressed** R8**Project Description**

The use of renewable energy for heating purposes can reduce energy use and greenhouse gas emissions within City facilities. The City currently has a solar hot water system installed at Craigie Leisure Centre which provides a portion of the heating required to heat the water used in the pool's showers. A further 15 solar hot water systems will be installed at seven locations in the City during 2013/14, including:

- Spiers Centre, Heathridge (1 system)
- Flinders Park Community Hall, Hillarys (2 systems)
- Warwick Community Centre, Warwick (3 systems)
- Mullaloo Surf Life Saving Club, Mullaloo (3 systems)
- Sorrento Surf Life Saving Club, Sorrento (3 systems)
- Heathridge Leisure Centre, Heathridge (2 systems)
- Joondalup Reception Centre, Joondalup (1 system)

The solar hot water systems are estimated to displace 405 MWh of electricity or 380tCO₂-e over the lifetime of the system (10yrs).

The Solar Hot Water project will be continued as funding opportunities arise and as part of new or significant redevelopments of the City's community facilities.

Project Objectives

- To reduce energy use and greenhouse gas emissions associated with City facilities.
- To increase the City's resilience to rising energy costs.

Deliverables

- A schedule of priority for installation of further solar hot water systems within City buildings and facilities.
- Further installations to be undertaken as opportunities and funding arise.

Project 1.8 Environmental Building Audits

Project Status
Existing Project

Mitigation ✓
Adaptation ✓
Risks addressed R5, R8

Project Description

Environmental auditing involves establishing the current energy (and water) use of a building and the identification of assets and processes that contribute to inefficiencies in energy use within facilities and operations. Audits also enable the identification of opportunities for energy conservation and identify opportunities for the use of renewable energy. In order to reduce energy consumption and greenhouse gas emissions within City buildings, Environmental Building Audits will be undertaken at key facilities in order to identify opportunities for upgrades or improvements in energy efficiency. Property energy usage data, provided by Planet Footprint, will be used to inform the Audits. A report will be developed that will include recommendations to improve energy use within the facilities.

To ensure recommendations are reviewed and where appropriate implemented; a schedule will be developed and recommended works will be incorporated into future Capital Works Programs and Maintenance Schedules.

The City completed an Environmental Audit of the Craigie Leisure Centre in June 2013. Audits of the Administration Building and Works Operations Centre are scheduled for 2013/14. A schedule will be developed to ensure audits are carried out at regular intervals (i.e. every 3 – 5 years) to ensure efficiencies are being met and improvements are continually being made.

Project Objectives

To increase energy efficiency and reduce greenhouse gas emissions within City building and facilities.

Deliverables

- Development of a schedule for conducting Environmental Audits at key City buildings.
- Environmental Building Audit Reports outlining findings and recommendations for key City facilities.
- Implementation schedules developed, approved and reported on for recommendations from the Environmental Audits.

Project 1.9 ECOSTAR

Project Status

Existing project

Mitigation ✓

Adaptation ✓

Risks addressed R8, R10

Project Description

ECOSTAR is a community awareness initiative that uses a star rating system to show improvements in both water and energy efficiency. ECOSTAR ratings are used in City of Joondalup facilities to promote retrofitting projects and to encourage the community to improve water and energy efficiency in their homes.

The Program utilises the ECOSTAR plaque which is a passive communication tool that demonstrates to the community the progress of each site towards achieving a six star energy and water efficiency rating. This communication helps to build greater trust in the community of sustainable technologies.

To date the following buildings have been audited and have achieved the maximum six star rating: Fleur Freame Pavilion (Padbury), Gibson Community Centre (Padbury), Seacrest Park Community Sporting Facility (Sorrento) and Sorrento Surf Life Saving Club amenity block.

An annual schedule for undertaking ECOSTAR ratings on City buildings will be developed to continue the ECOSTAR program.

Project Objectives

- Improve the City's environmental performance through systematically upgrading the City's community facilities with energy saving technologies.
- Raise the community's awareness of environmental technologies through the demonstration and promotion of technologies within City facilities.
- Communicate the progress of the City's environmental improvement initiatives through the placement of ECOSTAR plaques and completed stars.

Deliverables

- Installation of energy efficient technologies in City facilities.
- Evaluation and rating of City facilities using the ECOSTAR rating framework.
- Promotion of ECOSTAR rated facilities to the community through ECOSTAR plaques and on the City's website.

Project 1.10 City Fleet Project

Project Status

Existing Project

**Mitigation ✓
Adaptation**

Project Description

During 2012/13 the City's fleet used 20,477 GJ of fuel which resulted in 1522 t CO₂-e. The City fleet uses a variety of fuel sources: diesel 81.49%, unleaded petrol 15.18% and LPG 3.33%. The City's fleet consists of turf maintenance machines, trailers, loaders, weed sprayers, sweepers, water pumps, passenger sedans, light commercial vehicles and a variety of trucks.

The City has taken a number of steps to reduce the emissions from its fleet vehicles including purchasing hybrid vehicles and where possible replacing larger vehicles with four cylinder vehicles. The City also offsets its vehicle emissions through the Carbon Neutral program. Carbon Neutral undertakes biodiverse conservation plantings to offset greenhouse emissions; approximately 6 trees will sequester 1 tonne of CO₂-e over their lifetime. The City purchases annually the 'equivalent number of trees' to offset its annual vehicle emissions.

The City's current Fleet Asset Management Plan outlines the City's approach to fleet management including levels of service provision, future demand, whole of life costs, risk management and financial forecasting. The Plan uses a matrix to guide the selection of the light vehicle replacement program which has the following criteria and weighting:

- Annual whole of life cost – 70%
- Carbon Dioxide Emission – 10%
- Air pollution rating – 10%
- Safety rating – 10%

The City's Fleet Asset Management Plan is due for review in 2014/15. The review will include consideration of increasing the weighting to carbon dioxide emissions, investigating alternative fuels and further downsizing the size of vehicles where possible.

Project Objectives

- Ensure the City's Fleet Asset Management Plan gives adequate consideration to greenhouse gas emissions and environmental impact of vehicles.
Reduce the net greenhouse gas emissions associated with the City's fleet.

Deliverables

- Annual offsetting of the City's fleet emissions.
- The City's Fleet Asset Management Plan is reviewed and consideration is given to minimising greenhouse gas emissions and investigating alternative fuels.
- Identification of potential benefits and disadvantages of alternative fuels.

Project 1.11 Street Lighting Efficiency Project

Project Status

New Project

Mitigation ✓
Adaptation

Project Description

34% of the City's total energy use is used for street lighting; contributing 41% of the City's total greenhouse emissions. Increasing the efficiency of street lighting will make a significant contribution to decreasing the City's greenhouse gas emissions.

However there are a number of challenges to improving the City's street lighting network:

- Much of the street lighting infrastructure is owned by Western Power not the City of Joondalup.
- Much of the infrastructure is ageing and large scale replacement of existing infrastructure with newer technologies is costly.
- Availability of alternative technologies is still evolving i.e. LED's are now more widely available but solar lighting is still in development.

Research is required to identify opportunities for improving street lighting efficiency and the availability of alternative technologies, given the current challenges. Opportunities to increase efficiencies through changing current operations and practices will also be investigated.

The City will seek opportunities to partner with stakeholders including Western Power and the Western Australian Local Government Association in investigating options for increased efficiency in street lighting.

Project Objectives

- To partner with stakeholders to improve street lighting efficiency and reduce greenhouse gas emissions associated with the City's street light assets.

Deliverables

- Identification of opportunities to reduce the amount of greenhouse emissions resulting from street lighting.
- Identification of technologies to improve the City's street lighting network including any changes to City practices or policy that may be required.

Project 1.12 City of Joondalup Walkability Plan

Project Status

Existing Project

Mitigation ✓ Adaptation

Project Description

Creating environments that encourage people to choose active travel is increasingly being recognised as a way to foster more sustainable, healthier and safer communities. Walking and cycling are enjoyable, convenient and healthy modes of travel and also assist to reduce greenhouse gas emissions and improve the amenity of our local areas.

The City's *Walkability Plan 2013–2018* is a five-year plan designed to encourage and enable safe and accessible environments within the City of Joondalup for all users. It presents the analysis, results and recommendations of a detailed audit of the City's Key Walking Routes, Key Cycling Routes and Key Trails, and identifies how these can be improved. The Plan focuses on five Key Walking Areas, representing different walking and cycling contexts in the City of Joondalup's urban and natural environments.

