Climate Change Adaptation Plan Refresh 2030

Background Report 2018

HOBSONS BAY CITY COUNCIL

October 2018

Acknowledgements
This policy was compiled by Council's Sustainability team, within the Strategy and Advocacy Department. For further information contact Hobsons Bay City Council on 9932 1000 www.hobsonsbay.vic.gov.au

Council acknowledges the peoples of the Kulin Nation as the Traditional Owners of these municipal lands and waterways and pays respect to Elders past and present

Council acknowledges the legal responsibility to comply with the Charter of Human Rights and Responsibilities Act 2006 and the Equal Opportunity Act 2010. The Charter of Human Rights and Responsibilities Act 2006 is designed to protect the fundamental rights and freedoms of citizens. The Charter gives legal protection to 20 fundamental human rights under four key values that include freedom, respect, equality and dignity.

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Definitions

Adaptation – Adjustment in natural or human systems in response to actual or expected climatic changes or their effects. Adaptation can be carried out in response to or in anticipation of changes in climatic conditions. It entails a process by which measures and behaviours to prevent, moderate, cope with and take advantage of the consequences of climate events are planned, enhanced, developed and implemented.

Adaptive capacity – The ability of institutions, system and individuals to modify and adjust to climate change, either by taking advantage of opportunities, or by coping with the consequences. Adaptive capacity is multidimensional being dependent on social, political, economic, technological and institutional factors, the interaction of these factors and the scale of analysis[1].

Adaptive capacity building – The process of enhancing adaptive capacity by developing skills, knowledge, abilities, relationships and networks. The purpose of capacity building is to develop the decision making processes and strengthen social capital to expand the coping range and beneficial opportunities. Adaptive capacity building is central to this study of adaptive capacity and implementing planned adaptation.

Adaptive capacity indicators / index – To target interventions to reduce the negative impacts of climate change indicators and indices have been developed to generate an understanding of the different adaptive capacities of different sectors or groups. Indicators are information based on measured data used to represent a particular attribute, characteristic or property of a system.

Annual Exceedance Probability (AEP) – The likelihood of an occurrence of a flood of a given size or larger occurring in any one year. AEP is expressed as a percentage (%).

Climate change – A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability over comparable time periods[2].

Climate change risk – A combined function of the probability of a hazard (an event with the potential to cause harm, e.g. floods, droughts) occurring and the magnitude or severity of its potential consequences (injury, damage, loss of habitat etc.).

Mitigation – A human intervention to reduce or prevent the sources of greenhouse gases, including increasing the capacity of carbon sinks

Resilience – The capacity of individuals, institutions, businesses and systems within a geographical area to adapt, survive and thrive no matter what kind of chronic stresses and acute shocks they experience.

Vulnerability – The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It is considered a function of exposure and sensitivity to climate change, in addition to the system's capacity to respond.

[1] Vincent, 2007

[2] Defined by the United Nations Framework Convention on Climate Change

1. Executive Summary

Hobsons Bay is particularly vulnerable to the adverse effects of climate change due to its coastal location, extensive industrial footprint, and its potential to flood. As sea levels rise, erosion occurs in some of the sandy coastal parks around Hobsons Bay while other areas of coastal parkland will become inundated. As the effects of climate change are imminent, adaptation is needed to build the capacity of people and systems to adapt to more extreme variability.

The purpose of the Climate Change Adaptation Background Report is to provide the evidence base to clearly articulate Council's role and commitment to respond to climate change whilst building adaptive capacity and resilience within the community.

The Background Report builds on the work that Council has already done, specifically the development of a risk management framework. The Background Report provides the broad strategic directions and a framework for decision-making for the Climate Change Adaptation Plan Refresh (The Plan Refresh). The Plan Refresh builds on Council's existing actions currently in the Risk Register and identifies a series of adaptation actions that respond to the key climate risks. Key components of the report are aimed at:

- providing the evidence base for the development of the Climate Change Adaptation Plan Refresh.
- outlining the reasons for a shift from a risk management approach to adaptation planning
- highlighting the sectors that are more sensitive and vulnerable to the risks posed by climate change

This background report also identifies key themes and adaptation actions for Hobsons Bay to effectively adapt to climate change. These were developed following recent internal stakeholder and Councillor consultation. Key themes that emerged are:

- Shared Places – Create and sustain buildings, infrastructure and activities that promote social cohesion, equality of opportunity and health.
- Green Environment – Enhance the natural environment and green spaces of Hobsons Bay City.
- Stronger Together – Strengthen the resilience and adaptive capacity of our community.
- Sustainable Practice – Reduce Council and community waste sent to landfill and the use of water.

The following recommendations are made for inclusion in the Plan Refresh:

- embed adaptation actions into service planning processes and policies
- build resilience in the community through adaptation actions
- monitor climate-vulnerable communities through an adaptive capacity index
- advocate for government and scientific support to further develop the evidence base at the LGA level
- measure outcomes effectively through monitoring, evaluation and reporting processes

2. Introduction

Climate change is the most significant issue facing humanity. Australia is highly vulnerable to the consequences of a changing climate, from worsening heatwaves, droughts and bushfires, to devastating coral reef bleaching and exposure to sea level rise. Rarely has there been a consensus on any issues within the scientific community as there has been on climate change. The need to be prepared and resilient to the future impacts and implications of climate change has been reinforced by several events that have occurred across Australia in recent years including:

- heavy rainfall and localised flooding (2016)
- three consecutive years of the hottest summers on record (2013-14)
- drought-affected agricultural areas (2017-18)

Human and natural systems have a capacity to cope with climate variability but, with continuing climate change, adaptation is needed to build the capacity of people and systems to adapt to more extreme variability.

There is a commitment to international action aimed at limiting global average warming to below two degrees Celsius, but even a two degree Celsius change requires Australia and the region to manage substantial climate change and variability. Throughout the dynamic climate change debate, climate mitigation and, increasingly, adaptation, have been the primary responses to climate change. Although conceived separately, adaptation and mitigation actions address the need to reduce the risks associated with climate change. *Mitigation* is defined as actions to reduce the sources or enhance the sinks of greenhouse gases. Mitigation, however, is insufficient to fully protect or buffer populations from change, and recent literature provides examples of drastic, often irreversible, changes[3]. *Adaptation* consists of changes in natural or human systems to prepare for actual or expected changes in the climate to minimise harm, act on opportunities or cope with the consequences[4].

As the effects of climate change are becoming more apparent. It is increasingly acknowledged that adaptation to environmental change does not take place in isolation, rather it is unavoidably the result of actions of multiple actors and usually in response to multiple stresses. Therefore, adaptation and adaptation assistance are increasingly required by those made vulnerable through increased exposure to risk. This underscores the importance of pursuing actions that build resilience and adaptive capacity.

Council's Climate Change Adaptation Plan 2013-18 (CCAP 2013-18) identified a series of biophysical actions tailored to address the climate risks that were rated high in 2030. Since then, many adaptation actions from CCAP 2013-18 have been integrated into core business. As Council continues to learn from its work and that of others, it is crucial that Council considers the continually emerging scientific and policy information to effectively adapt to climate change while focussing on the human wellbeing of the community. Given this Council is currently reviewing the CCAP 2013-18.

[3] Chopra et al., 2005

[4] Department of Environment, Land, Water, and Planning, 2017

3. Purpose and Scope

Updated scientific information, recent policy developments from the Victorian Government, and the increasing importance of building adaptive capacity and resilience in the community have prompted Hobsons Bay City Council to assess and update the *Climate Change Adaptation Plan 2013-18*.

The purpose of this Background Report is to provide a summary of the evaluation from Council's current Climate Change Adaption Plan 2013-18. This includes a review of the strategic context, demographics of Hobsons Bay, feedback from internal stakeholders, and key risks to provide recommendations for an updated Climate Change Adaption Plan.

3.1 Climate Adaptation Key Principles

Climate change adaptation is a continuous process and needs to be assessed and reviewed as opportunities arise over time. To ensure that Council's adaptation responses and approaches remain valid and relevant to local priorities and climatic conditions, CCAP 2013-18 will be reviewed and updated through five key principles, as presented below, to support successful adaptation (Figure 1).

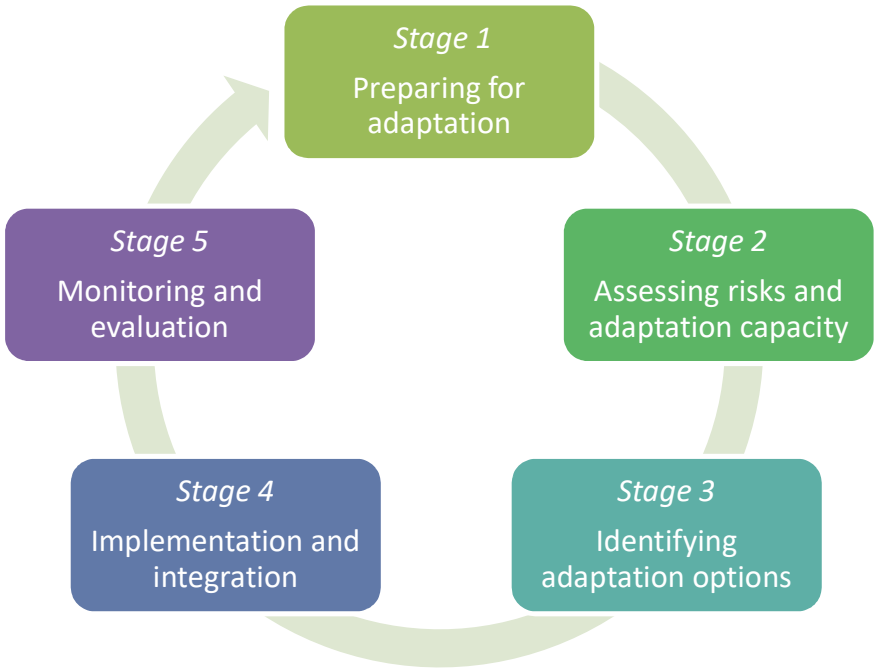

Figure 1 Climate change adaptation process. Hobsons Bay City Council is currently at stage 5 of the process.

3.1.1 Stage 1: Preparing for adaptation

This stage is the initial step to adapting to climate change. It is understood as introducing key elements important to building the basis for a successful adaptation process. Elements include the need to obtain high level support, set up adequate coordination mechanisms and clarify roles and responsibilities, explore funding opportunities, identify already available information and increase awareness or understanding of climate change issues.

3.1.2 Stage 2: Assessing risks and vulnerability

Adaptation cannot be planned solely on the basis of climate projections; information on risk and vulnerabilities is also needed to determine how the climate interacts with socio-economic issues. This step aims to help identify opportunities arising from climate change, provide information on how to assess adaptive capacity, and develop a comprehensive picture of current and future climate change risks.

3.1.3 Stage 3: Identifying adaptation options

This stage facilitates an exploration of potential adaptation options and helps identify relevant actions, and their potential co-benefits. Adaptation options can range from actions that build adaptive capacity to address climate change risks that were identified in Stage 2.

3.1.4 Stage 4: Implementation and integration

Once a strategic document on adaptation is adopted, the next step is to implement the strategy. This includes the preparation of an action plan which sets out what needs to be done to convert an action into reality. This involves specifying who is responsible for the action, the timelines and the allocation of sufficient resources.

3.1.5 Stage 5: Monitoring, Evaluation and Reporting

Monitoring, Evaluation and Reporting (MER) is a key aspect of the repetitive adaptation process. MER can help us to understand progress and performance, learn and communicate lessons and inform future policy and practice. It plays a critical role enabling adaptation to evolve and improve over time.

This Background Report is Stage 1 of the climate change adaptation process to ensure Council's adaptation planning and its approach responds to the issues identified in the *Hobsons Bay 2030 Community Vision*. The Background Report creates a framework aimed at building adaptive capacity and resilience within the community (Stage 2). Included in this report is a qualitative and quantitative evidence base to guide decision making and identify opportunities for Council and the community to enhance adaptation to climate change (Stage 3).

Facilitating adaptation is a combination of understanding the risks and having the capacity to act. Past adaptation responses have predominately focused on bio-physical and/or technological aspects; however, it is emerging that the socio-cultural constraints are comparable or may exceed bio-physical and/or technological constraints[5]. Building on the work Council has already done to adapt, assessing climate risks will continue to provide direction on how Council will plan and respond to the climate risks Hobsons Bay will face. However, to ensure that the municipality can adapt, Council needs to assess the community's adaptation capacity which has not been attempted in previous plans.

This background report provides a framework (Figure 2) on how Council can build its adaptive capacity and guide the development of the updated Climate Change Adaptation Plan.

[5] Adger et al., 2009; Adger and Barnett, 2009

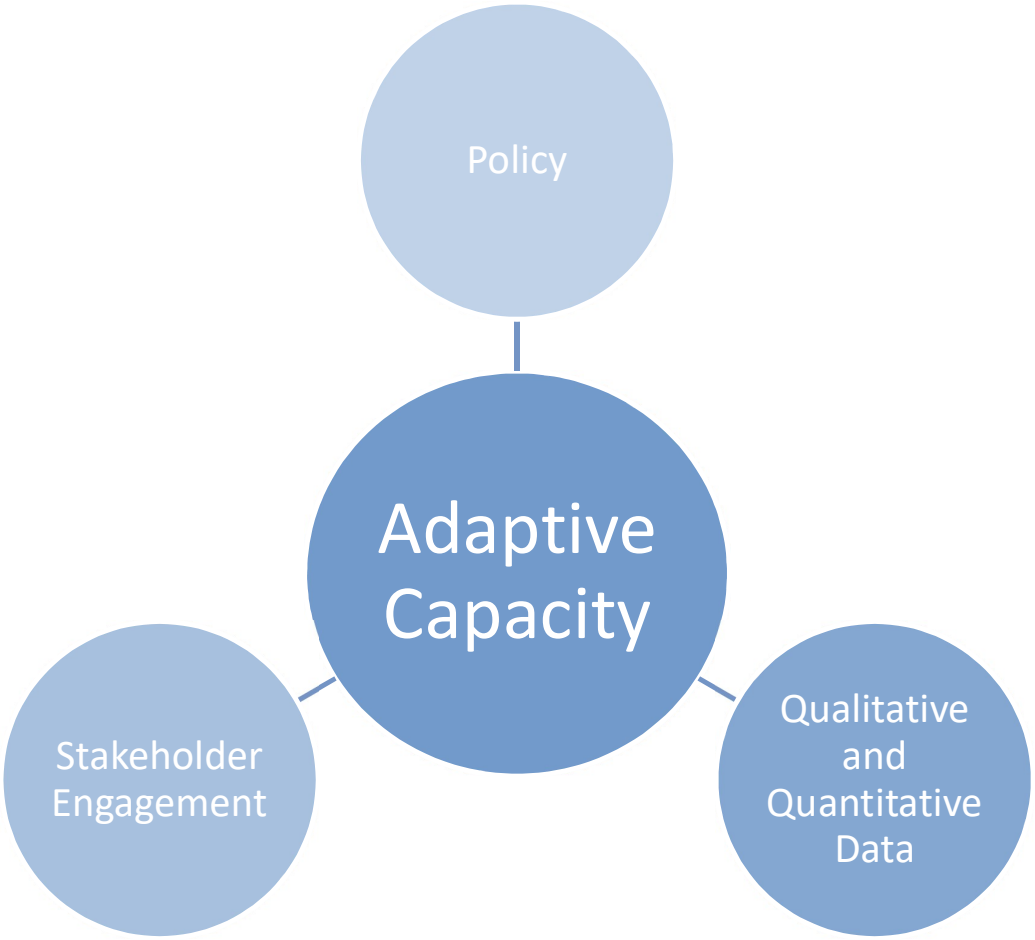

Figure 2 Framework of Hobsons Bay climate change adaptation theme

The framework to achieve adaptive capacity comprises the following three components:

- identify the policy context and the requirements of federal, state and local of government
- undertake an analysis of qualitative and quantitative data to identify best practice
- undertake stakeholder engagement both internally and externally

Adaptive capacity will include the development of an Adaptive Capacity Index (ACI) which involves the identification of key indicators to measure and monitor progress and determine appropriate adaptation responses.

4. Strategic Context

There have been significant changes in federal, state and regional policies and legislation which has increased the regulatory and legal requirements for Council to consider since Council adopted the CCAP 2013-18. The evidence base has also evolved and the risks, identified in the CCAP 2013-18, have increased.

It is Council's role to understand how the strategies and legislation of the Australian and Victorian Government can be translated into local decision making, and consequently address any gaps in knowledge.