The *Walkability Plan 2013–2018* provides a strategic guide to investing in and managing walking and cycling infrastructure to ensure usability, appropriate signage and efficient and effective linkages. The Plan also identifies opportunities for enhanced community education and awareness of active recreational opportunities in the region.

Project Objectives

The objectives of the *Walkability Plan 2013–2018* include the following:

- Identify opportunities to improve walkability within the Joondalup City Centre and major suburban shopping districts.
- Develop a planned and consistent approach to the establishment and maintenance of trails within natural bushland, wetland and coastal areas.
- Promote pathways and trails to the community and ensure they are accessible to residents and visitors.

Deliverables

- Improved walking and cycling infrastructure within key areas of the City of Joondalup.
- Greater provision of walking and cycling information to the community.

Project 1.13 City of Joondalup Bike Plan

Project Status

New Project

**Mitigation ✓
Adaptation**

Project Description

Creating environments that encourage people to choose active travel is increasingly being recognised as a way to foster more sustainable, healthier and safer communities. Cycling is an enjoyable, convenient and healthy mode of travel and also assists to reduce greenhouse gas emissions.

The City of Joondalup Bike Plan was developed in 2009 to promote cycling in the City of Joondalup and to increase the number of cyclists using Joondalup's bicycle network and facilities. The Plan was developed through review of an existing plan and conditions, desktop studies, consultations with stakeholders and the community, and site surveys.

The Plan recommends the implementation of cycling infrastructure such as pathways, bike parking and signage within the City and also includes initiatives to raise the awareness of cycling and its benefits within the community.

In order to ensure alignment with State Government objectives for cycling within Western Australia, a major review of the Bike Plan 2009 will be undertaken in 2015/16 with a new Bike Plan being developed at this time.

Project Objectives

- To improve cycling infrastructure and facilities within the City of Joondalup.
- To promote the benefits of cycling to the community
- To increase the provision of cycling information to the community.

Deliverables

- Additional cycling infrastructure and facilities within the City of Joondalup.
- Greater provision of cycling information to the community.

Project 1.14 City of Joondalup Integrated Transport Management Plan

Project Status

New Project

Mitigation ✓ Adaptation

Project Description

Integrated transport planning aims to ensure that there is a suitable, safe and interconnected transport infrastructure for different transport modes such as private vehicles, public transport, walking and cycling, which results in improving the community's accessibility to jobs, services, recreation and other daily activities.

Within a local government context, transport services and responsibilities extend mainly to the consideration of roads, public transport, road safety and path networks. These responsibilities are also shared across a variety of stakeholders, including Main Roads WA, the Department of Transport, the Public Transport Authority, Department of Planning and Transperth.

The City of Joondalup recognises the need to develop a strategic approach to the planning, construction and maintenance of transport related infrastructure and acknowledges that partnerships with State government agencies and other stakeholders have the potential to improve the efficiency and reduce expenditure for the delivery of transport infrastructure.

Improved public transport, cycling and walking facilities can also lead to a reduction in the use of private vehicles resulting in a decrease in greenhouse gas emissions.

Project Objectives

- To provide a strategic framework for the delivery of projects and initiatives from the following Plans and Programs:
 - Road Asset Management Plan
 - Bike Plan
 - Walkability Plan
 - Road Safety Action Plan
 - Joondalup CAT Bus Service Funding Agreement
- To reduce transport related greenhouse gas emissions through improvements in public transport, walking and cycling within the City.
- To align the City's transport related activities with the priorities outlined in State government plans and strategies.
- To identify and address shortcomings across the City's current transport network; and determine future drivers and targets for modal shifts.
- To identify opportunities for funding for the planning, construction and maintenance of transport related infrastructure.

Deliverables

- Integrated transport planning practices that guide future planning and development of the City's transport network.
- Improved and interconnected public transport, walking and cycling infrastructure.

Key Focus Area **Land Use Planning and Development**

Objective 1: To ensure the City’s planning documents and processes support climate change adaptation.

Objective 2: To ensure the City’s planning documents and processes support climate change mitigation.

Project 2.1 Review of the City’s Local Planning Strategy and Local Planning Scheme
Project Status Existing Project
Mitigation Adaptation ✓ Risks addressed R9
Project Description Local Governments have scope to recognise and respond to climate change adaptation requirements through local planning processes including Local Planning Strategies and District/Local Planning Schemes. The City’s Local Planning Strategy (LPS) outlines the vision and strategic planning direction for the City over the next 15 to 20 years. The City’s District Planning Scheme is the document that controls exactly how land may be used within the City of Joondalup. The City is currently finalising its Local Planning Strategy and undertaking a review of the current <i>District Planning Scheme No. 2 (DPS2)</i> with a view of putting in place a new Local Planning Scheme. The strengthening of climate change considerations into the next Local Planning Strategy will ensure that specific adaptation measures are incorporated into the provisions of the following local planning scheme review.
Project Objectives <ul style="list-style-type: none">▪ Ensure the City’s Local Planning Strategy and Local Planning Scheme adequately recognise and addresses climate change risk.▪ Ensure that climate change impacts are considered in the City’s land use planning decisions.
Deliverables <ul style="list-style-type: none">▪ Review of the City’s Local Planning Strategy and Local Planning Scheme.▪ A Local Planning Strategy and Local Planning Scheme that incorporate climate change impacts and risk.

Project 2.2 Review of Local Planning Policies to include climate change mitigation and adaptation

Project Status

New Project

Mitigation

Adaptation ✓

Risks addressed R9

Project Description

Local Planning Policies are developed by the City to guide decision making relating to planning and development within the City.

Local Planning Policies are not part of a Local Planning Scheme and do not impose any mandatory requirement upon development. However decisions under the Scheme need to give 'due regard' to Local Planning Policies and therefore can provide guidance for applicants and the City regarding proposed development.

As a part of the local planning scheme review, the City's local planning policies will also be examined and should consider integrating mitigation and adaptation practices into planning standards, where appropriate. The review should also take into consideration the outcomes of the City's Coastal Vulnerability Assessment Studies and Fire Management Plan for the City as well as the requirements of State Coastal Planning Policy 2.6.

Project Objectives

- To ensure the City's local planning policies support the City's coastal risk assessment and adaptation planning processes.

Deliverables

- The City's local planning policies are reviewed and updated where appropriate to include climate change considerations.
- If necessary new planning policies are developed that support the City's other Climate change adaptation documents.

Project 2.3 Implementation of State Coastal Planning Policy 2.6

Project Status

New Project

Mitigation

Adaptation ✓

Risks addressed R9, R11

Project Description

The State Coastal Planning Policy 2.6 provides guidance for decision making within the coastal zone including managing development and land use change; establishment of foreshore reserves; and to protect, conserve and enhance coastal values.

The Policy requires that coastal hazard risk management and adaptation is appropriately planned for; and encourages innovative approaches to managing coastal hazard risk.

When approving developments under the City's District Planning Scheme the City is required to give due regard to State Planning Policies.

Key aspects of the Policy in relation to climate change adaptation planning include:

- Requirement for coastal hazard risk management and adaptation planning to be undertaken in areas at risk of being affected by coastal hazards over the planning timeframe.
- Disclosure of identified coastal hazard risks when considering approval for subdivision and/or development by providing a notification on the certificate of title so current and/or future lot owners are aware of the coastal hazard risk.
- Where risk assessments identify a level of risk that is unacceptable, adaptation measures to reduce those risks down to acceptable levels are required. Adaptation measures should be sought from the following hierarchy: *avoid, planned or managed retreat, accommodate* and as a final option *retreat*.

The Policy specifies that the allowance for sea level rise should be based on a vertical sea level rise of 0.9 metres over a 100-year planning timeframe to 2110. Coastal vulnerability allowances based on a 0.9m SLR by 2110 as part of the City's Coastal Vulnerability Studies. These allowances will need to be considered as part of the City's examination of its local planning policies as part of the current *District Planning Scheme No.2* review; the next review of the local planning strategy and scheme review; and the current planning processes and day to day decision making.

Project Objectives

- To ensure the City adequately considers the new State Coastal Planning Policy 2.6 in land use planning processes and decisions.

Deliverables

- Planning decisions are made in accordance with the new State Coastal Planning Policy 2.6.
- Existing coastal assets are managed in accordance with the State Coastal Planning Policy 2.6.