4.1 International Cooperation

4.1.1 United Nations Framework Convention on Climate Change (UNFCCC)

The 1992 UNFCCC is the primary framework for international climate change cooperation. Its overarching objective is to stabilise greenhouse gas concentrations at a level that would prevent dangerous human induced interference with the climate system.

4.1.2 Paris Agreement 2015

Australia ratified the Paris Agreement in 2016. Under the Paris Agreement, Australia has committed to reduce emissions by 26 to 28 per cent below 2005 levels by 2030 (known as Australia's Nationally Determined Contribution to the Paris Agreement, or NDC). This target represents a halving of emissions per person and a two-thirds reduction per unit of GDP. There is political uncertainty in relation to this target as the two major parties have not reached a consensus on an energy policy or Australia's approach to achieving this target.

4.1.3 Intergovernmental Panel on Climate Change

In 2018, the Intergovernmental Panel on Climate Change (IPCC) published a special report on the impacts of global warming of 1.5 degrees Celsius above pre-industrial levels and related global greenhouse gas emission pathways. This special report built on the Fifth Assessment Report (AR5)[6] which reviewed and assessed the current state and future projections for the global climate system.

The IPCC is the international body for assessing the science related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policy makers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. IPCC assessments provide the scientific basis for governments at all levels to develop climate related policies. The assessments underlie negotiations at the UN Climate Conference – the United Nations Framework Convention on Climate Change (UNFCCC). The assessments are policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take.

4.2 Federal

4.2.1 National Climate Resilience and Adaptation Strategy

On 2 December 2015, the Australian Government released a *National Climate Resilience and Adaptation Strategy* that developed a set of principles to guide effective adaptation practice and resilience building whilst outlining the Government's vision for the future. The Strategy notes the roles and responsibilities for climate change adaptation in Australia. It identifies the role for local government to include:

- administer relevant legislation to promote adaptation as required including the application of relevant codes, such as the Building Code of Australia
- manage risks and impacts to public assets owned and managed by local governments
- manage risks and impacts to local government service delivery

[6] Hartmann et al, 2013

- collaborate across councils and with State Government to manage risks of regional climate change impacts
- ensure policies and regulations under their jurisdiction, including local planning and development regulations, incorporate climate change considerations and are consistent with State and Commonwealth Government adaptation approaches
- facilitate building resilience and adaptive capacity in the local community, including through providing information about relevant climate change risks
- work in partnership with the community, locally-based and relevant NGOs, business and other key stakeholders to manage the risks and impacts associated with climate change
- contribute appropriate resources to prepare, prevent, respond and recover from detrimental climatic impacts

4.2.2 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* is the primary commonwealth legislation applicable for biodiversity protection across all states and territories. Climate change threatens biodiversity directly, by affecting ecosystem processes and habitats, and indirectly, by compounding the impacts of existing and ongoing pressures on biodiversity.

There are eight plants and 11 animals within Hobsons Bay that are protected under this legislation. If proposed works or actions, including the clearing of vegetation from public or private property, has the potential to impact on any of these flora or fauna, then approval must be obtained from the Commonwealth Environment Minister.

4.3 State

4.3.1 Climate Change Act 2017

In 2017, the Victorian State Government passed the *Climate Change Act 2017* (the Act) to repeal and re-enact with amendments of the 2010 Act. The Act requires Council to

- have regard to the potential impacts of climate change
- consider the long and short-term economic, environmental, health and other social impacts, of climate change

The Act will give Council the confidence to continue investing in measures to reduce emissions and increase the communities' resilience to climate change. Before the Act was passed in 2017, the Department of Environment, Land, Water, and Planning (DELWP) published the *Climate Change Adaptation Plan 2017-2020*[7] outlining the State Government's plan for the next four years aimed at helping Victorians meet the challenges and act on the opportunities from climate change, including support for local governments.

4.3.2 State Environment Protection Policy (Air Quality Management)

The *State Environment Protection Policy (Air Quality Management)* sets air quality objectives and goals for the whole State of Victoria and adopts the requirements of the National Environment Protection Council (Ambient Air Quality) Measure (NEPM). It requires that all producers of greenhouse gas emissions avoid and minimise emissions in accordance with the

[7] Department of Environment, Land, Water and Planning, 2017

principles of the waste hierarchy, pursue continuous improvement, and apply best practice to the management of their emissions.

4.3.3 Marine and Coastal Act 2018

The *Marine and Coastal Act 2018* provides a simpler, more integrated and coordinated approach to planning and managing the marine and coastal environment to enable protection of the coastline and the ability to address the long-term challenges of climate change, population growth and ageing coastal infrastructure.

4.3.4 Local Government Act 1989

Local councils must operate in accordance with the *Local Government Act 1989*. According to the Act, the primary objective of a Council is to achieve the best outcomes for the local community having regard to the long term and cumulative effects of its decisions, including climate change.

4.3.5 Planning and Environment Act 1987

The purpose of the Victorian *Planning and Environment Act 1987* (P&E Act) is to establish a framework for planning the use, development and protection of land in Victoria in the present and for the long-term interests of all Victorians. The P&E Act requires each Council to prepare a planning scheme. Hobsons Bay City Council is the Responsible Authority for administering the Hobsons Bay Planning Scheme. The planning scheme determines what land use and development can occur within a given area.

The Hobsons Bay Planning Scheme contains a provision for Council to prepare for and respond to the impacts of climate change through planning (Clause 13) and to influence the impacts of climate change in planning (Clause 21.02).

4.3.6 Other Relevant State Legislation

Climate change will influence all aspects of Council's work which must adhere to a range of legislation outside of the environment:

- *Catchment and Land Protection Act 1994*
- *Emergency Management Act 2013*
- *Environment Protection Act 1970*
- *Flora and Fauna Guarantee Act 1988*
- *Public Health and Wellbeing Act 2008*

For more information about how legislation will be affected by climate change, please refer to **Appendix 1**.

4.4 Local

Since the implementation of the CCAP 2013-18, Council's policy framework has changed. Council has developed the *Hobsons Bay 2030 Community Vision* as a guiding document for the development of the *Council Plan 2017-21*. The *Hobsons Bay 2030 Community Vision* includes Council's integrated Municipal Public Health and Wellbeing Plan and incorporates Council's requirement to activate sustainable practices and address climate change.

Council has been at the forefront of adaptation and mitigation responses to climate change commencing with its Climate Policy 2013. Council adopted the Climate Policy in 2013 (the Policy) to manage its climate change vulnerability, mitigate greenhouse gas emissions,

respond and adapt to the risks posed by climate change and reduce the environmental impacts.

Following the Policy, Council developed a suite of supporting strategies and plans to outline its strategic intent in relation to environmental management, including the Sustainability Framework. The Framework guides the development, implementation and continuous improvement of a suite of sustainability policies, plans and strategies to address climate change and other sustainability issues relevant to Hobsons Bay.

The diagram below shows the policy context within which the Sustainability Framework sits:

The policies that are guided by the Sustainability Framework respond to Priority 5 of the *Hobsons Bay 2030 Community Vision*: activate sustainable practices. They also align with Objective 3.5 of the Council Plan: work with the community, businesses and all levels of government to actively and innovatively address climate change and promote sustainable living.

4.4.1 Climate Change Adaptation Plan 2013-18

The CCAP 2013-18 focuses on preparing Council's infrastructure, programs and services so that they can manage the anticipated impacts of climate change. The CCAP 2013-18 also provides an initial assessment of the resources required for preparing for the challenges of climate change by outlining the activities and plans that Council will implement to meet the challenges associated with climate change impacts.

4.4.2 Biodiversity Strategy

In 2017, Council adopted the *Biodiversity Strategy* and committed to protect Hobsons Bay's unique biodiversity. Hobsons Bay has 13 plants and 26 animals that are protected under the Victorian Government's *Flora and Fauna Guarantee Act 1988* (FFG Act) and eight plants and 11 animals that are protected under the Federal Government's *Environment Protection and Biodiversity Act 1999*. As Hobsons Bay prepares to adapt to climate change, Council must consider how to protect these species.

4.4.3 Environmental Sustainable Development (ESD) Policy DRAFT

The ESD Policy Statement provides the broad strategic directions to facilitate a coordinated and co-operative approach to environmentally sustainable development. The ESD Policy outlines a mechanism to deliver:

- guidance on how Council and the community can improve environmental, social and economic outcomes through the application of best practice ESD design standards and practices
- an amendment to the Hobsons Bay Planning Scheme to include more robust provisions for ESD with respect to urban development

Clause 22.13 Environmentally Sustainable Development was gazetted into the Planning Scheme in October 2018. The ESD Policy Statement is due to be considered by Council for adoption on the 13 November 2018.

4.4.4 Integrated Transport Plan 2017-30

Council's Integrated Transport Plan 2017-30 establishes a long-term vision for integrated transport in Hobsons Bay bringing different travel methods together. Active and public transport not only reduces carbon emissions, but also encourages a healthier lifestyle which in turn can build resilience in a community.

4.4.5 Integrated Water Management Plan 2014-19

The Integrated Water Management Plan (IWMP) 2014-19 is a key strategic document to guide Council's water management activities. With the significant effects of climate change on rainfall and atmospheric temperatures in south-east Australia, this plan is essential to advocate for improved water management outcomes, in particular, the potential to reduce water use. The IWMP 2013-19 seek to enhance stormwater, groundwater and wastewater management whilst seeking alternative water supply options and incorporating water sensitive urban design in the built environment, to minimise environmental degradation and improve aesthetic and recreational appeal.

4.4.6 Greenhouse Strategies

The Corporate Greenhouse Strategy 2013 -2020 and the Community Greenhouse Strategy 2013-2030 identifies a series of delivery mechanisms to reduce corporate and community greenhouse gas emissions and achieve the goal of becoming a zero net emissions municipality. Both strategies assist in mitigating climate change.

4.4.7 Waste and Litter Management Plan 2030 (DRAFT)

The Waste and Litter Management Strategy 2030 DRAFT seeks to deliver a new direction for waste and litter management in Hobsons Bay that concentrates on avoidance, reuse, recycling, and resource recovery rather than disposal to landfill. As climate change becomes more prominent, it is important for Council to reuse resources and significantly decrease waste to landfill. The draft Strategy is due to be considered by Council to be placed on public exhibition in early 2019.

4.4.8 Other Council Policies

Other Council policies and strategies relevant to the implementation of the Climate Change Adaptation Plan include:

- Asset Management Policy 2017

- Business Continuity Policy 2015-18
- Economic Development Strategy
- Learning Communities Strategic Plan 2016-19
- Municipal Emergency Management Plan 2017
- Street Tree Policy 2010

4.5 Hobsons Bay's International and National Commitments

Since Hobsons Bay City Council adopted the CCAP 2013-18, Council signed national and international partnership agreements to show leadership in climate change adaptation and mitigation and pledge to become a more sustainable community. This includes:

4.5.1 Global Covenant of Mayors for Climate and Energy

On 5 June 2017, on World Environment Day, Council committed to the Covenant of Mayors. As members of the coalition, Council pledges to implement policies and undertake measures to reduce local greenhouse gas emissions, increase access to sustainable energy, prepare for the impacts of climate change, and publicly track progress. As part of the Covenant of Mayors, Council is required to conduct a climate change risk and/or vulnerability assessment within two years of joining.

4.5.2 ICLEI – Local Governments for Sustainability

In June 2017, Council became a member of ICLEI – Local Governments for Sustainability. It is the leading global network of over 1,500 cities, towns, and regions committed to building a sustainable future.

4.5.3 United Nations Global Compact – Australian Cities Partnership Programme

The Australian Cities Partnership Programme works to advance the United Nations Global Compact and the Ten Principles, along with the Sustainable Development Goals (SDGs) in cities and regions. The Cities Programme works to advance the SDGs that directly relate to cities – Goal 11 – 'Make cities inclusive, safe, resilient and sustainable'.

4.5.4 Resilient Melbourne

The Resilient Melbourne project is overseen by the City of Melbourne in collaboration with the councils that make up Greater Melbourne, including Hobsons Bay City Council, and many associated partners. The project is led by the Chief Resilience Officer who has been funded by the 100 Resilient Cities initiative – pioneered by the Rockefeller Foundation.

Resilient Melbourne marks an important point in Melbourne's development. It presents the first of the city's resilience strategies: a starting point that brings together individuals and organisations critical to the resilience of Melbourne and its diverse communities. It offers a new way to address the chronic stresses and acute shocks Melbourne is likely to experience, and to achieve a vision of a city that is viable, sustainable, liveable and prosperous, today and long into the future.

4.5.5 Take 2

TAKE2 is the Victorian State Government's collective climate change program supporting individuals, government, business and other organisations to help the state achieve net zero emissions by 2050. Hobsons Bay City Council was one of the founding partners.

4.5.6 Western Alliance for Greenhouse Action (WAGA)

Hobsons Bay City Council is a member of the Western Alliance for Greenhouse Action, a regional government partnership that aims to lead and support collaborative action to decrease greenhouse gas emissions and increase the resilience and adaptive capacity of its communities.

5. Climate Change Adaptation for Hobsons Bay

To plan for climate change, and prioritise adaptation activities, it is important to understand the climate change projections for Hobsons Bay and how vulnerable the community is to impacts of climate change, and what capacity the community has to adapt.

This chapter of the report highlights the current state of the climate based on the most recent scientific projections, the demographics of Hobsons Bay, and the community's adaptive capacity.

5.1 Updated scientific data

Planning for a changing climate is challenging but important when it comes to understanding how it will affect Hobsons Bay. Model simulations of the future climate is the only method that allows us to study how the climate may respond to increasing levels of greenhouse gases in the atmosphere. Climate projections can realistically simulate the past and present climate conditions and are considered the best tools to predict future climate change. Climate model projections provide policy makers with information so that they can develop both adaptation and mitigation responses.

In recognition of the impacts climate change will have on Australia, the Australian Government developed the Regional Natural Resource Management Planning for Climate Change Fund[8]. The research found Australia's climate to be changing rapidly due to global average carbon dioxide concentrations. In 2016, emissions rose by 0.8 per cent[9] from human activities like burning fossil fuels, intensive agriculture and land clearing.

Box 1 What are Representative Concentration Pathways?

In the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, four Representative Concentration Pathways (RCPs) were developed to capture future trends. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations and can be used to build scenarios about the climate change impacts. The numerical values of the RCPs (2.6, 4.5, 6.0 and 8.5) refer to the concentrations in 2100. Current emissions are tracking closer to the RCP 8.5 pathway (relating to the resulting level of greenhouse-gas radiative forcing by 2100, measured as 8.5 watts per square metre, or W/m2). To meet the Paris Climate Agreement, the world needs to be on at least an RCP 4.5 pathway (forcing by 2100 of 4.5 W/m2).

Australia is witnessing higher average surface temperatures, more frequent and intense extreme heat events, reduced rainfall during the wet season, and rising sea levels[10]. The

[8] Webb and Hennessy, 2015
[9] WMO, 2017
[10] BOM and CSIRO, 2016

Climate Change Adaptation Plan 2013-18 identified four climate risks Council will face in the near future:

1. sea level rise
2. increase in average temperature
3. reduction in rain fall
4. increase in frequency and intensity of storm events

Below are the most recent data projections of the four risks Council will face. Climate change information for Hobsons Bay is available from the Bureau of Meteorology (BoM) and CSIRO. This information is based on global greenhouse gas emissions scenarios and models used in the IPCC Fifth Assessment Report (AR5)[11].

5.1.1 Sea Level Rise

As oceans warm, they expand and sea level rises. Ocean warming has contributed about a third of the observed global sea-level rise of over 0.20 metres since the late 19th century[12]. According to the IPCC AR5, the global mean sea level will continue to rise during this century and will very likely exceed two millimetres per year due to increased ocean warming.

Sea level rise around the Australian coastline is project by 2100 to be between 0.28 and 0.98 metres higher. According to CSIRO's State of the Climate Report, Australia is already seeing a rise in sea levels. The rates of sea-level rise to the north, west and southeast of Australia have been higher than the global average since 1993, and rates of sea-level rise on the central east and southern coasts of the continent have been closer to the global average due to warming temperatures[13].

In 2030, the Williamstown sea level is projected to rise an average of 12 centimetres and by 2070 rise by 39 centimetres with RCP 8.5 emissions, also known as business-as-usual emissions; however, if we reduce emissions significantly to RCP 4.5 concentrations, the sea level will only rise by 32 centimetres[14] in 2070 (Appendix 5).