Key Focus Area Parks and Reserves

Objective 1: To reduce water consumption at the City's parks and reserves.

Objective 2: To ensure that the amenity, useability and safety of the City's parks and reserves are maintained in future climates.

Project 3.1 Water Recycling Opportunity Study
Project Status New project
Mitigation Adaptation ✓ Risks addressed R2, R8
Project Description <p>Wastewater has traditionally been viewed as a waste product; however with declining water availability, it is now recognised as a potential valuable resource. The City will investigate water recycling opportunities in the City. The City will liaise with the Water Corporation and other relevant stakeholders to investigate partnership opportunities.</p> <p>Potential water recycling opportunities from City owned facilities will be investigated and could include utilising pool backwash at Craigie Leisure Centre or small scale greywater reuse schemes.</p> <p>A Study investigating water recycling opportunities will be produced detailing the feasibility in terms of economic, social and environmental considerations.</p>
Project Objectives <ul style="list-style-type: none">▪ To identify opportunities of using recycled water for irrigation purposes within the City.
Deliverables <ul style="list-style-type: none">▪ A Study into potential water recycling opportunities within the City is conducted.

Project 3.2 Rain Sensor Program

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R2

Project Description

The sustainable use of water resources is critical in the context of a drying climate. As irrigation accounts for a large proportion of the City's water use the efficient use of irrigation systems is vital to ensuring the long term conservation of groundwater resources. Rain sensors identify localised rain events and can be used to automatically turn off irrigation systems when rainfall is present. Rain sensors will be installed across all City parks to inform irrigation regimes. Rain sensors will also improve efficiency by allowing for automatic shut down of irrigation systems in response to local weather conditions.

Project Objectives

- To reduce water consumption through improvements in irrigation efficiency by utilising the best available local climate information.
- To demonstrate leadership to the community through the sustainable use of water resources.

Deliverables

- The establishment of a program to install rain sensors in City parks, focusing initially on active and high profile parks, at a rate of 10 per year.

Project 3.3 Parks Redevelopment Program

Project Status
Existing project

Mitigation
Adaptation ✓
Risks addressed R2

Project Description

Irrigation accounts for a large proportion of the City's water use the efficient use of irrigation systems is vital to ensuring the long term conservation of groundwater resources. As part of the implementation of the City's Landscape Master Plan the City is implementing a program of hydrozoning and ecozoning, and redesigning irrigation systems, to reduce groundwater use within parks and open space areas.

A hydrozone relates to water delivery and is the practice of establishing separate areas or zones to receive different amounts of irrigation water. An ecozone relates to the vegetation that can best accommodate a given watering regime and is usually a grouping of plants with similar water requirements.

As part of the project, amenity is also being improved to ensure community expectations are balanced with sustainable water management. To date the project has been successful in reducing groundwater use by up to 50 per cent in some City parks.

Project Objectives

- Implement hydrozoning and ecozoning principles to reduce groundwater use in City parks.
- Increase the amenity and diversity of parks in the City.

Deliverables

- Development of detailed landscaping and irrigation design for identified parks to reduce irrigated areas and therefore water use.
- Implementation of redevelopment projects including: site preparation, reticulation removal and reconnection, turf removal, landscaping, installation of hard surfaces, mulching and provision of signage, at a rate of at least one park per year.
- Development of consultation strategies and provision of information to the local community on projects in their area.

Project 3.4 Urban Planting Program

Project Status

Existing project

Mitigation ✓

Adaptation ✓

Risks addressed R2, R3

Project Description

The reduction of vegetation within urban areas, coupled with the increase in built surfaces has contributed to the Urban Heat Island Effect. With projected increases in temperature expected due to the impacts of climate change, the warming of urban areas may impact the amenity and useability of urban environments. The impact of the Urban Heat Island Effect can be significantly reduced by increasing the amount of vegetation cover within these areas.

The City supports the greening of verges by supplying and planting trees on residential verges free of charge, at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property. Trees are planted during the winter period.

The City also undertakes annual tree planting on the City's public open space, verges and medians to provide more shade and reduce the effects of the Urban Heat Island Effect.

Project Objectives

- Continue to plant trees in residential verges, City open spaces, parks, verges and medians with a minimum of 500 trees being planted per year.
- Provide increased shade to reduce the impacts of the urban heat island effect within urban environments of the City of Joondalup.
- Increase the amenity and diversity of parks and open spaces in the City.

Deliverables

- Planting of at least 500 trees per year within residential verges, City open spaces, parks, verges and medians.

Key Focus Area Natural Environment

Objective 1: To ensure the City's integrated catchment management planning for the Yellagonga wetlands takes into account future climates.

Objective 2: To ensure the City's management of natural areas takes into account the impacts of future climates.

Project 4.1 Yellagonga Integrated Catchment Management Plan 2014 – 2018
Project Status New project
Mitigation Adaptation ✓ Risks addressed R3
Project Description <p>The Yellagonga Regional Park is located on the Swan Coastal Plain within the City of Joondalup and the City of Wanneroo and is comprised of a chain of linear wetlands extending from Lake Joondalup in the north, through Beenyup Swamp and Walluburnup Swamp, to Lake Goollelal in the South. The Yellagonga Regional Park consists of a number of different tenures and is managed in partnership between the City of Joondalup, City of Wanneroo and Department of Parks and Wildlife (DPAW).</p> <p>The Yellagonga wetlands are one of the City's most valued environmental assets, providing important habitat for flora and fauna as well as providing valued recreation and tourism opportunities. Improving the health and viability of the Yellagonga catchment and wetlands will increase its resilience to future climate changes.</p> <p>The impacts of climate change on the Yellagonga wetlands are likely to be numerous and varied, and may include:</p> <ul style="list-style-type: none">▪ Reduced groundwater and surface water availability.▪ Reduced water quality due to declining water levels and potential mobilisation of heavy metals.▪ Increase in potential and actual acid sulphate soils.▪ Increased threat from weeds, predators and fire.▪ Change in the abundance, distribution and diversity of aquatic biota.▪ Changing and restricted habitats for fauna and flora. <p>The Yellagonga Integrated Catchment Management Plan (YICM) 2009-2014 was developed to provide a holistic and long-term strategic plan to improve catchment health and protect the diverse values of the Park. The development of the new Yellagonga Catchment Management Plan will ensure the long term protection of the Yellagonga Wetlands will a focus on addressing the current and future impacts of climate change.</p>
Project Objectives <ul style="list-style-type: none">▪ To maintain the health and viability of the Yellagonga Regional Park and to increase its resilience to climate change impacts.
Deliverables <ul style="list-style-type: none">▪ The development of the Yellagonga Integrated Catchment Management Plan 2014 – 2019.

Project 4.2 City of Joondalup Natural Area Management Plans

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R3

Project Description

Climate change will have significant impact on the health and viability of the City's natural areas. Reduced rainfalls will result in lower groundwater levels and drying out of the lakes and consequently less water being available for flora and fauna. Changes in temperatures can also alter breeding and habitat patterns. Threats from weeds and fire are also likely to increase and coastal natural areas will be increasingly affected by storm surge and coastal erosion.

To improve the strategic management of the City's native vegetation and ecosystems and to increase resilience to climate change, the City is developing Natural Areas Management Plans.

Natural Areas Management Plans identify baseline information on the current state of natural areas and identify environmental threats that pose a risk to biodiversity values within the natural area. Natural Areas Management Plans are being developed for the City's natural areas in order of prioritised ranking.

It is important to ensure that climate change is adequately recognised in the City's Natural Areas Management Plans.

Project Objectives

- To increase resilience of the City's natural environment through the development and implementation of Natural Area Management Plans.

Deliverables

- Natural Area Management Plans that incorporate climate change risk and management recommendations to address the threats to biodiversity associated with climate change.

Project 4.3 City of Joondalup Pathogen Management Plan

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R3

Project Description

The impact of climate change on pathogens is uncertain. However changing rainfall patterns i.e. less rain in winter and more in summer is likely to promote the spread of pathogens by increasing the periods of warm, moist soil conditions in which pathogens are most active and likely to spread.

Vegetated areas within the City are at risk from pathogens which pose a serious threat to the biodiversity values within the City's parks and bushland areas. In order to protect the City's native vegetation and ecosystems a Pathogen Management Plan has been developed. The Plan identifies the level of risk for pathogens becoming introduced to City parks and natural areas and prioritises the areas for further on ground investigations.