In 2009, the Victorian Government computed the Victorian Coastal Inundation Dataset using the Coastal Inundation model developed and processed by the University of Tasmania[15], using input data from a number of source datasets of varying spatial accuracy and temporal scale. The dataset output was used to visualise sea level rise in Hobsons Bay (Figure 3). As we can see from the map, the Altona Coastal Park, Jawbone Nature Conservation Reserve, and the Altona Foreshore Reserve will be greatly affected by sea level rise by 2040. Parts of the Esplanade along the Altona Foreshore will also be affected by rising sea levels.

[11] Hartmann et al, 2013
[12] Sweet et al, 2017
[13] BOM and CSIRO, 2016
[14] Department of Environment, Land, Water and Planning, 2015
[15] Available from www.data.vic.gov.au

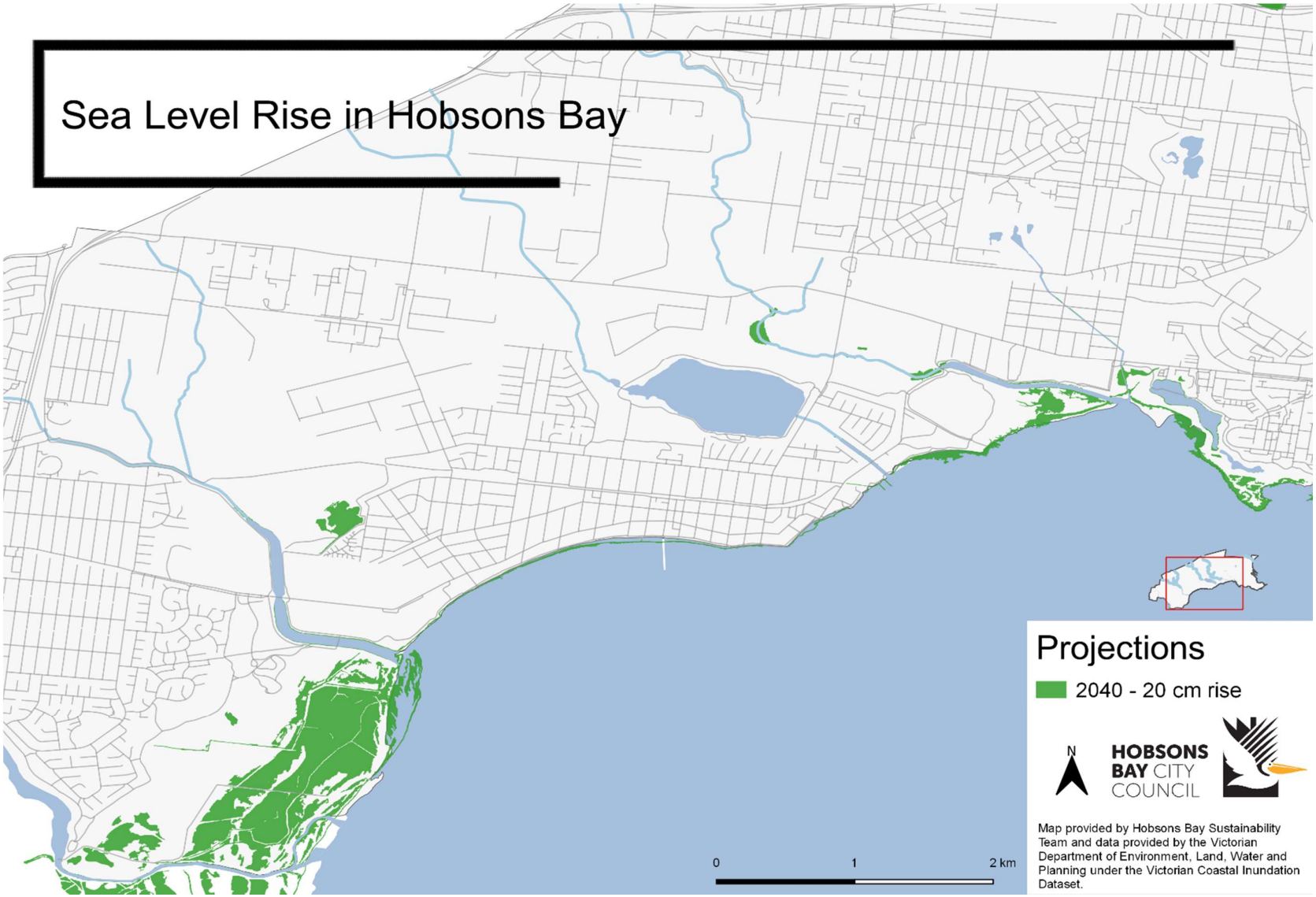

Figure 3 Sea level rise projections in Hobsons Bay from 2040 and 2070. Data provided from Victorian State Government Department of Environment, Land, Water, and Planning.

5.1.2 Increase in Average Temperature

Globally averaged surface air temperature has warmed to about 0.9 degrees Celsius over the period from 1880 to 2012 according to the IPCC's AR5[16]. Seventeen of the world's 18 hottest years on record have occurred in the 21st century and extreme heat days will likely occur with a higher frequency and duration. Globally, 2017 was the third-warmest year on record since 1850[17] following the world's warmest year in 2015, and second warmest year in 2016.

This shift to a warmer climate in Australia is accompanied by more extreme heat events on a daily, multi-day and seasonal timescales. Since 2001, warm monthly maximum temperatures increased by nine percent when compared to warm monthly maximum temperatures 30 years ago, and night-time temperatures occurred nine percent of the time compared to 30 years ago when they occurred two per cent of the time[18]. These increases have been more notable across autumn, winter and spring, with the smallest trends in summer.

Australia's top five warmest years on record include 2013, 2014, and 2015 with 2013 being the warmest year on record[19]. In Victoria, the average mean temperature has increased by approximately 0.87 degrees Celsius between 1910 and 2010.

Hobsons Bay currently experiences on average 11 days over 35 degrees Celsius and 1.6 days over 40 degrees Celsius. Projections show there will be more frequent hot temperature and fewer cold temperature extremes as global mean temperatures increase. By 2030[20], Hobsons Bay is expected to experience between two to four more hot days above 35 degrees Celsius and one to two more hot days over 40 degrees Celsius than we experience currently[21].

[16] IPCC AR5, 2013
[17] NOAA, 2017
[18] BOM and CSIRO, 2016
[19] BOM and CSIRO, 2016
[20] Based on RCP 8.5 concentrations
[21] Webb and Hennessy, 2015

5.1.3 Increase in Extreme Storm Events

Rainfall is an important factor in climate change, but it is hard to model; however, we expect an increase in the proportion of heavy rainfall over Australia causing intense flooding. Climate models vary considerably in their projections for future annual average rainfall in Australia. There is high confidence of winter drying in southern Australia and high confidence in projections that extreme rainfall events (wettest day of the year and wettest day in 20 years) will become wetter in greater Melbourne[22].

The fraction of Australia receiving a high proportion (greater than the 90th percentile) of annual rainfall from extreme rain days (greater than the 90th percentile for 24-hour rainfall) has been increasing since the 1970s. The warming trend in sea surface temperatures (SSTs) to the north of Australia may have contributed to the magnitude of recent heavy rainfall in 2010-11 in eastern Australia — contributing around 10 to 20 per cent of the heavy rainfall anomalies. Warmers SSTs increased the chances of above average rainfall in eastern Australia in March 2012 by five per cent to 15 per cent.

Climate change is increasing the probability of flooding and it will continue to be a problem for areas already prone to flooding like Hobsons Bay (Figure 5, 6). For example, Skeleton Creek in Altona Meadows, Truganina Swamp in Spotswood, and the Altona Yacht Club frequently flood during average storm events.

Long periods of dry weather broken by intense precipitation often leads to urban flooding. This is partially due to existing infrastructure being unable to cope with the volume of water, but also a result of soil so dry that it cannot absorb water. Heavy rainfall events, such as the floods experienced in 2010 and 2011, could become more frequent, though the level of confidence of this prediction is low[23].

[22] CSIRO and BOM, 2016
[23] CSIRO and BOM, 2016

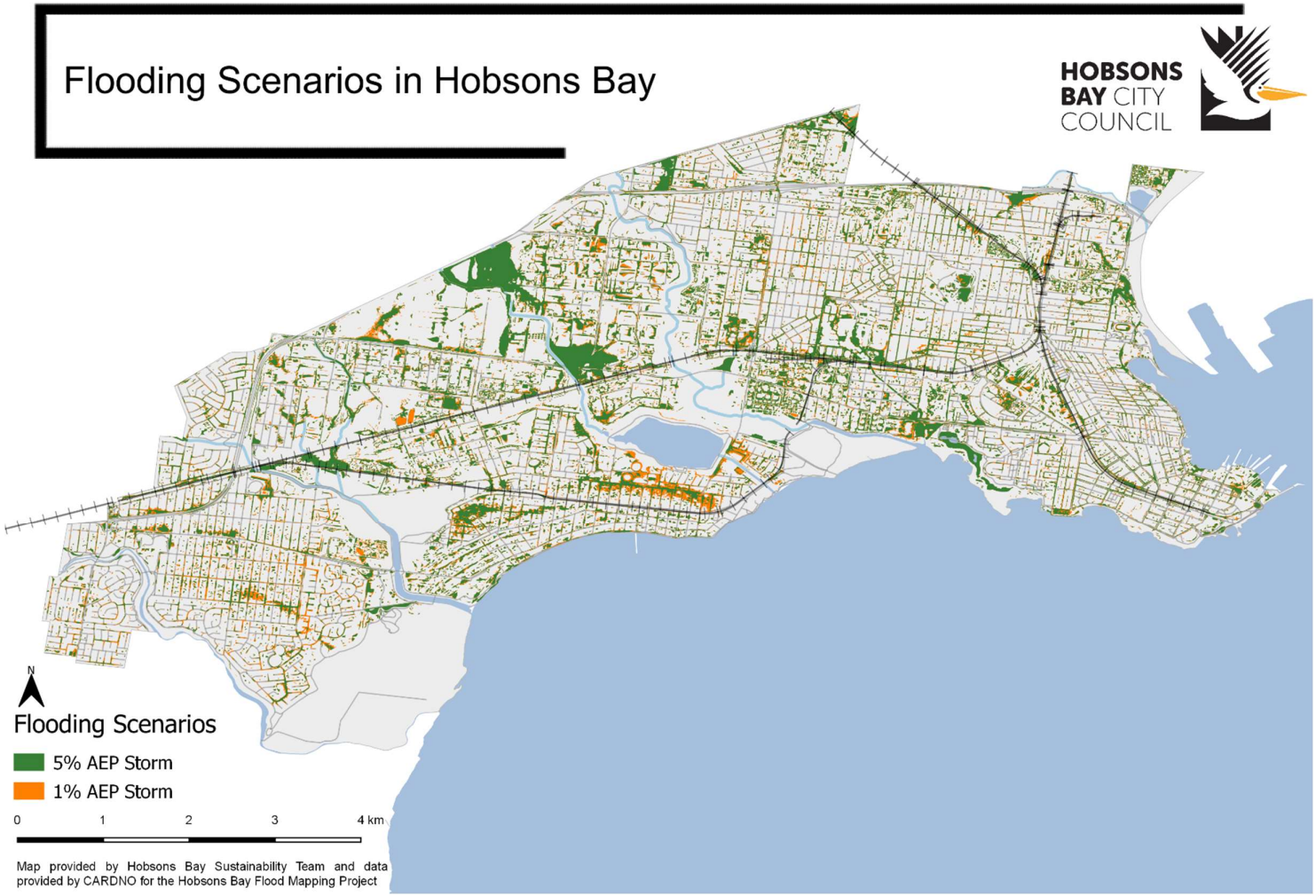

Figure 6 Flooding in Hobsons Bay with an annual exceedance probability of one per cent and five per cent. This flood modelling does not take into account overflow from rivers and streams.

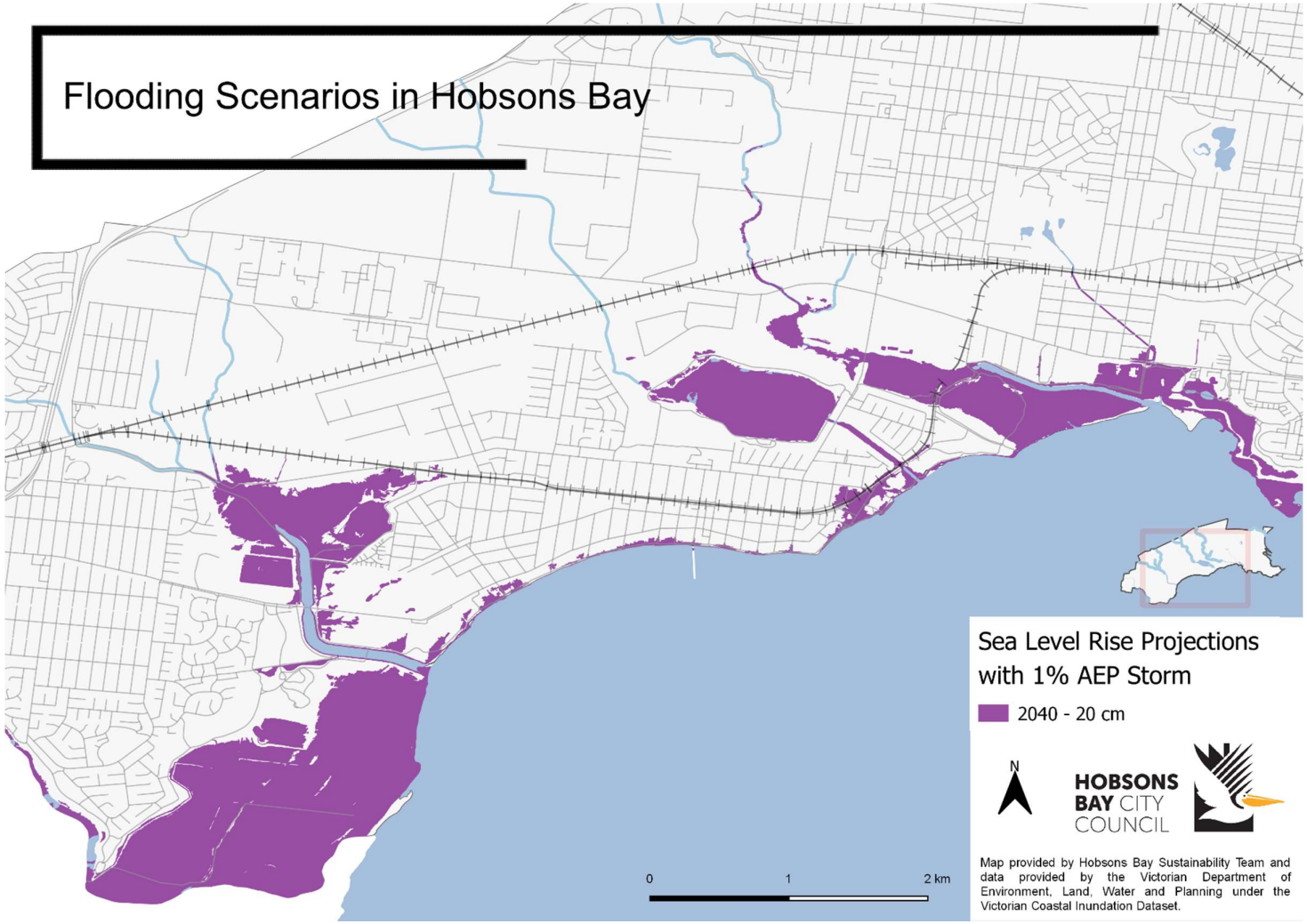

Figure 7 Sea level rise with a 1 per cent annual exceedance probability (AEP). From the map we can see that most Hobsons Bay coastal reserves will be inundated during a flooding event with 20 cm sea level rise.

5.1.4 Decrease in Rainfall

With rising atmospheric temperatures and decreasing rain fall, Australia can expect a dryer environment in turn increasing the severity of droughts.

Fronts from the Southern Ocean, which typically bring rain across southern Australia during the winter and spring growing seasons, have shifted southwards with a warming climate, leading to declines in rainfall in southwest and southeast Australia and increasing the risk of drought conditions in these regions.

Rainfall for the period 1996 to 2015 has decreased by around 11 per cent since national rainfall records began in 1900. This period encompasses the Millennium Drought, which saw low annual rainfall totals across the region from 1997 to 2010. Since the mid-1990s, southeast Australia has experienced a 15 per cent decline in the late autumn and early winter rainfall and a 25 per cent decline in average rainfall in April and May.

In Victoria, increases in temperature will be accompanied by reductions in annual rainfall; however year to year variability and multi-year wet periods will persist. The extent and frequency of droughts may also more than double by 2050, and the frequency of very high fire danger days may also greatly increase.[24] Average annual stream flows to Melbourne's four major water harvesting storages could decrease by seven per cent by 2020 and by 18 per cent by 2050.

Greater Melbourne is already becoming drier and average rainfall in Melbourne will continue to decrease by 1.66 per cent in 2030 and by 4.58 per cent in 2070 if RCP 8.5 concentrations of greenhouse gases continue to be emitted into the atmosphere. However, global emissions are lowered by RCP 4.5 concentrations, average rainfall in 2070 will only decrease by 3.05 per cent (Appendix 5).

[24] Department of Environment, Land, Water and Planning, 2015

5.2 Hobsons Bay City's Demographic Profile

A demographic profile of the Hobsons Bay population is a valuable tool to understand the diversity within the municipality, as well as current and projected community needs.

This demographic profile provides information to assist in identifying residents in Hobsons Bay who are most at risk from the impacts of climate change. Most data discussed in this section is drawn from the 2016 Census of Population and Housing.[25]

5.2.1 Population

In 2016, the Estimated Resident Population of Hobsons Bay was 93,392. Hobsons Bay's population is forecast to grow by just over 20 per cent (around 19,000 people) in the next twenty years, an average annual growth rate of around one per cent. This growth rate is significantly less than our neighbouring council, Wyndham City Council, where the forecast population is set to almost double in the next 20 years to 435,000 people.[26] More specifically, the combined population of the Point Cook-Hoppers Crossing neighbourhoods are expected to exceed Hobsons Bay's total population by 2021.

Hobsons Bay's population is spread across 11 neighbourhoods. Altona Meadows (the neighbourhood with the largest land area) currently has the highest population (20,141 people), while Brooklyn has the smallest (1,945 people). Around half of Hobsons Bay residents (46,343 people) live in just three neighbourhoods: Altona Meadows, Altona-Seaholme and Altona North.

Spotswood-South Kingsville (69% increase or 3,200 people) and Altona North (59% increase or 7,500 people) will experience substantial population growth in the next twenty years. Most other neighbourhoods are forecast to experience modest (up to 20%) population growth, and some will have lower (or even negative) growth.

5.2.2 Older People

Older people are more sensitive to a changing climate due to lifetime exposures, physiological changes and limited adaptive capacity. With increasing years, the body's defence mechanisms decline. Older people also often are living with chronic health conditions and functional limitations that may contribute to frailty and disability.

In 2016, 14.8 per cent of Hobsons Bay City's population were aged 65 years or more compared to 14.0 per cent in Greater Melbourne. While Hobsons Bay City had a higher proportion of people aged 65 years or more, it is important to note that this varied across the City. Proportions ranged from a low of 8.3 per cent in Seabrook to a high of 21.7 per cent in Altona North. The five areas with the highest percentages were Altona North (21.7%), Altona - Seaholme (19.3%), Williamstown North - The Rifle Range (15.5%), Altona Meadows (14.4%), and Williamstown (14.4%).

5.2.3 Culturally and Linguistically Diverse People

People from culturally and linguistically diverse (CALD) backgrounds can face greater challenges during extreme heatwaves due to socio-economic disadvantage, linguistic barriers, poor housing conditions, and cultural practices (such as heavy clothing or not drinking enough

[25] See .id (2017a) City of Hobsons Bay Community Profile, profile.id.com.au/hobsons-bay

[26] .id (2017b) City of Wyndham Population Forecast, forecast.id.com.au/wyndham, accessed 8/11/17.

water). They have a lower substantive adaptive capacity, which makes some CALD communities more vulnerable than others.

In 2016, 28.9 per cent of Hobsons Bay City's population were from CALD communities compared to 32.3 per cent in Greater Melbourne. While Hobsons Bay City had a lower proportion of CALD community members, it is important to note that this varied across the City. Proportions ranged from a low of 14.2 per cent in Williamstown to a high of 48.4 per cent in Laverton. The four other areas with the highest percentages after Laverton were, Altona North (47.7%), Brooklyn (39.3%), Seabrook (36.2%), and Altona Meadows (35.3%) (Figure 8).

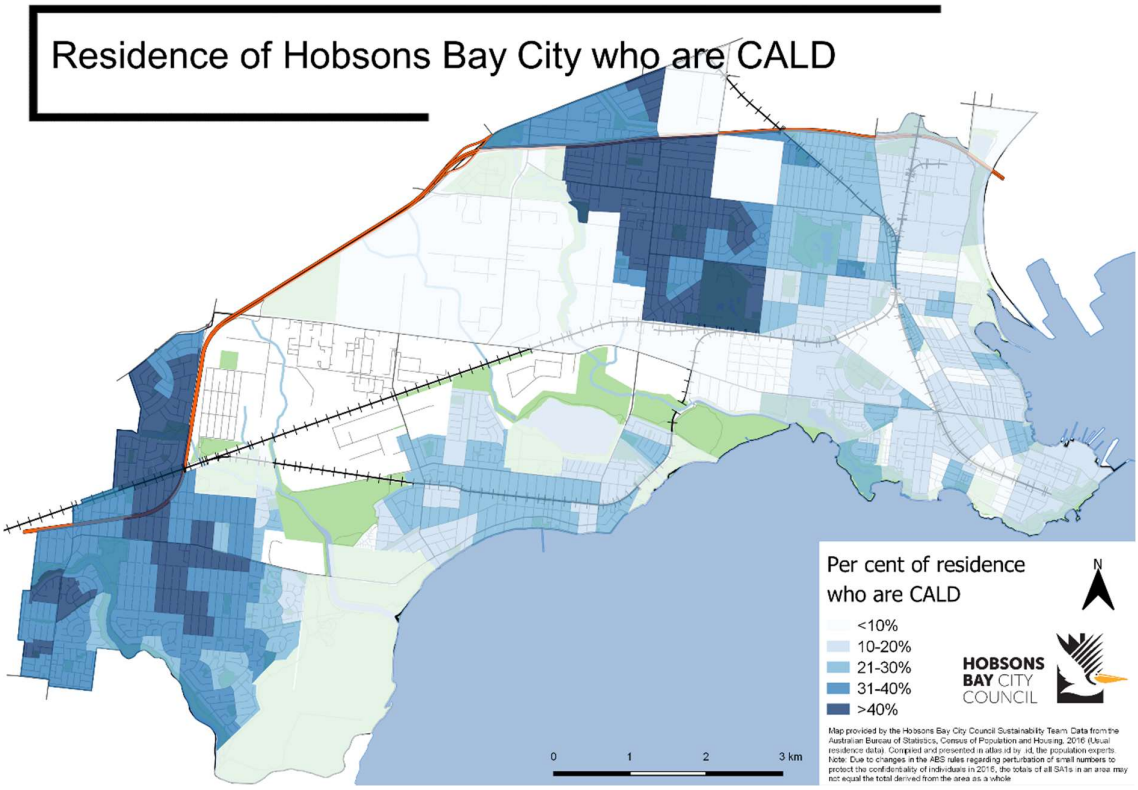

Figure 8 Percentage of Hobsons Bay City residents not fluent in English based on 2016 census. The CALD dataset includes all persons who speak a language other than English at home as their main language, and who stated an answer to both Language and Proficiency in English in the Census.

5.2.4 People with a Disability

Due to existing inequities and disparities, people with a disability can face a disproportionate impact due to climate change. Problems experienced by people with a disability on a day to day basis are magnified when there is a natural disaster.

There are around 16,300 people with a disability in Hobsons Bay, making up 17 per cent of the population.[27] A smaller cohort of residents (almost 5,000 people or 5.6% of the population) require some assistance with self-care, mobility or communication. This group has increased

[27] ABS, 2017

by over 550 people between 2011 and 2016 and continues to be above the Greater Melbourne average (4.9%).

A majority of this group are older people, including over 1,000 people aged 85 or above. However, almost 2,000 people under the age of 65 also require assistance in Hobsons Bay. The following data demonstrates a lower level educational and employment opportunities which can result in material disadvantage.

People aged between 19 and 64 who require assistance are substantially less likely to have completed year 12, compared to people in the same age group who do not need assistance (35.4% vs 71%). Similarly, substantially more people who require assistance left school before year nine (13.6% vs 2.1%) or did not go to school at all (8.1% vs 0.5%).

A much lower proportion of people aged between 26 and 64 who require assistance (15.9%) have a Diploma (or higher) as their highest qualification, compared to people in the same age group who do not need assistance (48.4%). Notably, the proportion who hold a Certificate as their highest qualification is much closer (16.4% vs 18.3%).

5.2.5 Socio-Economic Disadvantaged Communities

While different people may face similar risks of exposure to the negative effects of climate change, their actual vulnerability is socially constructed i.e. it is dependent on their socio-economic conditions and the available resources and infrastructure. As climate change progresses, resource scarcity may intensify existing inequalities and result in greater gaps between communities.

The Socio-Economic Indexes for Areas (SEIFA) is an ABS product that ranks areas in Australia according to relative socio-economic advantage and disadvantage. The Index of Relative Socio-Economic Disadvantage highlights where relatively disadvantaged areas are located and has been constructed so that these areas have low SEIFA index values. The Index of Relative Socio-Economic Disadvantage is derived from attributes such as low income, low educational attainment, high unemployment, jobs in relatively unskilled occupations and variables that broadly reflect disadvantage rather than measure specific aspects of disadvantage (e.g. Indigenous and Separated/Divorced).

To maintain consistency with the other indexes, the higher an area's index value for the Index of Relative Socio-Economic Disadvantage, the less disadvantaged that area is compared with other areas.

In 2016, Laverton scored 908.2 on the SEIFA index of disadvantage, indicating it is the most disadvantaged area in Hobsons Bay City. Following Laverton, the other disadvantaged areas in Hobsons Bay include Altona North (946.3), Altona Meadows (980.1), and Brooklyn (984.4) (Figure 9).

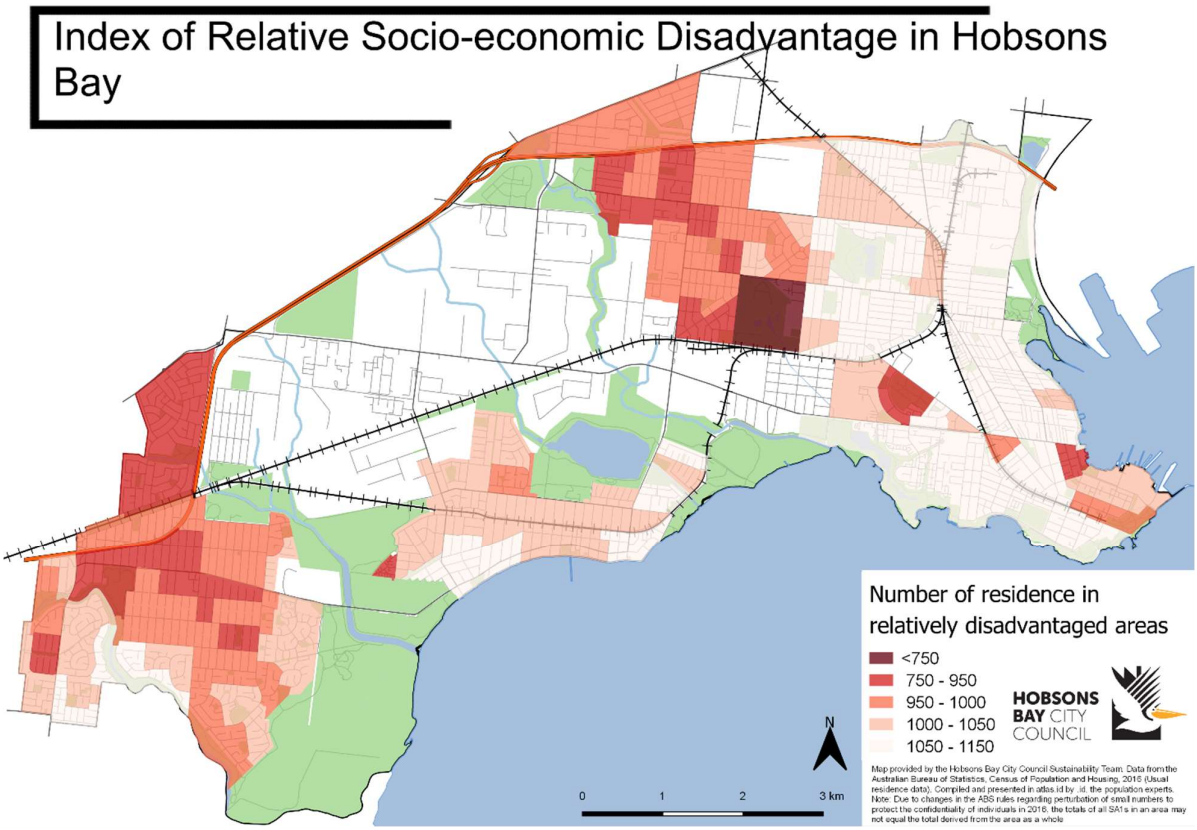

Figure 9 Hobsons Bay City Council SEIFA index of disadvantaged based on 2016 census. The Index of Relative Socio-Economic Disadvantage has "been constructed so that relatively disadvantaged areas have low index values".

5.3 Adaptive Capacity and Resilience

Adaptation to climate change and the associated risks takes place in a dynamic social, economic, technological, biophysical, and political context. These factors vary over time, location, and sector. Importantly, this complex mix of conditions determines the capacity of human and natural systems to adapt and potentially recover from natural disasters associated with climate change. People with high adaptive capacity are less likely to suffer from the impacts of climate change as they are better able to take advantage of the opportunities that are created as well as manage the consequences. In the face of climate change, building adaptive capacity within a vulnerable community is a key element to effectively managing the risks and impacts of climate change

Successfully adapting to change involves several elements. A community's ability to deal with change is shaped by vulnerabilities, resources, and ability to respond or adapt. The capacity of a community to modify or change behaviours to better cope with its vulnerabilities is known as adaptive capacity.[28] General receptiveness to change, or the ability to deal with change 'adaptively 'is understood as 'resilience'.

Adaptive capacity refers to the ability of systems (including individuals) to act in response to different drivers of change,[29] and is a collection of resources and assets that form a base from

[28] Maguire and Cartwright, 2008
[29] Yu Sheng et al, 2008

which adaptive actions can be pursued[30]. Factors contributing to adaptive capacity include categories such as economic wealth, technology and infrastructure, information, knowledge and skills, institutions, equity and social capital.

Resilience has many definitions that are applied to the different sectors. For example, psychological resilience is "the ability to successfully cope with a crisis and to return to pre-crisis status quickly".[31] Emergency Management Victoria defines resilience as "the capacity of individuals, communities, institutions, businesses and systems to survive, adapt and thrive no matter what kind of chronic stresses and acute shocks they experience."[32] In Hobsons Bay, in relation to climate change, Council is using the 100 Resilient Cities definition: "the capacity of individuals, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses and acute shocks they experience".

5.3.1 Building Adaptive Capacity

To effectively adapt to climate change, local government needs to understand the communities' capacity to adapt by highlighting variation over societal and geographical space. The purpose of capacity building is to develop the decision-making processes and strengthen social capital to expand the coping range and identify opportunities that are beneficial to the community.

Building adaptive capacity is a process of enhancing capacity by developing skills, knowledge, abilities, relationships and networks. Building adaptive capacity is defined as attempts to improve people's broad ability to cope with and adapt to change, and to take advantages of the opportunities provided by change. This might involve developing a community's awareness of their exposure to flood risk and providing information to enable them to build their resilience in the event of a flood.

Developing an Adaptive Capacity Index (ACI) will provide Council with a decision making tool that can help prioritise adaptation actions as well identify key locations to support the community to adapt to climate change as well as monitor their capacity to adapt. The ACI is comprised of a series of indicators that characterises a region's capacity to adapt by highlighting variation over societal and geographical space.

On the local scale, practical attempts to enhance or build adaptive capacity often overlap with key components of sustainable development, such as promoting livelihood diversification, adding value to products aimed at mitigating the effects of climate change, reducing poverty, improving literacy, and employing good governance. But not every community will need enhancement of the same aspects of adaptive capacity—some, for example, may already have diverse livelihood portfolios or effective governance.