The Plan also provides guidance on the management of pathogens within the City in order to minimise the spread of pathogens. Strategies to engage the community in order to raise the awareness of pathogens are also identified within the Plan.

Implementation of the Pathogen Management Plan is important for:

- Increasing the health and resilience of vegetated areas to climate change impacts.
- Decreasing the risk of pathogens spreading in a changing climate.

Recognition and consideration of future climate change and its impact on pathogens should be incorporated into the implementation of the Pathogen Management Plan and future reviews of the Plan.

Project Objectives

- To improve the health and resilience of the City's natural areas to climate change.

Deliverables

- Pathogen Management Plan projects and actions are implemented with consideration to climate change impacts.
- A reviewed Pathogen Management Plan that incorporates future climate change risk.

Project 4.4 City of Joondalup Fire Management Plan

Project Status

New project

Mitigation

Adaptation ✓

Risks addressed R3

Project Description

Bushfires are one of the key environmental threats to natural areas in the City of Joondalup. Bushfires can significantly degrade natural areas, destroy habitats, reduce flora and fauna numbers and create opportunities for weed and predator establishment. In addition bushfires can threaten and impact on nearby properties and communities.

Climate change is likely to result in a hotter and drier climate which is likely to result in an increase in both the intensity and frequency of bushfires in most regions. It is important to ensure that climate change is adequately recognised in the City's Fire Management Plan.

To provide an ongoing strategic approach to the management of natural areas in order to reduce the incidence of fire in the City a Fire Management Plan will be developed in 2014-15. The Fire Management Plan will also give consideration to the role of planning processes and approvals in providing an appropriate level of protection to private property from bushfires.

Project Objectives

- To improve the health and resilience of the City's natural areas to climate change.

Deliverables

- Development and implementation of a Fire Management Plan that considers future climate change impacts.

Project 4.5 City of Joondalup Coastal Foreshore Natural Areas Management Plan

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R3

Project Description

Climate change will have significant impact on the health and viability of the City's coastal foreshore natural areas. Impacts include increased coastal erosion and loss of vegetation and habitat due to sea level rise and increased storm surge, and impacts on flora and fauna due to increased temperatures and reduced rainfall. Climate change will also impact on the viability and effectiveness of some of the City's management practices i.e. fencing and revegetation practices.

The City's coastline stretches for 17km and includes areas of significant conservation value. The City has developed a Coastal Foreshores Natural Areas Management Plan. The purpose of this Plan is to:

- Outline the current physical and management context of the foreshore reserve within the City of Joondalup.
- Identify areas within the foreshore reserve that are considered to have the highest conservation values, giving consideration to natural features including landform, flora and fauna, along with cultural values.
- Outline management issues apparent at various locations of the reserve, and suggest management strategies to manage those in the short to medium term.
- Identify current best practice management practices that can be implemented by the City.

The Plan provides overarching management direction for the coastal foreshore area, with individual Management Plans to be developed for discrete sections of the coast in the future.

It is important to ensure that climate change is adequately recognised through the implementation of the City's Coastal Foreshore Natural Areas Management Plan.

Project Objectives

- To improve the health and resilience of the City's coastal foreshore areas to the impacts of climate change.

Deliverables

- Implementation of the Coastal Foreshore Natural Areas Management Plan that incorporates management actions to address future climate change.

Project 4.6 City of Joondalup Waste Management Plan

Project Status
Existing project

Mitigation ✓
Adaptation

Project Description

Waste that is sent to landfill decomposes and produces greenhouse gases. Therefore the diversion of waste from landfill through waste minimisation, recycling or reusing methods can reduce the City's greenhouse emissions.

The City of Joondalup is responsible for the collection of residential waste and manages household waste through a number of methods and facilities:

- Materials Recovery Facility – items from the yellow lidded bins are recycled at the resource recovery facility, contaminated items are sent to landfill,
- Resource Recovery Facility – organic items from the green lidded bins are recycled at the materials recovery facility, the remaining items are sent to landfill,
- Greens recycling – green waste (i.e. tree prunings etc) that is collected through the bulk verge greens collection or taken to the greens recycling facility is recycled into mulch.
- Landfill – the remaining waste that the City is unable to recycle or recover is sent to landfill.

The development of a Waste Minimisation Plan will provide direction to the City in increasing efficiency of waste services and initiatives in the future.

Project Objectives

- To increase efficiency of waste services and reduce waste to landfill and greenhouse gas emissions through sustainable waste management practices which incorporate increased re-use and recycling.

Deliverables

- Development and implementation of a Waste Minimisation Plan that directs the City's operational waste management practices.

Key Focus Area Corporate Responsibility and Good Governance

Objective 1: To demonstrate responsible leadership and governance practices in the City's climate change management activities.

Objective 2: To incorporate climate change management into the City's strategic and corporate planning.

Project 5.1 City of Joondalup Project Management Framework
Project Status Existing Project
Mitigation Adaptation ✓ Risks addressed R1, R2, R5, R6
Project Description <p>The City's Project Management Framework is a guide to planning and managing projects across the City. The Framework sets out the major phases in the life of a project and provides guidance on the activities and how they are managed within each phase. Under the Project Management Framework projects are categorised a:</p> <ul style="list-style-type: none">▪ Major Projects;▪ Capital Works Program Projects;▪ General Projects; and▪ Process Improvement Projects. <p>In order to incorporate climate change management into the City's strategic and corporate planning a review of the City's Project Management Framework will be undertaken to ensure climate change is adequately recognised within each stage of project planning and implementation.</p>
Project Objectives <ul style="list-style-type: none">▪ To ensure climate change risks are adequately considered in the proposal and planning stages of the City's projects.
Deliverables <ul style="list-style-type: none">▪ Development of Project Management Framework documents that prompt officers to consider climate change risks.▪ Development of information on future climates and anticipated impacts to assist officers in identifying climate change risks.

Project 5.2 Review of City of Joondalup Workforce Plan

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R6, R8

Project Description

The *Workforce Plan 2013 – 2017* determines the workforce requirements necessary to resource and deliver the organisation's *Corporate Business Plan* and in doing so, assist in the achievement of strategic objectives contained within *Joondalup 2022*. The *Workforce Plan 2013 – 2017* recognises external drivers for workforce planning including skills shortage, changing technology, local government reform, population changes, legislative changes and regional development.

Project Objectives

- Ensure that the City is adequately resourced and staffed to respond to impacts that climate change will have on City operations, activities and services.

Deliverables

- An updated Workforce Plan that recognises climate change as a potential external driver for workforce planning.

Project 5.3 **City of Joondalup Risk Register**

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R6, R11

Project Description

The City of Joondalup maintains a corporate risk register which identifies overarching risks for the organisation in delivering the City's vision and aspirational outcomes. The City also identifies risks relating to service delivery for each of its business units.

Risk assessment involves assigning a risk priority, identifying current controls in place and any further action required. Future and ongoing risk assessment by the City will ensure that climate change risks are adequately recognised and incorporated into the City's risk registers.

Project Objectives

- To ensure that the City's decision making processes consider climate change risks.

Deliverables

- Climate change risks are adequately recognised in the City's Corporate Risk Register.

Project 5.4 Annual Policy Manual review**Project Status**

Existing project

Mitigation**Adaptation** ✓**Risks addressed** R6**Project Description**

The City's Policy Manual includes City Policies and Council Policies that provide guidance to the City in decision making. City Policies are those which are developed for administrative and operational imperatives and have an internal focus. Council Policies are those which set governing principles and guide the direction of the organisation to align with community values and aspirations.

In order to demonstrate responsible leadership and governance practices City and Council policies should be reviewed annually to ensure that where appropriate the impacts of climate change are recognised and the City's commitment to climate change management is demonstrated. In addition any gaps in policy that is considered important for climate change management will be identified.

Project Objectives

- To ensure the City's policies adequately support the City's commitment to climate change management.

Deliverables

- Relevant policies are updated to recognise the impacts of climate change and reflect the City's commitment to climate change.
- The need for any new policies relating to climate change is identified and developed accordingly.

Project 5.5 Planet Footprint

Project Status
Existing Project

Mitigation ✓
Adaptation

Project Description

The City subscribes to the Planet Footprint service which measures the City's environmental performance, providing energy, water, and fleet consumption data including costs and greenhouse gas emissions. This information is presented on the Planet Footprint website where the City has access to data and reports on environmental performance.