Understanding where Council should focus efforts in building adaptive capacity requires community engagement and knowledge of the demographic profile of the region. The creation of an index is a useful policy tool for building adaptive capacity as it allows for investments to

[30] Adger, 2004
[31] Robertson et al., 2015
[32] Emergency Management Victoria, 2013

be more clearly targeted at the regional scale to reduce the negative impacts of climate change.[33]

Attempts to build adaptive capacity also need to consider issues of social equity in adaptation measures, such as who will win and lose, the social and legal legitimacy of adaptation processes, and the efficiency and costs of adaptation. These are important considerations because certain adaptation measures, such as rebuilding infrastructure after a disaster, can exacerbate existing inequalities—making already vulnerable people even more vulnerable. In general, building infrastructure to reduce sensitivity and exposure is expected to increase costs and unintended consequences more than building adaptive capacity. Understanding and overcoming constraints and inequities will be key to improving the effectiveness of projects aimed at building adaptive capacity.

There are four major components Council can invest in to build adaptive capacity: assets, learning, social organisation, and flexibility.

5.3.1.1 Building Assets

Poverty affects the ability of people to build adaptive capacity. People can be trapped into behaviours that actually reinforce their own poverty because they are socially excluded, lack critical skills, and are unable to take the same risks as the wealthy.

Breaking poverty traps and the reinforcing behaviours will be a critical component of improving adaptive capacity in many parts of the municipality. The accumulation of assets, diversification of livelihoods, and house and land improvements are factors most often related to people's ability to move out of poverty.[34]

5.3.1.2 Building the Capacity to Learn

Fostering the ability of individuals and institutions to learn about climate change, to learn from a wide-range of experiences, and to learn to live with change and uncertainty is critical to building adaptive capacity.[35] Practical learning, traditional knowledge, formal education, and literacy are key components in people's ability to absorb and process information on the causes and consequences of climate change.

Council needs to provide timely and easily accessible information and resources in relation to climate change as this will be critical to building adaptive capacity in the community. However, combining different types of knowledge, including scientific and traditional ecological knowledge, can improve adaptive management.[36] By Council creating and supporting networks that allow communities to share management experiences is one way to ensure a continuous information-building process. This type of support from Council can help share different resources and climate change knowledge.

5.3.1.3 Building the Types of Social Organisation That May Facilitate Adaptation

Building the capacity of people to network or to act collectively is another key part of fostering the type of social organisation that helps people adapt to climate change.[37] For example, in

[33] Harley et al, 2008
[34] Adato et al., 2006; Krishna, 2006
[35] Adger et al., 2005; Folke et al., 2005
[36] Berkes and Seixas, 2006; Folke et al., 2005
[37] Adger, 2003

times of disaster, social cohesion helps reduce the loss and damage of assets, such as boats and coastal dwellings.[38]

5.3.1.4 Building Flexibility

The flexibility of organisations and institutions to adapt to change is another key dimension of adaptive capacity in the context of climate change. Adaptive management is considered an ongoing process by which organisational and institutional arrangements, rules of management, and ecological knowledge are continually monitored, tested, and revised in a process of learning-by-doing.[39]

Building the flexibility components of adaptive capacity will require the development of skills and access to capital to allow the most marginalised people to diversify their livelihoods. Importantly, programs promoting livelihood diversification or new technologies should not attempt to diversify into sectors that may be highly sensitive to climate impacts, particularly in locations with high levels of exposure to climate change. Flexibility in institutions will be improved by supporting the emerging transition toward adaptive co-management, but these need investments and capacity building to ensure that management can respond to feedback from social and environmental groups.

5.3.2 Adaptive Capacity Indicators

Indicators are widely used as benchmarks to assess climate change adaptation including vulnerability, adaptive capacity, and resilience. An index involves the aggregation of variables to identify the factors that have a significant statistical relationship. The intent of the indicators would be to help demonstrate improvements in adaptive capacity or increased resilience to climate impacts. Measuring adaptive capacity through an Adaptive Capacity Index (ACI) of indicators can indicate how well a community is adapting to climate change.

In consideration of what types of indicators may be useful and distinguishing between the different types of climate relevant information, the following are proposed:

- indicators relating to community wellbeing
- indicators relating to economic development, vulnerability, and climate
- indicators relating to biophysical changes

5.3.2.1 Indicators relating to community wellbeing

The process of developing community wellbeing indicators and community plans is an excellent way to inform and involve local people and organisations, and a meaningful task for the community. These indicators can help local government to govern better; improve Councils' knowledge, responsiveness, effectiveness and accountability; and can strengthen local communities in direct and practical ways like their sense of identity.

Community wellbeing indicators provide a concrete focus to engage local citizens and strengthen communities in discussions about what matters to them and enables Council to identify key issues, discuss priorities, and plan future directions for their community.

Potential indicators may include:

[38] Badjeck et al., 2010
[39] Olsson et al., 2004

- self-reported health
- subjective wellbeing
- feeling part of the community
- social and support networks
- perceptions of safety
- food security
- waste water recycling

Building the capacity of people to network or to act collectively helps people adapt to climate change.

5.3.2.2 Indicators relating to economic development, vulnerability, and climate

In addition to measuring the impact of climate change, indicators tracking measures of vulnerability and adaptive capacity within the community based on more traditional indicators of socio-economic, but climate impact relevant could also be considered. These could be of benefit to broader Council programs and services. Examples of indicators may include:

- proportion of businesses or residents with insurance protection for extreme climatic events
- number of residents in poverty
- proportion of care services rescheduled or cancelled during extreme weather events
- number of private properties within current flood risk or bushfire risk zones

5.3.2.3 Indicators relating to biophysical events

Reducing societal exposure to biophysical climate change events, such as high-intensity storms and sea-level rise, will require more traditional bio-physical adaptation techniques. However, disaster preparedness, resilience building, and planning for change will also play a critical role. Specifically, controlling settlements in low-lying areas will reduce flooding disasters, and how and where dwellings are built. Developments must follow Clause 13.01 of the Planning Scheme (Clause 13.01 – Coastal inundation and erosion) to reduce the risk of flooding and the impacts..

The focus of these indicators is on being able to track and monitor the impacts of extreme weather events (including heatwaves and storms) on Council and the community and the implications of more incremental changes in climate on Council assets and services.

Potential indicators of extreme events may include:

- number of SES callouts within Hobsons Bay
- number emergency/extraordinary maintenance requests to Council (i.e. tree removals, drainage works etc.)
- number of heat alerts issued by Council
- number of extreme rainfall days
- increased watering requirements in parks and gardens during periods of drought
- damage ($) or disruption (time) to Council assets or services (for example temporary closure of a Council swimming pool due to a specific weather event)

Potential indicators of the implications of incremental change may include:

- increase in average annual cost for watering of parks and gardens
- increase in average annual cost for road repairs
- increase in annual insurance costs incurred by Council
- increase in annual uninsured losses incurred by Council

Council may also wish to consider development of local climate statistics and trends that help paint a changing climate for the community. This approach is best demonstrated by the CSIRO Bureau of Meteorology's State of the Climate reports (2010 and 2012) which tracks trends in temperature increases and other climate variables. BOM maintains several weather stations within Council's boundary which could be used to collate information and track indicative trends. While caution is required in relation to local indicators, particularly the attribution of climate change to any observed changes, the indicators can be useful to demonstrate change and the need to enhance flexibility and responsiveness

6. Engagement to Adapt

Stakeholder engagement provides advice in regards to the strengths, issues, and potential solutions to climate change. Importantly, it recognises that the people involved in implementing the actions must form part of the decision making process. Two engagement processes are discussed in this section: the first provides a summary of an engagement process for Council officers to identify key themes and actions and the second provides a review of risks identified in the CCAP 2013-18.

6.1 Engagement Process

In order for Council to prepare for climate change, greater awareness and an understanding of the risks is required by Council, the community and businesses as well as permission and associated resources to undertake adaptation measures. Climate change will impact all aspects of the operations of Council and local businesses and the way in which the community conducts their lives. It will impact infrastructure management, human health and wellbeing, business continuity, and emergency management. Early engagement with respective stakeholders can fill in those knowledge gaps and build the capacity to act on the climate risks that Hobsons Bay will face.

Council has commenced a series of workshops to build awareness among stakeholders of the impacts of climate change and to identify short, medium and long term actions. The actions are seeking to both manage the risks of climate change and reduce our emissions to avoid the worst case climate scenario.

6.1.1 Internal Workshops

Internal staff workshops were conducted in August, September and October 2018 and focussed on identifying adaptation actions through scenario thinking. Scenario thinking offers a way for Council to visualise the threats and identify opportunities for the future in relation to the potential impacts that climate change will have on the community. To achieve engagement with a broad range of officers, Council established four working groups charged with developing and prioritising future actions. The groups were based on the four major climate risks and applied scenario thinking. The four groups are:

1. Human Wellbeing
2. Emergency Management and Business Continuity
3. Natural and Built Environment

4. Coastal Adaptation

Each working group comprised officers who are experts in the area. Their task was to identify actions Council could take to address their key risk and adapt to climate change. Between August and October each working group met twice.

Two scenarios were used to identify key themes and associated climate adaptation actions for the future. The two scenarios were:

1. **Predictive scenarios: what is likely to happen?** 2030 projections from CSIRO and DELWP were used to guide a risk assessment and identify adaptation actions.
2. **Normative scenarios: what should happen?** A local impact scenario was used to stimulate creative thinking about possible adaptation options that could be applied to a best case scenario assessment for 2050.

The first workshop produced a set of actions to adapt to 2030 projections and a vision for Hobsons Bay was identified for 2050. The second workshop teased out the actions, established timelines and identified potential indicators to monitor and report on progress.

6.1.2 Councillor Workshop

On 30 October 2018, a workshop was conducted with Councillors to identify key themes and associated actions that would both build on the internal workshops and provide strategic advice in relation to the key themes and actions of importance to Council.

6.1.3 Community Engagement

External consultation with the community is due to occur in February and March 2019. The goal of the engagement is to build an Adaptive Capacity Index with the community based on the vision of key themes and actions from the internal workshops. The community workshops will explore adaptive capacity and determine which indicators are most important for the community; as well as how Council should approach building adaptive capacity within the community.

6.2 Evaluating the *Climate Change Adaptation Plan 2013-18*

To understand the effectiveness and success of any climate change adaptation plan, assessing the previous plan ensures that future adaptation planning draws on lessons learnt through a review process. To determine success, it is necessary to set out what needs to be measured, how it can be measured, over what timeframes the measurement will take place, and what success looks like when they are achieved.

6.2.1 Adaptation Actions from the CCAP 2013-18

An evaluation of the CCAP 2013-18 has been undertaken through an analysis of the adaptation actions set out in the CCAO 2013-18 and by evaluating the effectiveness of the Hobsons Bay Risk Register in regards to managing the climate change risks. The evaluation will help determine where Council should focus its efforts and update its approach accordingly.

In the CCAP 2013-18, a risk management framework was used to assess the climate change risks for Hobsons Bay based on risks identified through the WAGA Climate Change Risk Assessment. Council's risk management process involved: defining the likelihood of the risk occurring, defining the consequence should the risk materialise, and determining a risk rating by combining the likelihood and consequence scores. Following the assessment, a total of 38 risks were identified in the CCAP 2013-18 and added to the Hobsons Bay Risk Register.

Analysis of the adaptation plan in relation to the Risk Register reveals that as of August 2018:

- adaptation treatments have commenced to manage 16 risks
- five risks have action plans in place but these plans have not commenced.

In addition there are 39 adaptation actions listed from the CCAP 2013-18, 25 have been completed. Thirteen adaptation actions are not being progressed within the timeframes proposed in the plan. Most incomplete actions did not progress in the given timeframe due to resourcing, budget constraints, and a lack of guidance or knowledge in relation to the appropriate actions required to mitigate the risk.

For a list of the 38 actions from the CCAP 2013-18 please refer to Appendix 2. The list identifies all 39 actions and indicates whether or not they have been completed.

Progress has been made through the CCAP 2013-18. The achievements include creating tangible adaptation actions to reduce climate risks in our city and incorporating some adaptation actions into our core business.

6.2.2 Hobsons Bay Risk Register

To better evaluate the adaptation responses, owners of climate risks in the Hobsons Bay Risk Register were asked a series of questions about their role as an owner of a climate risk and the CCAP 2013-18. For the survey questions please refer to Appendix 3.

From the survey, it was determined that the application of the CCAP 2013-18 in their everyday work is sporadic and the actions were too high-level. Some teams used the CCAP 2013-18 regularly for service planning while other teams were not aware that Council had a Climate Change Adaptation Plan. Of the actions assigned to a team, some actions were difficult to complete due to a lack of resources (i.e. funding and officers) and the complexity of the actions. Overall, owners of climate change risks suggested more engagement was required from the Sustainability Team during the initial phase of identifying and rolling out the risks and adaptation actions.

As Council moves forward, it is important to understand the implementation process of Council's previous adaptation responses. From the evaluation, there is currently a gap within Council between understanding the risks associated with climate change and the capacity to act on those risks to enable long-term adaptation outcomes. Based on the review of the CCAP 2013-18, there was a lack of collaboration in the writing of the plan which highlights the lack of support it received. Going forward, significant collaboration is required in the identification of the key themes and associated actions to enhance buy-in along with a focus on building the capacity to implement the actions.

6.2.3 Climate Change Adaptation Governance

In 2017, the Department of Environment, Land, Water and Planning (DELWP) commissioned an analysis of climate change adaptation governance across local governments in Victoria. The baseline analysis looked at how climate change is considered across ten areas of corporate governance in Victorian councils. Fulfilling a commitment under the Victoria Government's *Climate Change Adaptation Plan 2017 – 2020*, the aim of the project was to assist council staff to effectively integrate climate change considerations into the organisation's core activities, helping to minimise risk to council and the community.

In summary, they recommend that Council: explore the effect of climate change on resourcing Council operations; create a detailed analysis of the exposure of all Council assets to climate change; and acknowledge the need to manage both the direct and indirect effects of climate change. Lastly, the report suggested that Council should explore the financial ramifications that climate change may present on its asset value, including depreciation and exposure to increased extreme events. Please refer to Appendix 4 for more on DELWP's evaluation.

7. Discussion

As Council develops a vision of a climate-adaptive Hobsons Bay, the principles of resilience and adaptation underpin adaptive planning.

Short term climate change projections for Australia are expected to continue with more extreme climate variability, requiring communities and organisations to respond to these impacts. The issue of responding to climate change has predominantly been focused on adapting and mitigating the biophysical risks. However, more recent research shows that the socio-cultural constraints are equal or may exceed biophysical and/or technological constraints[40]. These challenges are marred by uncertainty and complexity due to the intricate interaction of ecological processes and the societal relations embedded within these. Due to this complexity and uncertainty the need to understand the key features of adaptive capacity and then build the capacity of the community to adapt to changing conditions is paramount.

7.1 Evaluating Climate Risks in Hobsons Bay

The four major risks Hobsons Bay will face are projected to occur more regularly. Providing the most appropriate response and preparing for these risks is increasing important. Delaying action to reduce vulnerability to the climate change risks may increase both costs and the extent of the risk. Even with considerable future reductions in global greenhouse gas emissions, the lag in the climatic system means that many of these impacts are now unavoidable, requiring Council to act.

7.1.1 Sea Level Rise

Hobsons Bay is a low-lying municipality which will heighten the conflict over space for native vegetation and human needs.

As sea levels rise, erosion will occur in some of the sandy coastal parks around Hobsons Bay while other areas of coastal parkland will become inundated. Most of Hobsons Bay's shorelines are sandy beaches which are already experiencing shoreline erosion; Hobsons Bay can expect more erosion in its beaches as climate change becomes more apparent.

Hobsons Bay has two of the three swimming beaches on the west side of Melbourne which are big tourist attractions for residents living in and around Melbourne. Any alteration of Hobsons Bay City's beaches due to climate change will have significant economic impacts including a decrease in tourism, damage to properties, increased maintenance, repairs and replacement for buildings, and reduced access to essential services and transport. Globally, we are already seeing the destruction storm surges and sea level rise can bring to coastal communities due to big storm events. For example, Hurricane Irma cost Florida USA 1.8 million out of-state visitors in 2017 with an associated loss in spending of USD $1.5 billion.

[40] Adger et al. 2009; Adger and Barnett, 2009

Declines in visitor spending flowed through the Florida economy, resulting in a total economic loss of USD $2.5 billion.[41]

Increases to the intensity of extreme events is a significant risk for transport infrastructure. Across Australia, 26,000–33,000 kilometres of roads and 1,200–1,500 kilometres of rail lines and tramways are exposed to the combined effects of inundation and shoreline recession for a sea-level rise of 110 centimetres. In Victoria, a 110 centimetres sea level rise will also put up to 125 kilometres of railways, 2,000 commercial buildings and 3,500 kilometres of its roads at risk.[42]

As human populations expand, and climate impacts intensify, the costs and limitations of artificial coastal barriers are becoming more apparent. Sea walls, for example, are brittle; they break rather than flex and have unwanted effects on surrounding areas by, for instance, diverting wave energy to unprotected locations. Around the world, researchers and governments are looking to natural coastal infrastructure, including dunes, gravel beaches and mangroves, to protect communities from flooding. Hobsons Bay is already home to three naturally occurring mangrove forests: Kororoit Creek at Williamstown, the Jawbone Marine Sanctuary at Williamstown, and Stony Creek Backwash, under the Westgate Bridge in Spotswood;

The coastal systems at greatest risk are estuaries and associated wetlands, coral reefs, constrained tidal flat communities and beaches where there is a lack of sediment replenishment. Not only do these systems have intrinsic environmental value, they provide a range of ecosystem services such as acting as nursery grounds for commercially and recreationally important fish and crustaceans and protecting vulnerable parts of the coastline.

The most effective way to enable coastal ecosystems to adapt to climate change impacts is to leave space for coastal ecosystems to retreat, particularly along waterways, to build resilience through revegetating, and to reduce current threats such as weeds and pest animals. Coastal ecosystems not only protect inland areas but also provide habitat for endangered species, fish nurseries and natural water-cleaning services. In addition, they can help to combat climate change by storing carbon as they grow.

Hobsons Bay supports a diverse array of wetlands and salt marshes that can be used to protect the community from sea level rise. Biolinks along Kororoit Creek and Laverton Creek will be particularly important to manage successfully due to the climate change impacts on the Altona Coastal Park and the Cheetham Wetlands. Council is also collaborating with the University of Melbourne on a mangroves project in the Altona Coastal Park. Preserving these natural ecosystems will have long-term benefits for Hobsons Bay.

7.1.2 Increase in Average Temperature

Heat waves will affect Hobsons Bay's infrastructure, tourism, environment, and community. Hobsons Bay can expect impacts on its outdoor and sporting events, disruption to services, stress on health and emergency services, and changing ecological dynamics.

Melbourne is already feeling the heat of climate change with days of extreme heat expected to increase over the coming decades. Urban areas experience heat stress more because of

[41] Visit Florida, 2018
[42] CSIRO and BOM, 2015

the higher concentration of constructed surfaces which trap and store heat for longer periods than natural environments; it can be responsible for urban temperatures up to seven degrees Celsius hotter than the cities peri-urban periphery. This phenomenon is known as the urban heat island (UHI) effect.

As Melbourne's population grows and urban development increases, the effects felt by the UHI is expected to become more profound. Hobsons Bay and the surrounding municipalities contain a lack of natural environments and canopy cover, with a high percentage of the land-use zoned as industrial. Hobsons Bay is home to core and secondary industries which are known to store and emit high amounts of radiant heat (Figure 10). Industrial estates and major roadways absorb a significant amount of light and radiation emitting it as heat. This occurs through dark buildings, pavements and bitumen which have a significant effect on warming the surrounding areas depending on wind direction. Hobsons Bay can expect the suburbs surrounding industrial areas to experience an increase in the risks associated with extreme heat.

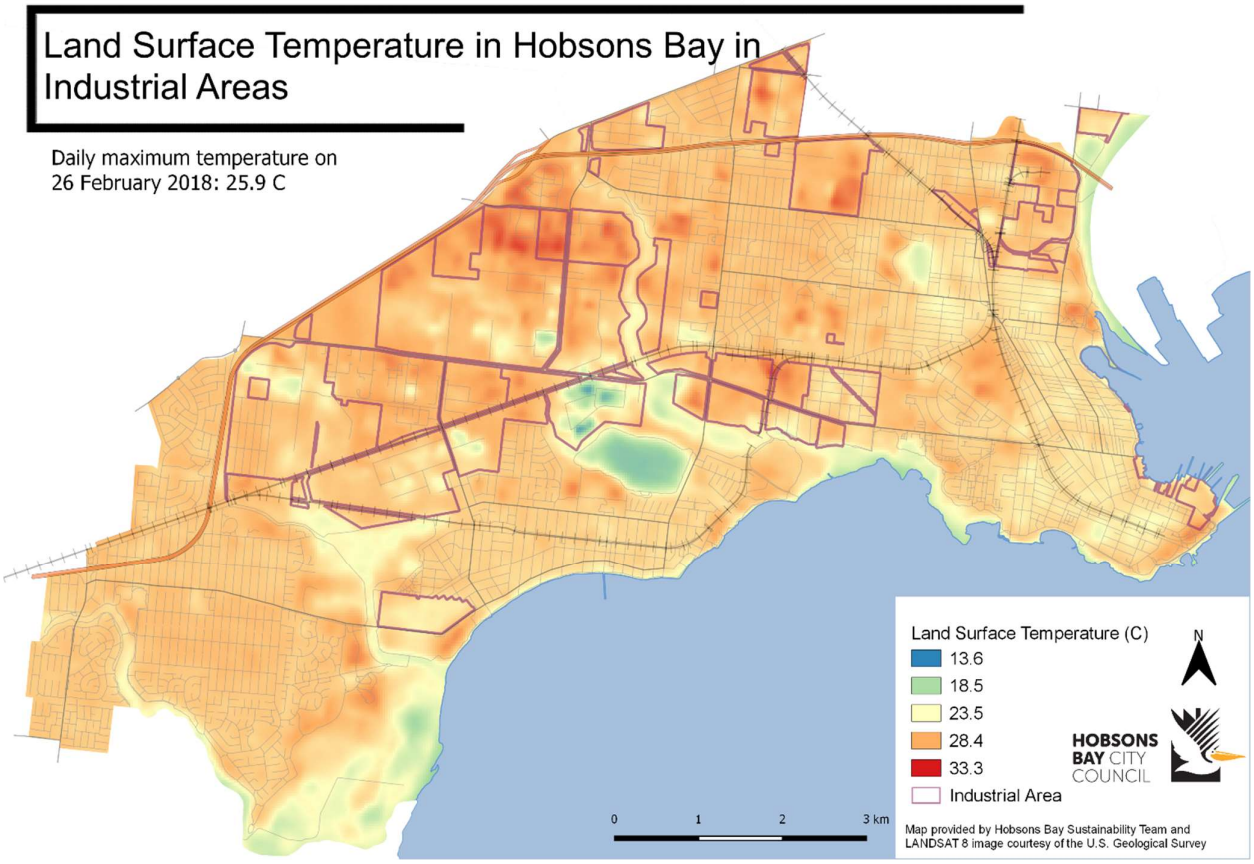

Figure 10 Heat map of Hobsons Bay overlayed with industry overlays for Hobsons Bay. The higher land surface temperature locations are within the industrial overlays indicating heat is absorbed more in these areas. For information on how surface temperature data was obtained and analysed, please see Appendix 7.

During heat events, critical infrastructure, including roads, railways and power lines, are vulnerable to failure. For example, railways buckled from heat stress during Melbourne's 2009 heatwave, cancelling over one-third of train services.

Hotter temperatures place outdoor and manual labourers at increased risk of heat-related illnesses, work accidents and death, while the increased incidence of extreme weather events increases occupational risks for emergency services. Heat stress in the workplace resulting in reduced productivity and absenteeism is estimated to cost the Australian economy $6.2 billion per annum.

Human vulnerability is relative to the climatic event being experienced – e.g. heat impact is likely to effect the elderly and those with pre-existing health concerns. Urban flooding impacts socio-economic disadvantaged communities. Increasing temperatures and extreme weather events pose a serious risk to human health. Heatwaves can cause heatstroke and organ failure. During the 2009 Melbourne heatwave, heat-related hospital admissions increased eight-fold, and there was a 62 per cent increase in mortality over what would normally be expected during the same period[43].

People living in urban areas are particularly at risk of heat-related disease and death because they are already exposed to high temperatures, and socially disadvantaged groups often experience greater urban heat exposure. Heat risks significantly increase the vulnerability of household health such as those with pre-existing medical conditions, the elderly, and infants. These risks can be compounded by rising electricity prices, poor housing stock, socio-economic status, and perceptions around being unable to afford energy bills.[44]

Low-income families living in low-quality and community housing are highly vulnerable to extreme heat, chiefly because the housing stock is not insulated sufficiently. Compared to households on medium to high incomes, key risk factors for heat-related health issues were twice as prevalent in low-income households, undermining resilience and exacerbating vulnerability. Low-income households are further exposed to heat-related health risks because they are associated with suburbs with the highest land surface temperatures. Appropriately targeting neighbourhoods to increase canopy cover is important for adaptive capacity, due to the increase in mental and physical health issues during extreme heat days.

Understanding where the UHI effect is located in Hobsons Bay can assist Council in prioritising adaptation responses. Based on the map below (Figure 11), on a 25 degree Celsius day, areas of high SEIFA index of disadvantaged are located near UHI locations.

[43] Steffen et al., 2012
[44] Nicholls et al., 2017

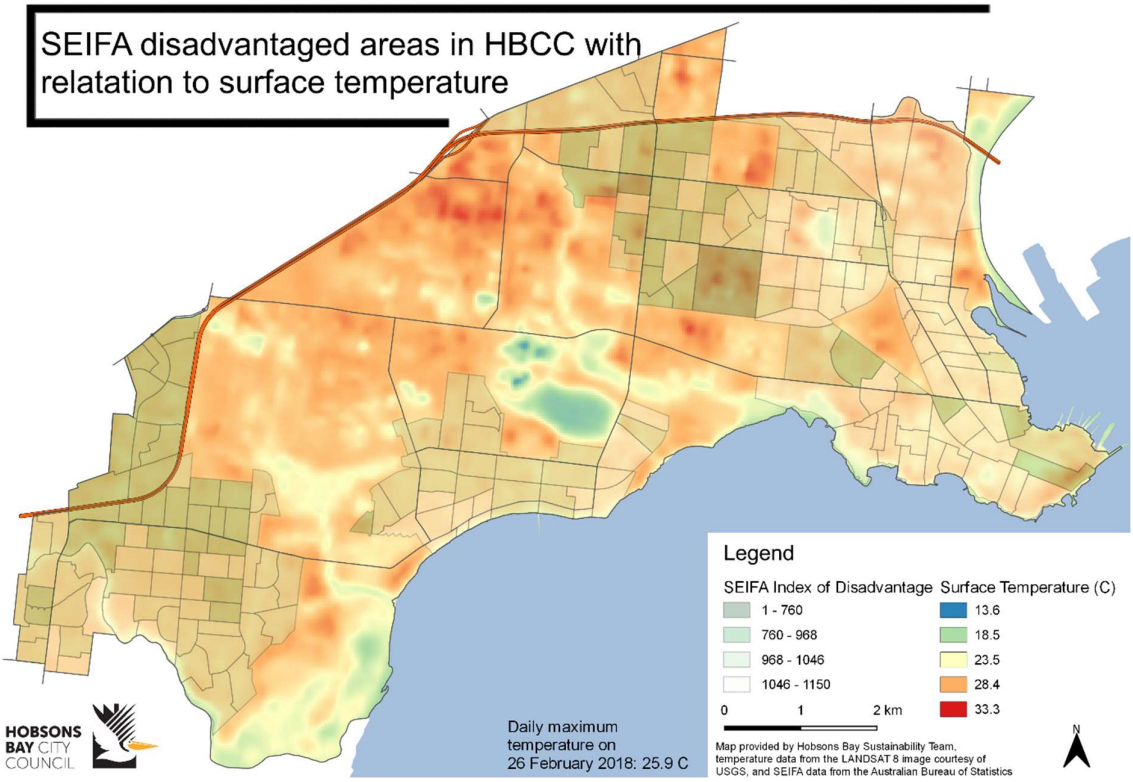

Figure 11 Heat map of Hobsons Bay overlayed with SEIFA index for Hobsons Bay. For information on how surface temperature data was obtained and analysed, please see Appendix 7.

Hobsons Bay can expect its grasslands, waterways, and wetlands to be impacted by rising temperatures and decreasing rainfall. Hobsons Bay supports a diverse array of ecosystems that provide habitat to an impressive range of flora and fauna, including many rare and threatened species that will be affected by climate change. As populations increase, green spaces are increasingly being lost to built areas and paved, impervious surfaces. For example, Hobsons Bay lost canopy cover by around 2.5 per cent[45] in 2014 possibly due to development and industry.

Vegetation is among the most effective mitigation actions to decrease the impact of hot days. It is important to prioritise green infrastructure for heat mitigation especially in areas with socio-economic vulnerability, areas with heat exposure, and areas of behavioural exposure (i.e. near service centres, public transport hubs, and walking and cycling routes). For example, increasing overall vegetation cover has been proven to be effective at reducing land surface temperatures during the extreme heat event during both the day and night. Trees and vegetation that directly shade homes can decrease the need for air conditioning, making homes more comfortable and reduce energy bills. Trees also protect a community's health by improving air quality, by providing cooling shade for outdoor activities, and reducing exposure to harmful UV radiation.

[45] Jacobs et al., 2014

7.1.3 Increase in Extreme Storm Events

The most immediate threat of extreme storm events, such as flooding, is the threat of damage to human property. The psychological impacts of flood events are severe for both adults and children, particularly for those with no insurance or safety net to protect their assets. These impacts can cause people to move away from the area[46].

In the longer term, the increased frequency of storm damage can affect the cost of insurance premiums and the willingness of governments to provide support for flood-affected residents. Local businesses may experience increased business costs associated with energy and water supplies and rising insurance premiums. Hobsons Bay's tourism industry can also be effected by extreme flooding events. Beach erosion caused by storm surge or extreme high tides can undermine foundations and impact infrastructure on coastal and estuarine foreshores[47]. Access to the beach may be limited by stormwater overflows sending contaminants downstream into the bay; therefore limiting water related activities for several days. Considerable economic implications arise from this.

Natural ecosystems have an important role to play in flood mitigation, for example by slowing flow rates and providing a buffer to flooding. Hobsons Bay is home to a variety of natural ecosystems which provide a diverse range of habitat to an impressive range of flora and fauna, including many rare and threatened species. Flooding in these waterways can impact negatively on the health of individual species or positively by recharging groundwater and restoring nearby ecosystems. Changes in freshwater and saltwater inputs can alter the mix of saline and freshwater in estuarine habitats. The flow of freshwater into these habitats is important to sustain life: freshwater brings with it nutrients that are essential for coastal productivity but can also lead to poor water quality.

The impacts of extreme storm events on Hobsons Bay's settlements and infrastructure will be exacerbated by interactions between several factors during extreme events. Drought or dry season impacts the soils ability to absorb rainfall, putting additional pressure on stormwater drainage systems. For example, where storm surges coincide with heavy local rainfall, stormwater systems become ineffective, further intensifying flooding as sea water pushes back up stormwater drains, preventing run-off from being discharged to the sea. Hobsons Bay is susceptible to this already due to Melbourne Water's drain pipes leading into Port Phillip Bay on Mannings Street and Millers Road.

Extreme flood events will have major impacts on infrastructure as well as power loss, water supply contamination and the loss of property. Floating debris can cause additional damage or pressure, and the force of floodwaters can cause erosion and collapse of soils supporting a structure[48] as happened during the 2010-11 eastern Australia floods. Damage repair and recovery can extend over long periods of time and can be very costly. Council is currently reviewing its drainage assets with the aim to manage storm water and potentially add litter traps to manage these impacts.

[46] Apen et al., 2010
[47] Woodroffe et al., 2012
[48] Mason et al., 2012

7.1.4 Decrease in Rainfall

Droughts can have wide ranging effects on health including on nutrition, infectious diseases, on bush fires causing air pollution, and mental health problems, such as post-traumatic stress and suicidal behaviour[49]. Droughts can also contribute to increases in mortality rates. The World Meteorological Organisation has linked drought to 680,000 deaths globally from 1970–2012[50].

As the trend towards hotter, drier conditions continues in southern Australia, native species will continue to face habitat degradation, population declines, and in some cases extinction. If the rate of climate change that the continent is currently experiencing continues, many thousands of terrestrial and freshwater species in Hobsons Bay could be at risk.