The availability of consistent and accurate energy consumption data assists in identifying anomalies and assessing the effectiveness of the City's energy efficiency projects. Frequent monitoring and reporting of energy consumption data is also important in tracking progress towards the City's mitigation targets.

Planet Footprint monitors 36 of the City's buildings, as well as the City's overall energy use, and has energy consumption data for each property since 2006/07. Planet Footprint also reports on anomalies and notifies the City of any significant increases in energy consumption.

Project Objectives

- Enable consistent and ongoing monitoring of energy consumption data to measure targets, and to identify trends and anomalies.
- Provision of data to inform City decisions, reports and strategic direction relating to energy management.

Deliverables

- Development of energy consumption and anomaly reports.
- Continuation of a working group to investigate anomalies
- Annual reporting to the executive leadership team on the City's energy use.
- Inclusion of overall Corporate energy and greenhouse gas data within the City's Annual Report.

Project 5.6 City of Joondalup Carbon Offset Program

Project Status

Existing project

Mitigation ✓

Adaptation

Project Description

Since 2010/11 the City has purchased offsets for 75% of the electricity consumed at Craigie Leisure Centre and the Joondalup Library, Administration and Civic Centre.

In 2012/13 the City offset 3737 t CO₂-e which is equivalent to offsetting approximately 17% of the City's gross emissions.

The City has also offset a 100% of emissions from its vehicle fleet since 2007. The offsets are purchased through Carbon Neutral who undertake biodiverse native plantings to absorb the equivalent amount of emissions from the atmosphere. In 2012/13 the City offset 1596 t CO₂-e equivalent to offsetting approximately 7% of the City's gross emissions

The City should continue to purchase offsets as it makes a considerable contribution to reducing impact of the City's greenhouse gas emissions.

Project Objectives

- To reduce the impact of the City's greenhouse gas emissions through the purchase of offsets.

Deliverables

- Offsetting of the electricity consumed at the Craigie Leisure Centre and Joondalup Library, Administration and Civic Centre.
- Offsetting of emissions related to the City's vehicle fleet.

Project 5.7 Green Purchasing Protocol

Project Status
Existing project

Mitigation ✓
Adaptation

Project Description

The City can contribute to energy conservation and management through purchasing decisions which consider suppliers and products that are environmentally sustainable.

The City will develop a Green Purchasing Protocol that will integrate energy criteria, as well as other environmental impacts, into purchasing decisions. This will ensure that the City purchases services and products that are environmentally sustainable.

Project Objectives

- Ensure that energy efficiency is considered in City purchasing decisions are formalised through the Green Purchasing Program.

Deliverables

- Development and integration of energy efficiency criteria into the City's purchasing mechanisms.
- Consideration of energy efficiency within the City's purchasing decisions.

Project 5.8 Green Office 'Think Green' Program**Project Status**

Existing Project

Mitigation ✓**Adaptation****Project Description**

Staff education and awareness-raising is important in encouraging sustainable behaviour across the organisation. The Green Office 'Think Green' Program is a cultural change program targeting City staff to promote more sustainable behaviours and attitudes within their everyday work life. This Program commenced in February 2010 with an aim to increasing staff appreciation of the environmental impacts of their daily activities regarding energy, water, waste and travel. "Think Green" is branded and ongoing, to stimulate consistent change rather than ad hoc staff awareness.

The Program is focused on increasing participation by City staff in environmental projects and fostering behaviour change. The Program will include:

- Implementation of a Green Office Guide - to inform, engage and encourage staff to address energy, water, waste, and transport issues within the workplace.
- Staff events and activities to raise the awareness of climate change related issues.
- TravelSmart Workplace initiatives – Pool bikes and smart riders.

Project Objectives

- Raise awareness of the importance of energy resources amongst City employees.
- Ensure that staff utilise energy resources in a sustainable manner during work activities.

Deliverables

- Delivery of staff awareness raising initiatives on energy and climate change related activities and events that provide opportunities for staff participation.

Project 5.9 City Water Plan

Project Status

Existing project

Mitigation

Adaptation ✓

Risks addressed R2, R3, R8

Project Description

The City Water Plan 2012 – 2015 provides a coordinated approach for the City to sustainably manage water resources within City operations and the community. The Plan identifies the main water related issues impacting the City and sets objectives for scheme and groundwater conservation, water quality and quantity improvement.

The City Water Plan recognises that the City is facing a drying climate and a future with less available water, increased evaporation rates and more hot days. Reducing the City's scheme and groundwater consumption is of high importance and will provide a number of benefits including:

- Protecting local water resources and ensuring that there is more water available for the natural environment.
- Protecting the City against rising water costs and reduced water allocation levels.
- Encouraging the community to reduce its water consumption will also help them in becoming more resilient to rising water costs.

Through the City Water Plan the City has committed to the following water reduction targets:

- Reduce corporate groundwater use by 10% per capita below 2010/11 consumption by 2014/15.
- Reduce corporate scheme water use by 5% per capita below 2010/11 consumption by 2014/15.
- Reduce community scheme water use by 5% per capita below 2010/11 consumption by 2014/15.

The City will continue to implement the City Water Plan and continue to monitor and manage its corporate scheme water and groundwater consumption.

Project Objectives

- To reduce the City's scheme water and groundwater use to reduce its impact on the natural environment and increase the City's resilience to a drying climate.

Deliverables

- Corporate groundwater use is reduced by 10 per cent per capita below 2010/11 consumption by 2014/15.
- Corporate scheme water use is reduced by 5 per cent per capita below 2010/11 consumption by 2014/15.
- Community scheme water use is reduced by 5 per cent per capita below 2010/11 consumption by 2014/15.

Project 5.10 Strategic Partnerships

Project Status

New project

Mitigation ✓

Adaptation ✓

Risks addressed R2, R3, R8

Project Description

Keeping up to date with developments in the area of climate change management will ensure that the City is implementing best practice approaches to climate mitigation and adaptation. There are a number of government and non government groups and educational and research organisations within Western Australia and Australia that focus on building the capacity of local government to effectively mitigate climate change and increase resilience to impacts.

The City should investigate opportunities to partner with stakeholders, industry groups and research institutions to enable the City to build capacity and gain information relating to best practice approaches climate change mitigation and adaptation.

Project Objectives

- To ensure that the City is well informed of developments in climate change management by actively participating in research projects and working groups as opportunities arise.

Deliverables

- Increased support for the City in implementing greenhouse gas mitigation and climate adaptation activities.
- Increased knowledge of best practice approaches to climate change management.

Key Focus Area Community Wellbeing

Objective 1: To increase awareness in the community about climate change and its impacts.

Objective 2: To assist the City's residents and communities to become more resilient to the impacts of climate change

Project 6.1 Mosquito Monitoring Program
Project Status Existing Program
Mitigation Adaptation ✓ Risks addressed R4
Project Description <p>In Western Australia, the mosquito-borne diseases of most public health concern are Ross River virus disease, Barmah Forest virus disease and Murray Valley encephalitis. Increases in temperatures, changed rainfall patterns, and rising sea-level, can all potentially enhance activity and distribution of mosquito-borne diseases. While there is strong evidence linking climate parameters with the incidence of mosquito vectors, there is a large degree of uncertainty surrounding the exact impacts of climate change on the incidence of these diseases, but it is likely that impacts will occur.</p> <p>The City undertakes a Mosquito Monitoring program to determine base levels of mosquito activity at the City's lakes and wetland areas. The City undertakes localised trapping in response to reports of increased mosquito activity by the community. In addition the Department of Health notifies the City of any reports of mosquito-borne disease within the City's boundaries which the City then follows-up.</p>
Project Objectives <ul style="list-style-type: none">▪ To determine base levels of mosquito activity and mosquito-borne diseases within the City.
Deliverables <ul style="list-style-type: none">▪ Mosquito species and numbers at key sites within the City are monitored and reported.▪ Any notifications from the Department of Health of mosquito borne disease are followed-up by the City.

Project 6.2 Community Development Plan 2014-19

Project Status
Existing Project

Mitigation
Adaptation ✓
Risks addressed R10

Project Description

Projected climate changes will impact on the City's community. Vulnerable residents such as the elderly may be at risk from increased temperatures and extreme heat days. Increasing cost of utilities may place more stress on families and communities and may lead to a greater need for City services. Residents and communities may also be more likely to be at risk from increases in vector diseases, flooding, bushfire or extreme weather events.