Water scarcity in major cities, particularly Melbourne, Sydney and Perth, has been exacerbated by drought and remains an ongoing challenge. Most of Australia's population live in urban areas placing high demand on urban water supplies as populations continue to grow. Pressure on urban water supplies is projected to intensify as droughts increase in frequency and severity in the southwest and southeast[51]. Drought can significantly reduce inflows into vital urban water catchments, as occurred during the Millennium Drought, resulting in water restrictions. For example, from 2007–2010 Melbourne was placed on Stage 3 restrictions and in 2009 Melbourne's water storage levels fell to a record minimum of 25.6 per cent[52].

Drier conditions can lead to an increase in bush fires. Black Saturday is a good example of this. As Hobsons Bay becomes warmer, northerly winds could start a bush fire in the grasslands near Altona Meadows and Laverton.

The economic impacts of climate change will be significant in Hobsons Bay. Council sources its water outside of the municipality which will become more expensive as water becomes scarcer. Investing in storm water harvesting may offset the increasing cost of water. It will be important to maintain a range of Council-provided facilities including sporting facilities, parks, green open spaces, and street trees. There is also a high likelihood that in the future resource recovery from treating water (water itself, nitrogen, phosphorus) will cover the costs of the investment.

7.2 Outcomes from the Workshops

From the workshops, a number of themes were identified. Many actions identified related to educating and preparing the community for climate change through events and capacity building programs. Building adaptive capacity involves developing the community's capacity to respond to the impacts of climate change. Other actions focussed on creating a shared economy and making council buildings multi-use and more available to the community.

Both the internal and Councillor workshops envisioned a greener, more affordable, and more innovative future. Stormwater management, environmental sustainable design, active transport, and increase in tree canopy cover were common topics amongst all workshops.

[49] Haines et al., 2006
[50] World Meteorological Organization, 2014
[51] Collett and Henry, 2011
[52] Melbourne Water

From these common visions, four objectives and four actions areas for climate change adaptation were formed. The four objectives are:

1. **Shared Places** – Create and sustain buildings, infrastructure and activities that promote social cohesion, equality of opportunity and health.
2. **Green Environment** – Enhance the natural environment and green spaces of Hobsons Bay City.
3. **Stronger Together** – Strengthen the resilience and adaptive capacity of our community
4. **Sustainable Practice** – Reduce Council's and community's waste sent to landfill and the use of water

The four themes are provided along with examples of key actions:

- **Thrive**
  - more walkable neighbourhoods
  - provide and develop active transport infrastructure
  - create community gardens
  - encourage/support shared use of public spaces
- **Survive**
  - training staff to respond appropriately to emergency situations caused by extreme weather
  - empower communities to take active responsibility for their own and each other's wellbeing, safety and health
  - partner with scientists to model the future coastal processes for management purposes
- **Adapt**
  - promote rain water harvesting
  - community greening initiatives
  - adopted valuation of green assets
  - promote use of lower emission, electric, alternative fuels through education, infrastructure precision
- **Embed**
  - education campaigns raising awareness of climate risks for Councillors, community, and businesses
  - workshops/training for community members on the climate change risks Hobsons Bay will face
  - programs led by young people to create "change agents"

Many of the actions aligned with Council's *Integrated Transport Plan 2017-30* and the Draft Environmentally Sustainable Development Strategy. These actions and themes will be further tested with the community.

8. Recommendations for Action

The Climate Change Adaptation Plan Refresh for Hobsons Bay City Council provides the evidence base to clearly articulate Council's role and commitment to respond to climate change whilst building adaptive capacity and resilience within the community.

Prioritising climate change adaptation within Council's decision making processes requires an evidence based climate change policy framework that is supported by all groups across Council. There is currently a gap within Council between understanding the risks associated with climate change and the capacity to act on those risks. In order for Council to prepare for climate change the following is required:

- greater awareness and understanding of the risks among staff and the community
- a series of actions that are implementable
- accountability for the actions that are part of business as usual
- permission to undertake adaptation measures
- a monitoring, evaluation and reporting process to document progress

This background report identifies actions related for Hobsons Bay to effectively adapt to climate change while forming the bases of a Climate Change Adaptation Plan Refresh (Plan Refresh). The Plan Refresh will implement and integrate the action areas from stakeholder engagement (Stage 4 of five of the climate change adaptation process).

8.1 Identify Adaptation Objectives into Planning and Policy

The implementation of the adaptation plan should be integrated into planning and policy making. Ways to implement the adaptation actions are through continuous improvement measures and capacity building within the organisation and/or documenting actions that address the adaptation themes that have been identified through community engagement as well as policy objectives. Adaptation actions should form part of the Service Planning process and a corporate system should monitor service plans to ensure adaptation actions are part of a business as usual response.

8.2 Building Resilience

Carefully designed, well implemented and effective community engagement strategies are important components of effective and inclusive climate change adaptation measures. Citizen engagement in decisions and actions can have multiple benefits including securing local ownership and support; creating heightened trust, transparency and credibility for decision-making processes; making policies more practical and relevant; and achieving cost savings[53].

Increasingly, the meaning of resilience has come to encompass more than just responding to, and bouncing back after, an extreme event. The ability to change and adapt to changing conditions through cooperation and learning are cited as important components of building resilience into the future[54]. Building resilience includes ensuring communities and Council work to adapt to changing conditions, anticipate shocks and build up capacity to recover. To effectively build community resilience, Council must first understand the dimensions of social vulnerability in our community to determine which groups will bear the greatest burden from climate change impacts.

8.3 Monitor Climate-Vulnerable Communities

Vulnerability is "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is

[53] Fritze et al., 2009
[54] Moser, 2008

a function of the character, magnitude, and rate of climate variation to which a geographical area is exposed, its sensitivity, and its adaptive capacity".[55]

Currently, Council does monitor climate-vulnerable individuals which can be a mix of all of the groups described in Chapter 4, Section 2. As Council moves forward in working with the community on adapting to climate change, a category for climate-vulnerable groups should be defined to help target individuals and to emphasise where to prioritise building resilience and adaptive capacity.

8.4 Advocate for Governmental and Scientific Support

For effective adaptation Council needs to advocate and collaborate with state and federal government. Local government is best positioned to inform State Government and the Federal Government of local and regional needs, to directly communicate with the community, and to respond to local changes in an appropriate and timely manner.

Councils and communities need state and federal support to deliver effective strategies to reduce community emissions and to adapt to climate change. Council recognises this important collaboration and will be advocating to state and federal government on the importance of climate change legislation. Council also recognises the importance of using scientific evidence to form adaptation actions and will be working closely with CSIRO, DELWP and research groups to obtain the most up-to-date scientific data.

8.5 Measure Outcomes Effectively

When working with the community on adapting to climate change, communicating the impacts needs careful consideration to ensure that this information does not disempower the community. An alternative approach would be to focus indicators on measures that help show increased adaptive capacity or reduced vulnerability to climate change. Such indicators can convey a much more positive and proactive message to the community and assist Council in measuring progress towards a more resilient community.

To monitor and report on the actions from the Plan Refresh, Council will follow the Sustainability Framework guide which includes:

Collective Impact – are the actions sufficient to meet the agreed outcomes of the Plan Refresh?

Relevance – are the policies still relevant and appropriate? Do they respond to recent policy developments or political outcomes?

Stakeholder and Community Engagement – how was the community (or other target group) engaged throughout the policy implementation and were they able to learn together? Did they create and/or realise their vision for the future?

Community Innovation – were place based solutions found that were innovative and effective for the affected community?

Collaborative Leadership – the premise of Collaborative Leadership is that if you bring the appropriate people together in constructive ways, with information appropriate to the issue,

[55] McCarthy et al., 2001

they will create authentic strategies for addressing the issues identified in the policy. Was this achieved?

Quantitative Impact – analysing reach or experiences using surveys and administrative data

Flexible monitoring that prioritises capacity building and is outcomes focussed. One option is to include actions within the policy itself to increase the focus and enable more effective annual monitoring. Reporting will focus on both quantitative and qualitative analysis, including storytelling to report on key projects. This must also incorporate the needs of vulnerable communities to aid their planning and implementation. The use of outcomes-focused indicators will assist.

9. Conclusion

Adaptation enables our people, businesses, infrastructure, and the environment to cope with an increasingly variable and unpredictable climate. As the municipality will face the broad-ranging impacts of climate change, it is essential to build the capacity of people across Council, other organisations, and the community to adapt to climate change.

The intent of the Plan Refresh is to provide the broad strategic directions and a framework for decision-making (Stage 4 of the five stages of the climate change process). In the Plan Refresh, Council will focus on the capability of the community to adapt to climate change through adaptive capacity. Increasing the adaptive capacity of vulnerable communities and regions greatly influences their ability to manage the effects of climate change.

The actions identified as part of the Plan Refresh will build on Council's existing risks identified in the Risk Register and provide scenarios for Council to adapt to, along with manageable actions so that Council can better adapt to climate change. It will facilitate a coordinated and co-operative approach to climate change adaptation encouraging long-term planning for the benefit of Council, the municipality, and the broader environment over short-term gains.

The purpose of the Plan Refresh is to:

- identify new adaptation actions based on the climate risks discussed in Section 4
- prioritise adaptation actions and commitments
- articulate the responsibilities and accountabilities required to achieve the action
- establish long-term goals
- develop a scenarios to guide future actions

The Plan Refresh will guide Council's project planning, external funding streams, and advocacy activities to ensure that climate change is part of the decision making process. It will also provide a platform for collaboration between internal and external stakeholders including non-for-profits, State and Federal governments, and the community.

10. Next Steps

This Background Report will be used to inform community engagement and consultation on the proposed strategic direction and adaptation actions required by Hobsons Bay City Council to address climate change. Community consultation focussed on building adaptive capacity and creating an Adaptive Capacity Index will occur early 2019. The Plan Refresh

will be prepared after the community consultation for adoption by Council mid-2019. An evaluation plan will be part of the Plan Refresh along with an annual action plan.

11. References

Adato, M, Carter, MR, and May, J. 2006. Exploring poverty traps and social exclusion in South Africa using qualitative and quantitative data. Journal of Development Studies 42: 226–247.

Adger, WN. 2003. Social capital, collective action and adaptation to climate change. Economic Geography 79:387–404

Adger, N. 2004 Uncertainty in Adaptive Capacity, in Manning, M. Petit, M. Easterling, D. Murphy, J. Patwardhan, A. Rogner, H. Swart, R. and Yohe G. (eds), Describing uncertainties in climate change to support analysis of risk and options IPCC Workshop, Ireland, pp 49-51.

Adger, WN, Arnell, NW, and Tompkins, EL. 2005. Successful adaptation to climate change across scales. Global Environmental Change 15:77–86

Adger, WN and Barnett, J. 2009. Four reasons for concern about adaptation to climate change. Environment and Planning A, 41(12), pp.2800-2805.

Adger, N, Dessai, S, Goulden, M, Hulme, M, Lorenzoni, I, Nelson, D, Naess, L, Wolf, J, and Wreford, A. 2009. Are there limits to adaptation to climate change? Climatic Change, 93: 335-354.

AECOM, 2012. Climate Change Adaptation Plan Issues and Directions Paper

Apan, A, Keogh, DU, King, D, Thomas, M, Mushtaq, S & Baddiley, P. 2010, The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity, National Climate Change Adaptation Research Facility, Gold Coast, 171 pp.

Australian Bureau of Statistics. 2017. *Disability, Ageing and Carers, Australia: Summary of Findings 2015*, Catalogue No. 4430.0, Canberra.

Australian Greenhouse Office. 2006. Climate Change Impacts and Risk Management: A Guide for Business and Government. Commonwealth of Australia, Canberra. 75 pp. Available from: http://www.environment.gov.au/climate-change/adaptation/publications/climate-change-impact-risk-management.

Badjeck, MC, Allison, EH, Halls, AS and Dulvy, NK. 2010. Impacts of climate variability and change on fishery-based livelihoods. Marine Policy 34: 375–383.

Berkes, F, and Seixas, C. 2006. Building resilience in lagoon social-ecological systems: a local-level perspective. Ecosystems 8: 967–974.

Beyond Zero Emissions, ICLEI – Local Governments for Sustainability, and Ironbark Sustainability. 2018. Australian Local Government Climate Review 2018. 34 pp.

BOM and CSIRO, 2016. State of the Climate 2016. Available from: http://www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2016.pdf

Canadian Government. 2010, Adapting to Climate Change. Available from: http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/municipalities/407

Christiansen, L, Olhoff A, and Trærup, S (eds.). 2011. Technologies for Adaptation: Perspectives and Practical Experiences, UNEP Risø Centre, Roskilde.

Chopra K, Leemans R, Kumar P, Simons H, eds. 2005. Millennium Ecosystem Assessment: Responses Assessment. Vol. 3. Washington, DC: Island. 621 pp.

Clean Air and Urban Landscapes Hub. 2018. Urban Vegetation Cover Analysis, Melbourne western Region, (Unpublished Interim Report), Clean Air and Urban Landscapes Hub, Melbourne.

Collett, B, and Henry, N. 2011. Urban water supply and use. The Australian Collaboration–Factsheet.

CSIRO and Bureau of Meteorology. 2015. Climate change in Australia: Information for Australia's natural resource management regions: Technical report (CSIRO and Bureau of Meteorology, Australia)

Dempwolf, CS, and Lyles, LW. 2012. The uses of social network analysis in planning: A review of the literature. Journal of Planning Literature, 27(1), pp 3-21.

Department of Environment, Land, Water and Planning. 2015. Climate ready Victoria: Greater Melbourne. Available from: https://www.climate change.vic.gov.au/information-and-resources

Department of Environment, Land, Water and Planning. 2017. Victoria's Climate Change Adaptation Plan 2017 – 2020. Victoria State Government, Melbourne.

Department of Human Services. 2013. Strategic and Business Planning Tools for Not-for-Profit Organisations. Summary Report, June 2013. Victoria State Government, Melbourne.

Emergency Management Victoria. 2017. Community Resilience Framework for Emergency Management. Available from: https://files-em.em.vic.gov.au/public/EMV-web/Community_Reslience%20_Framework.pdf

Fritze, J, Williamson, L, and Wiseman, J. 2009. Community Engagement and Climate Change: Benefits, Challenges and Strategies, Report for Department of Planning and Community Development, Victorian Government McCaughey Centre, VicHealth Centre for the Promotion of Mental Health and Community Wellbeing Melbourne School of Population Health, University of Melbourne In collaboration with the Victorian Council of Social Service and Council on the Ageing, Victoria.

Folke, C, Hahn, T, Olsson, P, and Norberg, J. 2005. Adaptive governance of social-ecological systems. Annual Review of Environment and Resources 30: 441–473.

Friedl MA, Gray, JM, Melaas, EK, Richardson, AD, Hufkens, K, Keenan, TF, Bailey, A and O'Keefe, J. 2014. A tale of two springs: using recent climate anomalies to characterize the sensitivity of temperate forest phenology to climate change. Environmental Research Letters. 9: 054006

Haines, A, Kovats, RS, Campbell-Lendrum, D, and Corvalán, C. 2006. Climate change and human health: impacts, vulnerability and public health. Public health, 120(7): 585-596.

Harley, M. Horrocks, L., Hodgson N. and van Minnen, J. 2008. Climate change vulnerability and adaptation indicators. European Topic Centre on Air and Climate Change Technical paper 2008/9.

Hartmann, DL, et al. 2013. Observations: Atmosphere and Surface. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Hutley, N, and Harford-Davis, S, 2016. Climate Change and Directors' Duties. The Centre for Policy Development and the Future Business Council. 22 pp.

IPCC. 2013: Summary for Policymakers. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, T. F. Stocker, and Coauthors, Eds., Cambridge University Press. Accessed 18 April 2016. Available online at https://www.ipcc. ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf

IPCC. 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp 1-32.

Jacobs, B, Mikhailovich, N, and Delaney, C. 2014. Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment, prepared for Horticulture Australia Limited by the Institute for Sustainable Futures, University of Technology Sydney

Krishna, A. 2006. Pathways out of and into poverty in 36 villages of Andhra Pradesh, India. World Development 34: 271–288.

Lindgren, M, and Bandhold, H. 2003. Scenario Planning: The link between future and strategy, Pallgrave Macmillan: New York, NY

Maani, K. 2013, Decision-making for climate change adaptation: A systems thinking approach, National Climate Change Adaptation Research Facility, Gold Coast, 66 pp.

Maguire, B. and Cartwright, S. 2008. Assessing a community's capacity to manage change: a resilience approach to social assessment. Canberra: Bureau of Rural Sciences.

Mason, MS, Phillips, E, Okada, T and O'Brien, J. 2012. Analysis of damage to buildings following the 2010–11 Eastern Australia floods, National Climate Change Adaptation Research Facility, Gold Coast, 95 pp.