While the City may not be able to directly mitigate the impacts of climate change on its residents and communities it can assist its residents and communities in becoming more resilient to the impacts of climate change. The City's Community Development Strategy 2014-2019 guides the implementation of community development activities within the City of Joondalup. The Strategy provides a number of initiatives to be implemented over a five-year period to enhance the wellbeing of the City's community.

The implementation of the City's Community Development Plan will assist in addressing community climate change impacts, particularly those relating to social infrastructure and community capacity issues.

Project Objectives

- To increase the resilience of the City's residents and communities in adapting to the impacts of climate change.

Deliverables

Implementation of the City's Community Development Plan 2014 – 2019 including delivery of initiatives aimed at increasing community wellbeing.

Project 6.3 Think Green - Energy Program

Project Status

Existing project

Mitigation ✓

Adaptation ✓

Risks addressed R10

Project Description

The City has developed an ongoing community education program focusing on energy efficiency and energy conservation. The *Think Green – Energy Program* aims to promote energy conservation and climate change aware practices within the community in order to influence behaviour change and foster improved environmental management within the community.

Assisting households in reduce energy consumption not only reduces greenhouse gas emissions but will also assists households to become more resilient to rising energy costs.

To date the *Think Green – Energy* has included the development of:

- Energy and climate related education resources.
- Energy conservation and efficiency information in community newspapers, other publications and the City's website.
- Climate Change workshops and other energy education events.

In 2013/14 free Eco Home Audits were incorporated into the Program and have been made available to 100 households. The Audits focus on reducing home energy, water and resource use and include an energy and water saving retrofit to create immediate changes in the home.

Project Objectives

- Promote behaviour change in the community through the provision of energy conservation and climate change information and resources.
- Raise awareness in the community regarding renewable energy sources.
- Raise awareness in the community regarding future climates and the importance of adapting to climate change.

Deliverables

- Continued distribution of energy and climate change related resources for the community.
- Updating of program materials to include future climates and climate change adaptation.
- Delivery of a range of community education initiatives focused on energy efficiency, energy conservation and renewable energy.

Project 6.4 Think Green – Environmental Education Program

Project Status

Existing project

Mitigation ✓

Adaptation ✓

Risks addressed R10

Project Description

The City has developed a coordinated program of environmental education activities through its Environmental Education Program (EEP). Community education is vital in influencing behaviour change and fostering improved environmental management in the community.

The Environmental Education Program currently includes the:

- Adopt-a-Coastline Program.
- Adopt a Bushland Program.
- Food Garden and Sustainable Garden Workshops.
- Biodiversity tours (Night Stalks and Nyungar Bushtucker tours).
- Clean Up Australia Day (supporting local events).
- World Environment Day student photography competition.
- Environmental information on the City's website and development of materials for City residents on key environmental issues.

Where appropriate materials and resources for these projects and events should be reviewed and updated to ensure that information and education on climate change science, impacts and adaptation are included.

Project Objectives

- Raise awareness in the community regarding future climates and the importance of adapting to climate change.

Deliverables

- Updating of program materials to include future climates and climate change implications and community adaptation measures.
- Delivery of community education initiatives regarding climate change impacts.

Project 6.5 Lessee Environmental Education Program

Project Status
Existing Project

Mitigation ✓
Adaptation ✓
Risks addressed R8

Project Description

The City is committed to reducing its corporate energy and water consumption. The Lessee Environmental Education Program aims to educate and work with lessees of City buildings to reduce water and energy consumption as well as reduce waste and greenhouse gas emissions. The Program will involve the following steps:

- Review water and energy usage data for all City buildings using Planet Footprint data and identify the 10 leased buildings that use the most water and energy.
- Develop a Lessee Environmental Education Package including water and energy saving brochures, waste information, water and energy saving prompts and an environmental management plan template.
- Work with the identified 10 lessees to complete an environmental management plan. As part of this plan, lessees will be encouraged to work towards a goal of 10% water reduction and 10% energy reduction by 2014/15 as well as identifying opportunities for water and energy saving and promoting positive environmental behaviours amongst users of the buildings.

Project Objectives

- To reduce energy and water use in the City's leased buildings
- To educate lessees on how to better manage their energy and water consumption.

Deliverables

- A review of water and energy usage data for all City buildings is conducted and the ten highest energy and water using leased buildings are identified.
- Development of a Lessee Environmental Education Package.
- Development of individual Energy Management Plans for the City's ten highest water and energy using buildings.

Project 6.6 Emergency Management Planning

Project Status
Existing Project

Mitigation
Adaptation ✓
Risks addressed R4

Project Description

Climate change has the potential to change the frequency and magnitude of extreme weather events. This will have an impact on emergency management planning, preparation, response and recovery.

The City of Joondalup Emergency Management Risk Register has been developed to meet its obligations under the Emergency Management Act 2005. The Risk Register is a compilation of the risks identified as likely to impact on the City as a result of natural and technologically driven events. The risk register records identified risks and their severity and outlines the agencies responsible for mitigation of the risks and the current treatment strategies in place.

The main risks identified for the City include bushfire, severe storm, human epidemic / pandemic and chemical spills. The risk of bushfire and severe storm in particular are likely to increase with climate change however the Risk Register does not currently recognise the impact of climate change. During the next major review of the Emergency Management Risk Register the identified risks should be updated to reflect the impact that climate change may have on the frequency and magnitude of these risk events.

Project Objectives

- To ensure the City has adequate procedures and processes in place to implement emergency management planning as a result of climate change impacts.

Deliverables

- An updated Emergency Management Risk Register that recognises the impacts of climate change.

Draft Climate Change Strategy 2014-2019 Community Consultation Summary

Feedback Form Question/ Section	ID	Comment	City Response
What do you like about the Draft Climate Change Strategy 2014-2019	RR	The Strategy talks about reducing negative effects that is a good move.	Comment noted.
Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019	RR	<p>The Strategy should include active steps to be taken to reduce the effect of Co2 emissions:</p> <p>Enforce that verges are kept green</p> <p>Enforce that long term parking of large items on verges declines</p> <p>Plant saplings on all verges</p> <p>Plant, and take better care of, all saplings planted on verges</p>	<p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge, at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>Restrictions regarding parking within the City of Joondalup is enforced via the <i>Parking Local Law 1998</i></p> <p>The City undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p> <p>As detailed above.</p> <p>To ensure the continued planting of trees within the City's residential verges, parks, open spaces, verges and medians, Project 3.4- Urban Planting Program has been included within the Climate Change Strategy.</p>

Feedback Form Question/ Section	ID	Comment	City Response
		Protect matured trees by finally formulating the Significant Tree Register	The City is currently developing a Significant Tree Register which will include criteria for trees to be added to the Register.
Do you have any other comments?	RR	<p>If we have more trees on verges and medium strips the midsummer temperature will decrease making it more attractive to walk/bike. And the chances of rainfall increase.</p> <p>Once we have an urban forest we can sell CO2 certificates.</p>	<p>Comment noted.</p> <p>The planting of trees within the City will help to sequester carbon. However there are a number of key difficulties in having this carbon sequestration credited (through verified carbon units), including:</p> <ul style="list-style-type: none"> • For trees to be recognised for carbon sequestration they need to be additional plantings and not trees that would normally be planted by the City for rehabilitation or street trees; • Due to the large number of trees required to sequester carbon, large suitable areas for planting would need to be identified. It is estimated that approximately 6 trees will sequester 1 tonne of carbon dioxide over their lifetime. It is for this reason that offsets need to be purchased annually. • A combination of plantings is required to successfully sequester carbon and generally a mix of trees and shrubs are planted. However as the City has a policy of planting only local provenance species within natural areas, identifying suitable

Feedback Form Question/ Section	ID	Comment	City Response
			<p>species for sequestration may be difficult; and</p> <ul style="list-style-type: none"> • For trees to be recognised as carbon offsets they need to be legally protected for a period of up to 100 years. This is usually achieved through covenants or similar legal arrangements. <p>Meeting the requirements of accrediting the carbon sequestration of the City's tree plantings would have significant administrative and financial implications.</p>
What do you like about the Draft Climate Change Strategy 2014-2019	RP	Good to see the City acknowledges that there is climate change and at least talking about the future problems to be considered and addressed.	Comment noted.
Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019	RP	Would like to have seen a little more detail as to how the problems would be resolved and not just the targets set.	The projects that the City is undertaking to reach the targets within the Climate Change Strategy are listed in Section 4.2 of the Strategy and are further detailed in Appendix 1.

Feedback Form Question/ Section	ID	Comment	City Response
Do you have any other comments?	RP	<p>In the City of Joondalup there is the lack of trees. Every house should have a suitable shady street tree and as this is Council land they should not be removed only after consultation with the Council.</p> <p>More trees should be planted and maintained on roadside verges and Parks with better co-ordination between Council Departments so trees are not planted by one Department and then removed by another.</p> <p>Tighter conditions on land developers that each new sub division include larger uncleared areas and the stipulation each new lot has a verge tree planted and maintained at the developer's expense. Micro climates work just look at Singapore!</p> <p>Water tanks should be included at the construction stage of each new home and retrofitted to existing homes.</p> <p>Better collection and distribution of storm water to retain our remaining wetland.</p> <p>Smaller bins and education so people discard less and an</p>	<p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>The City also undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p> <p>Comment noted.</p> <p>Requirements for the construction of new homes and major renovations are prescribed within the Building Code of Australia (BCA). Whilst the City cannot enforce provisions over and above the BCA, the City does encourage the integration of environmentally sustainable design principles into new and retrofitted buildings within the City through its <i>Environmentally Sustainable Design Policy</i>.</p> <p>Stormwater management within the City of Joondalup is guided by the City's Stormwater Management Policy. The management of stormwater and its impact of the Yellagonga wetlands is addressed through the <i>Yellagonga Integrated Catchment Management Plan</i>.</p> <p>The City's <i>Draft Environment Plan</i> includes a project to develop</p>

Feedback Form Question/ Section	ID	Comment	City Response
		impost on industry to reduce packaging.	community waste education initiatives under the City's Think Green Environmental Education Program. The City will also be developing a <i>Draft Waste Management Plan 2014 – 2017</i> to provide guidance on the City's waste management operations.
What do you like about the Draft Climate Change Strategy 2014-2019	RVS	I like that you've got a Strategy and that it will set a broad framework for further budgets and decision making.	Comment noted.

Feedback Form Question/ Section	ID	Comment	City Response
<p>Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019</p>	RVS	<p>The Strategy could be improved by offering more specific subsequent projects to implement the Strategy across the local government's business areas.</p> <p>The Strategy should outline how its objectives will be incorporated into the Local Planning Strategy, Housing Strategy, Open Space planning, rezoning of land etc. A flowchart or illustration showing the heirachy or interrelationship of Council's other documents would assist.</p> <p>The Strategy is almost silent on trees, revegetation, street tree initiatives, both public and private realm. Trees are a major component of offsetting green house gas and reducing heat. I suggest the Strategy should be amended to provide the broad context for subsequent tree planting and tree retention initiatives.</p> <p>The CSIRO and Dept of Planning are looking at this issue of trees and the Climate Change Strategy should too. See here: http://ehia.curtin.edu.au/local/docs/CoolCommunities.pdf</p>	<p>The projects that the City is undertaking as part of the implementation of Climate Change Strategy are listed in Section 4.2 of the Strategy and are further detailed in Appendix 1 of the Strategy.</p> <p><i>Project 2.1 Review of the City's Local Planning Strategy and Local Planning Scheme</i> and <i>Project 2.2 Review of Local Planning Policies</i> will facilitate the incorporation of the objectives of the Climate Change Strategy into the City's planning documents.</p> <p>Reference to the urban heat island effect and the role trees and vegetation can play in reducing the effect of rising temperatures and the urban heat island effect, has been included within the <i>Draft Climate Change Strategy</i> on page 46.</p> <p>The City also undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p> <p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>Comment noted and the relevant document has been reviewed.</p>

Feedback Form Question/ Section	ID	Comment	City Response
Do you have any other comments?	RVS	<p>The Strategy should list key projects Council is prepared to enter into to implement the Strategy. It has already missed many very recent opportunities and I fear more opportunities will be missed.</p> <p>Examples include: No trees planted at Sorrento Beach car park or new park. Lack of native trees planted in road reserves and around sports fields for shade and habitat and cooling impact. Lack of bike lane down Glengarry Drive (north end). Lack of rezoning around Marri Park where back fences exist along 3 sides of park. Lack of high rise opportunities in Housing Strategy.</p>	<p>The projects that the City is undertaking as part of the Strategy's implementation are listed in Section 4.2 of the Strategy and are further detailed in Appendix 1 of the Strategy.</p> <p>Comments noted.</p>
What do you like about the Draft Climate Change Strategy 2014-2019	RD	Question not answered.	

Feedback Form Question/ Section	ID	Comment	City Response
Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019	RD	<p>Far too much "fluff" type of expressions. Should speak in a more precise & concise language that can be trusted to actually achieve the goal. I believe that when writing a report, the quality of the words used are much more powerful than the quantity of "fluffy" stuff. It is as if the author was paid by number of words and not "straight" talking facts from authorities sources.</p> <p>I think that this strategy lacks being bold and doesn't aspire to reach the highest international bench mark. An opportunity lost.</p> <p>Start again with absolute sincerity to the task.</p> <p>Remembering that this is an ideal opportunity to show-case, not only to Australia but the whole world, what the City of Joondalup can do in planning to make living here in future years like being in a Garden of Eden.</p>	<p>Comment noted.</p> <p>Comment noted.</p> <p>Comment noted.</p> <p>Comment noted.</p>
Do you have any other comments?	RD	Get the best and right people to honestly assess this draft without fear or favour to no one.	Comment noted.
What do you like about the Draft Climate Change Strategy 2014-2019	TM	Question not answered.	

Feedback Form Question/ Section	ID	Comment	City Response
<p>Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019</p>	<p>TM</p>	<p>It should be rewritten to reflect the urgent need to drastically slash emissions by a far higher percentage to avert climate crisis, given new IPCC report.</p> <p>The world's leading climate scientists and authorities are calling for a tripling of renewables and targets around 30-40% emissions reductions to avoid catastrophic impacts of climate change.</p> <p>The City should not follow the inadequate response to global warming of the Abbott Government, but instead lead to protect its residents with adequate measures.</p>	<p>Since the City's <i>Draft Climate Change Strategy</i> was drafted, three new relevant reports have been released:</p> <ul style="list-style-type: none"> • CSIRO and BoM (2014) State of the Climate 2014. • IPCC (2014) Climate Change 2014: Impacts, Adaptation and Vulnerability. Fifth Assessment Report. IPCC • IPCC (2014) Climate Change 2014: Climate Change Mitigation. Fifth Assessment Report. IPCC. <p>These reports have been reviewed and referenced within the City's <i>Draft Climate Change Strategy</i>.</p> <p>The targets set within the Draft Climate Change Strategy have been made within the context of:</p> <ul style="list-style-type: none"> • The 20% reduction in greenhouse gas emissions the City has already achieved through the implementation of the Greenhouse Action Plan 2007-2011. • The City has already implemented many of the lower cost and therefore easily achievable reductions and further substantial reductions in the City's Corporate greenhouse gas emissions will require greater investment and resources from the City. • Many of the funding programs previously available from the State and Federal Government to support greenhouse reductions are no longer available. • Balancing environmental outcomes with financial responsibility towards the City's ratepayers.

Feedback Form Question/ Section	ID	Comment	City Response
		<p>Sea level rises are now expected to be several metres, which will impact City, along with increased bushfire risks. There are many dying trees throughout the City due to continued drying - a major replanting and re vegetation program needs to be undertaken to try to restore microclimate/resilience.</p>	<p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>The City also undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p>
<p>Do you have any other comments?</p>	<p>TM</p>	<p>Streets need to be planted up to reduce heat island effects during heatwaves and residents encouraged to make changes now to adapt and to mitigate climate change - most are not aware there is even a problem.</p> <p>The City is not doing enough to transition to a low to zero carbon economy/future, nor prepare its residents for the fast looming impacts that 50 degree summers and longer, hotter anticipated dry spells will bring if not enough action</p>	<p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>The City also undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p> <p>To ensure the continued planting of trees within the City's residential verges, parks, open spaces, verges and medians, Project 3.4- Urban Planting Program has been included within the Climate Change Strategy.</p> <p>Climate change is a global, national and local issue. Climate change adaptation and mitigation is the responsibility of all spheres of government as well as businesses, the community and individuals. While the City recognises that local government has an</p>

Feedback Form Question/ Section	ID	Comment	City Response
		<p>taken on climate.</p> <p>Funding for specific climate change resilience training and programs should be provided to help transition City and its residents to low to zero carbon economy/future. Support needs to be provided for businesses and ventures working on clean energy and other climate-friendly ventures.</p> <p>All City vehicles should be hybrid or ideally electric.</p>	<p>important role in both mitigation and adaptation, it is also important to recognise that many strategies for mitigation and adaptation are outside of the statutory responsibility or influence of local government.</p> <p>The scope of this Strategy is limited firstly to the geographical boundary of the City, and secondly to the roles and responsibilities of the City as a local government authority.</p> <p>In regard to mitigation, the City's responsibilities relate to reducing its own emissions and encouraging and supporting the community to reduce their emissions through education, behaviour change programs and planning and development processes.</p> <p>Comment noted.</p> <p>The City's Fleet consists of turf maintenance machines, trailers, loaders, weed sprayers, water pumps, passenger sedans, light commercial vehicles and a variety of trucks. The City has a number of hybrid vehicles and where possible has purchased smaller engine vehicles. The City has included <i>Project 1.10 City Fleet Project</i> within the <i>Draft Climate Change Strategy</i> which aims to reduce the net greenhouse emissions associated with the City's fleet. However given the nature of some the City's fleet (trucks, machinery etc) it is not practical for the City's fleet to be all hybrid or electric.</p>

Feedback Form Question/ Section	ID	Comment	City Response
What do you like about the Draft Climate Change Strategy 2014-2019	HB	The City is to be applauded at producing a strategy that integrates mitigation and adaptation through a risk assessment framework. The addition of specific projects that translates the ideas into actions is also a strong point.	Comment noted.
Are there any changes / improvements that you think should be made to the Draft Climate Change Strategy 2014-2019	HB	<p>My comments are around the issue of extreme heat. The impact on health and environment is clear. This should be extended to potential impacts on infrastructure such as energy and transportation (ie as part of Risks 1 and 5). There is no mention in the strategy about how the City plans to manage the issue of urban heat island (UHI) - caused by reductions in vegetation (particularly trees) and increases in built surfaces. Without an UHI mitigation plan it is likely that development will drive up temperatures even further. This situation has the potential to reduce rather than increase resilience to climate change. It will also tend to increase energy use and thereby hamper mitigation efforts.</p> <p>Unlike climate change at the global level, which the City clearly has limited opportunities to address, UHI effects occur as a result of local decisions. UHI mitigation strategies (focused on trees/vegetation in urban areas and</p>	<p>Reference to the urban heat island effect and the role trees and vegetation can play in reducing the effect of rising temperatures and the urban heat island effect, has been included within the <i>Draft Climate Change Strategy</i> on page 46.</p> <p>The City supports the greening of verges by supplying and planting trees on residential verges free of charge at the request of the property owner. Residents may apply to have one or more trees planted by the City on the verge adjacent to their property.</p> <p>The City also undertakes annual tree planting on the City's public open space, verges and medians. In 2013 the City planted 1182 trees across the City including 401 trees for playground shade; 40 trees within the CBD streetscape, 363 trees on verges (including resident street tree requests), 258 trees on medians and 120 trees in parks.</p> <p>To ensure the continued planting of trees within the City's residential verges, parks, open spaces, verges and medians, Project 3.4- Urban Planting Program has been included within the Climate Change Strategy.</p> <p>Comment noted.</p>

Feedback Form Question/ Section	ID	Comment	City Response
		albedo of built surfaces) therefore represent a significant opportunity to reduce the risk associated with climate change. In addition, there is a large body of knowledge and evidence that is available to address this situation. This issue has a relationship to a significant number of your 11 overarching risks and should therefore be addressed as a matter of urgency.	
Do you have any other comments?	HB	1000 characters is extremely limited to comment on such a large document.	Comment noted.
What do you like about the Draft Climate Change Strategy 2014-2019	DoP	<p>Thank you for the opportunity to comment on the City of Joondalup's (the City) Draft Climate Change Strategy (the Strategy). Comment is provided in respect to State Planning Policy No. 2.6 State Coastal Planning Policy (SPP2.6).</p> <p>The City of Joondalup is commended for producing a thorough and forward thinking climate change mitigation and adaptation strategy. The Strategy addresses the major anticipated climate change impacts and considers the possible consequences for both Council operations and the community. Through meeting the objectives set out in the Strategy the City will be well placed to respond to the current and future impacts of the changing climate.</p>	<p>Comment noted.</p> <p>Comment noted.</p>
Are there any changes / improvements that you think should be made to the Draft	DoP	The Strategy outlines a series of projects to be undertaken by the City over the next 5 years. No priority or order has been outlined for the projects, nor have they been casted or given an approximate time expected to complete. Aiming to complete a certain number of projects per year is optimistic, especially as many of the projects cannot be	<p>Following adoption of the <i>Climate Change Strategy</i> an Implementation Plan will be developed to guide the delivery of projects over the next five years. The Plan will include assignment of responsibilities and timelines for specific projects.</p> <p>The Implementation Plan will be based on budgetary and planning</p>

Feedback Form Question/ Section	ID	Comment	City Response
Climate Change Strategy 2014-2019		completed within one calendar year. The City should consider how best to incorporate these new projects into Councils existing project management and priority setting system. An implementation plan utilising the risk management process already described would help to clearly identify which risks cannot be tolerated, thus requiring immediate action.	considerations/constraints and will be operational in nature and as such is not included as part of the <i>Draft Climate Change Strategy</i> .
Do you have any other comments?	DoP	<p>Following the completion of the Coastal Vulnerability Studies the City plans to prepare a Coastal Adaptation Plan and an associated policy; as described in <i>Project 1.1 Coastal Adaptation Planning and Implementation Project</i>. It is suggested that the City utilises the WAPC model of a Coastal Hazard Risk Management and Adaptation Plan (as established in SPP2.6 and the State Coastal Planning Policy Guidelines). The attached DRAFT Coastal Hazard Risk Management and Adaptation Plan Guidelines provide more detail on what is expected. The City could consider incorporating projects 1.2 and 1.3 into the CHRMAP process.</p> <p><i>Project 2.3 Implementation of State Coastal Planning Policy 2.6's</i> deliverables are directly the result of completion of projects 1.1, 1.2, 1.3, 2.1, and 2.2, and is not achievable independently. Additionally, any planning applications within the City must be in accordance with SPP2.6 due to its status as a State Planning Policy. This project, in its current form, provides no benefit to the City, and its response to climate change.</p> <p><i>Project 4.5 City of Joondalup Coastal Foreshore Natural Areas Management Plan</i> will require updating as a result</p>	<p>The City will review and assess the Coastal Hazard Risk Management and Adaptation Plan for its suitability when implementing Projects 1.1, 1.2, and 1.3.</p> <p>Comment noted.</p> <p>The outcomes of <i>Project 1.1 Coastal Adaptation Planning and Implementation Project</i> and other projects undertaken as part of</p>

Feedback Form Question/ Section	ID	Comment	City Response
		<p>of the other projects listed in this strategy such as the infrastructure and coastal hazards analysis. The City should review the existing document and outline when this review is required in coordination with the expected timeframes of related projects.</p> <p><i>Community Consultation</i></p> <p>The risk management approach requires community understanding and engagement to be effective. Risk management measures require consideration of both coastal hazards and the consequences of those hazards. Assessing those consequences requires a full understanding of the value of all assets (natural and artificial) within potentially affected areas.</p> <p>While determining likely coastal hazards may be able to be done by technical experts in isolation from affected communities, assessing consequences is best done as an open process with input from an informed community.</p> <p>Consult SPP2.6, its associated Guidelines and the Coastal Planning and Management Manual (WAPC 2003) and consider inclusion of a community consultation component to both this document and the individual projects listed within.</p>	<p>the Climate Change Strategy will be incorporated into updates and reviews of the City strategic, planning and policy documents including the <i>Coastal Foreshore Natural Areas Management Plan</i>, where appropriate, as part of the City's annual review processes.</p> <p>The City undertakes engagement and consultation with the community and stakeholders in accordance with the City's Community Consultation and Engagement Policy</p> <p>Comment noted.</p> <p>Comment noted.</p>

No. of community members or stakeholders who provided feedback on the Draft Climate Change Strategy: 7

Requests for feedback were sent to 22 stakeholders.