Mccarthy, JJ, Canziani, OF, Leary, NA, Dokken, D & White, KS (eds.). 2001. Climate change 2001: Impacts, Adaptation and Vulnerability, Summary for Policymakers. Cambridge: Cambridge University Press.

Melaas, EK, Wang, JA, Miller, DL, and Friedl, MA. 2016. Interactions between urban vegetation and surface urban heat islands: a case study in the Boston metropolitan region. Environmental Research Letters, 11: 054020

Moser, S. 2008. Whether our levers are long enough and the fulcrum strong? Exploring the soft underbelly of adaptation decisions and actions, Proceedings of the Conference Living with Climate Change: are There Limits to Adaptation? Royal Geographical Society: London, UK.

Nicholls, L McCann, H Strengers, Y Bosomworth, K. 2017,' Heatwaves, Homes & Health Why household vulnerability to extreme heat is an electricity policy issue' Centre for Urban Research, RMIT University.

NOAA. 2017. Global Climate Report. Available from: https://www.ncdc.noaa.gov/sotc/global/201713

Olsson, P, Folke, C, and Berkes, F. 2004. Adaptive co-management for building resilience in social-ecological systems. Environmental Management 34: 75–90.

Rahmstorf, S, Cazenave, A, Church, JA, Hansen, JE, Keeling, RF, Parker, DE, and Somerville, RC. 2007. Recent climate observations compared to projections. Science, 316(5825), pp 709-709.

Repetto, R. 2008. The climate crisis and the adaptation myth. Working Paper 13, Yale School of Forestry and Environmental Studies, New Haven.

Richards, R, Sanó, M, Roiko, A, Carter, RW, Bussey, M, Matthews, J and Smith, TF. 2012. Bayesian belief modelling of climate change impacts for informing regional adaptation options. Environmental Modelling & Software, 44, pp 113–121. Available from: http://dx.doi.org/10.1016/j.envsoft.2012.07.008.

Robertson, Ivan T.; Cooper, Cary L.; Sarkar, Mustafa; Curran, Thomas. 2015. Resilience training in the workplace from 2003 to 2014: A systematic review. Journal of Occupational and Organizational Psychology. 88 (3): 533–562. doi:10.1111/joop.12120. ISSN 0963-1798

Steffen, R, Bouchama, A, Johansson, A, Dvorak, J, Isla, N, Smallwood, C, and Memish, ZA. 2012. Non-communicable health risks during mass gatherings. The Lancet infectious diseases, 12(2): 142-149.

Sustainability of Victoria. 2017. Victorians' perceptions of climate change. Report, 16 pp.

Sweet, WV, Kopp, RE, Weaver, CP, Obeysekera, J, Horton, RM, Thieler, ER, and Zervas, C. 2017. Global and regional sea level rise scenarios for the United States. NOAA Technical Report NOS CO-OPS 083

Tourism Economics. 2017. The Impact of Hurricane Irma on the Florida Tourism Economy. Prepared for Visit Florida.

Vandergert, P, Collier, M, Kampelmann, S, Newport, D. 2015. Blending adaptive governance and institutional theory to explore urban resilience and sustainability strategies in the Rome metropolitan area, Italy. International Journal of Urban Sustainable Development. Available from: http://dx.doi.org/10.1080/19463138.2015.1102726

Vincent, K. 2007. Uncertainty in adaptive capacity and the importance of scale. Global Environmental Change, 17(1), pp.12-24.

Webb, LB and Hennessy, K. 2015. Projections for selected Australian cities. CSIRO and Bureau of Meteorology, Australia

World Meteorological Organization. 2017. The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2016. WMO Greenhouse Gas Bulletin. Available from: https://library.wmo.int/opac/doc_num.php?explnum_id=4022

Woodroffe, CD, Cowell, PJ, Callaghan, DP, Ranasinghe, R, Jongejan R, Wainwright, DJ, Barry, SJ, Rogers, K and Dougherty, AJ. 2012. Approaches to risk assessment on Australian coasts: A model framework for assessing risk and adaptation to climate change on Australian coasts, National Climate Change Adaptation Research Facility, Gold Coast, 205 pp.

Yu Sheng, E, Nossal, K, Zhao, S, Kokic, P and Nelson, R. 2008. Exploring the feasibility of an adaptive capacity index using ABS data. ABARE and CSIRO Report for the National Land and Water Resources Audit, Canberra.

Appendix 1: Legislation

Public Health and Wellbeing Act 2008

The principles of *the Public Health and Wellbeing Act 2008* recognise that health is influenced by multiple factors ranging from the individuals themselves to the environment in which they live.

The Act requires municipal legislation to have regard to climate change – assistance with meeting obligations under the *Climate Change Act 2017*, with s. 14 identifying councils as one of the decision-makers that must consider climate change during the preparation of a municipal public health and wellbeing plan.

Catchment and Land Protection Act 1994

The *Catchment and Land Protection Act 1994* (CaLP Act) provides a framework for the management of land within Victoria. This includes the control of noxious weeds and pest animals. Under this legislation both public and private land holders must take reasonable steps to control noxious weeds and pest animals on their land. Changes in Hobsons Bay's ecosystem will change due to the increase in weeds and pest animals.

The Flora and Fauna Guarantee Act 1988

The *Flora and Fauna Guarantee Act 1988* is a key part of Victoria's legislative framework for the protection and management of biodiversity.

The Act's objectives aim to conserve all of Victoria's native plants and animals and establishes a range of mechanisms to achieve this objective, including:

- listing threatened species, communities and threats to native species
- requiring an overarching strategy for Victoria's biodiversity
- enabling the declaration of habitat critical to the survival of native plants and animals
- placing a duty on public authorities to have regard to the objectives of the Act in their operations
- requiring permits for activities that could harm threatened plants and fish and communities.

Environment Protection Act 1970

The 1970 Act provides a legal framework to protect the environment in the State of Victoria. It applies to noise emissions and the air, water and land in Victoria, the territorial sea along the Victorian coast and to the discharge of waste to the Murray River from any premises in Victoria.

Key aims of the Act include sustainable use and holistic management of the environment, ensuring consultative processes are adopted so that community input is a key driver of environment protection goals and programs and encouraging a co-operative approach to environment protection.

Emergency Management Act 2013

The *Emergency Management Act 2013* establishes Emergency Management Victoria (EMV) which leads emergency management in Victoria by maximising the ability of the emergency management sector to work together and to strengthen the capacity of communities to plan for, withstand, respond to and recover from emergencies.

Appendix 2: Progress of the risks identified in the Climate Change Adaptation Plan 2013-2018

Adaptation actions in the CCAP 2013-18 that have not been completed.

Adaptation action	Council division responsible	Time Frame	Complete?
Provide increased education and communication with sporting clubs and the community on climate change hazards.	Infrastructure and City Services	2 years	No
Review and update the Asset Management Plan for buildings to take climate change impacts into consideration (including structural, mechanical and electrical services).	Infrastructure and City Services	2 years	No
Incorporate potential climate change impacts into the normal review of licences and leases for the Council's assets/services.	Infrastructure and City Services	2 years	No
Undertake (or obtain data from the state or national government if available) detailed analysis of future water and energy price trends so that they canbe incorporated into future budget projections.	Infrastructure and City Services	2 years	No
Review and incorporate climate change risks into the Street Tree Asset Management Plan (STAMP).	Infrastructure and City Services	2 years	No
Integrate best available climate change projections and consideration into capital works projects/planning and design to help manage insured risks.	Infrastructure and City Services	2 years	No
Review and update existing planning overlays including Land Subject to Inundation Overlay (LSIO), Special Building Overlays (SBO) and Flood Overlays to take into account future flood conditions.	Strategic Development	2 years	No
Review Community Services Infrastructure Plan to assess the need to consider sea level rise and storm surge impacts on community facilities.	Infrastructure and City Services	3-7 years	No
Investigate alternative forms of planning controls (e.g. design and development overlays).	Strategic Development	3-7 years	No
Review and update existing safe work guidelines, procedures and training for the Council's staff to take into account additional and/or new risks arising from climate change.	Corporate Services	3-7 years	No
Investigate, identify and secure alternative sites for relocation of coastal assets.	Infrastructure and City Services	7+ years	No

Build a business case for a more frequent maintenance and inspection regime for stormwater and drainage networks.	Infrastructure and City Services	7+ years	No
Continue to monitor Council's long term financial plan to ensure changes to operating cost are incorporated*	Finance		No
Increase membership and involvement in advocacy groups to facilitate the Council's climate adaptation efforts.	All	2 years	Yes
Undertake a detailed coastal vulnerability assessment to identify locations most vulnerable to sea level rise, storm surge inundation and erosion and developa long term management plan that considers avoiding (e.g. setbacks from the coast), adapting (e.g. raising building and infrastructure heights), defending (e.g. beach stabilisation, nourishment, restoration, groynes), and retreating (e.g. purchasing land to move development back from the shoreline). This may be undertaken with other stakeholders, including state government and the Associationof Bayside Municipalities.	Infrastructure and City Services	2 years	Yes
Active review of new technologies/ best practice for replacement plant and materials at the Council's facilities to ensure they are best able to cope with extreme weather conditions.	Infrastructure and City Services	2 years	Yes
Review, and where appropriate, increase resources for the resurfacing of Council-owned roads.	Infrastructure and City Services	2 years	Yes
Further examine the Council's legal liabilities of flood-related climate change.	Strategic Development	2 years	Yes
Review, update and implement the Business Continuity Plan (BCP) to ensure the Council has capacity during extreme events.	Corporate Services	2 years	Yes
Increase awareness and education of the 'heat list' to vulnerable members of the community.	Strategic Development	2 years	Yes
Review Heat Health Plan to include communication measures with the economically disadvantaged.	Strategic Development	2 years	Yes
Improve, promote and support sharing of information around 'at risk' members of the community with service providers and the state government.	Strategic Development	2 years	Yes
Increase public awareness, community education, and neighbour caring during extreme events to increase community resilience.	Strategic Development	2 years	Yes
Review current Council policies relating to the maintenance of sports ground and play areas during extreme, dry weather (focusing on surface hardness and potential risk or injury).	Infrastructure and City Services	3-7 years	Yes

Review and extend the Council's *Water Action Plan 2009-2014* to include sports grounds.	Infrastructure and City Services	3-7 years	Yes
Incorporate climate change risk into the review of Asset Management Plans.	Infrastructure and City Services	3-7 years	Yes
Develop an alternative venue strategy for temporary disruptions (which are incorporated into user agreements).	Infrastructure and City Services	3-7 years	Yes
Incorporate new proven technology into the Council's buildings (e.g. air-conditioning).	Infrastructure and City Services	3-7 years	Yes
Employ CCTV pipe condition assessment program as part of the Asset Management Plan for the drainage network.	Infrastructure and City Services	3-7 years	Yes
Increase intervention levels to remove identified hazard trees.	Infrastructure and City Services	3-7 years	Yes
Where appropriate, consider drought tolerant species for planting and revegetation of Council-managed open spaces and recreation grounds.	Infrastructure and City Services	3-7 years	Yes
Develop a central water irrigation and monitoring control system.	Infrastructure and City Services	3-7 years	Yes
Advocate for (and where possible undertake in concert with regional partners) comprehensive, scenario- based, coastal vulnerability assessments which include sea level rise, coastal processes, erosion mapping, hazard and risk assessment for the entire Port Phillip Bay	Strategic Development	3-7 years	Yes
Investigate whether the Council has a staff policy or ability to change work rosters according to extreme weather conditions.	Corporate Services	3-7 years	Yes
Ensure climate change consideration is applied to the planning and management of all new, and replacements of existing, foreshore infrastructure and assets.	Infrastructure and City Services	7+ years	Yes
Review funding requirements for major repairs and maintenance works in light of changing climatic conditions.	Infrastructure and City Services	7+ years	Yes
Continue to work with insurers and brokers on the adequacy of insurance policies based on detailed analysis of climate change risks.	Corporate Services	7+ years	Yes
Increase the use and/or purchase of smart water meters for the Council facilities.	Infrastructure and City Services	7+ years	Yes
Raise coastal retaining structures in the next 10-20 years.	Infrastructure and City Services	7+ years	Yes

*action in Section 4.5 of adaptation plan

Appendix 3: Evaluation of Climate Change Adaptation Plan 2013-18

On 6 September, 2018, 12 survey questions were sent out to owners of the climate change risks in the Risk Register. The aim of the questions was to determine the owner's awareness of Council's *Climate Change Adaptation Plan 2013-18*, awareness of the climate change adaptation risks, understanding of reporting requirements associated with the Risk Register, and ability to manage the risk.

These questions are:

1. Were you and your team involved in the development of the adaptation actions? If so, how?
2. Do you use or refer to the Climate Change Adaptation Plan 2013-18 in your role? If so how? If not, why not?
3. What assistance do you need to fully understand the adaptation risks assigned to you?
4. What has been your experience implementing the adaptation risks? Do the actions based off of the risks feel integrated into your work plan or do you consider then an addition to your core work?
5. What would help you make the long-term adaptation actions more integrated into your work plan?
6. Besides the Risk Register, is there another process where you report on the progress of monitoring the risks and adaptation actions?
7. What are some ways the Sustainability Team can streamline reporting of the review process?
8. Did you have the capacity (i.e. knowledge, time, funding etc.) to successfully deliver your adaption actions based off of the risks? If no, what support do you need in the future to successfully deliver actions?
9. What (if any) barriers did you encounter that prevented and limited the management of the climate change risks assigned to you?

Appendix 4: DEWLP's analysis of climate change adaptation governance

In 2017, the Department of Environment, Land, Water and Planning (DELWP) commissioned a baseline analysis looking at how climate change is considered across ten areas of corporate governance in Victorian councils.

The analysis was based on local government's publicly available information at July 2017. It does not capture all internal processes in Council that manage climate-related risk; however, it provides a starting point for understanding adaptation governance in Council, and opportunities for peer-learning to build capacity to consider climate risk.

Based on the evaluation from DEWLP, these are the recommendations they provided to us to significantly consider climate change in Council's governance:

Recommendation

Council Plan needs to have a very strong consideration of climate change

Climate change should be specifically mentioned in all Council. General terminology in the Council Plan should: acknowledge the need to manage both the direct and indirect effects of climate change, include resilience development in a carbon-constrained economy, and have a range of key performance indicators across all Council functions

Recommendation

Undertake a review of key financial planning documents and include general statements about climate change

Climate change is increasingly seen as a financial management issue. The cost of direct and indirect impacts will cascade through the economy and affect costs associated with a local government's activities and responsibilities.

Recommendation

Council should include climate change in asset management planning documents and/or policies

The asset management plan should require a detailed analysis of the exposure of all Council assets, quantify the number or extent of the exposure (e.g. kilometres of road exposed to sea level rise inundation), and state the value of that exposure.

Recommendation

Council should ensure that at least two elements of climate change are listed as an objective or desired outcome in the local element in the planning scheme (as well as having climate change in the introduction/ context)

Council should expand its consideration of climate change from issues associated with just hazards to broader indirect and environmental issues. These include considerations for water and food security, protection and enhancement of ecosystem services under a changing

climate, planning layers that identify and protect renewable energy resource sites, transition to low carbon economy.

Recommendation

The Municipal Emergency Management Plan should refer to climate change and have a comprehensive inclusion of climate change

Climate change needs to be considered in all elements of the Planning, Preparation, Response, Recovery (PPRR) process. An advanced emergency management plan will identify the changing landscape of risk under a changing climate. It is important to link emergency management planning with land use planning and align the considerations of climate change between these two areas.

Appendix 5: Climate Change Projections in Greater Melbourne

The projections are given for 20-year periods centred on 2030 (2020–2039) and 2070 (2060–2079). Changes are relative to the period 1986–2005. The projections are presented as a middle value (median) and a range that excludes the lower and upper 10% of results.[56]

Projections	2030 (RCP 8.5)	2070 (RCP 4.5)	2070 (RCP 8.5)
Average temperature (°C)	0.94 (0.63 to 1.29)	1.54 (1.17 to 1.88)	2.57 (2.05 to 3.13)
Average rainfall (%)	-1.66 (-12.23 to 3.01)	-3.05 (-16.17 to 4.56)	-4.68 (-23.38 to 4.48)
Evaporation (%)	4.3 (2.56 to 6.80)	6.31 (3.70 to 9.22)	10.87 (6.41 to 14.48)
Solar radiation (%)	2.09 (0.42 to 3.64)	2.42 (0.69 to 4.89)	4.09 (1.37 to 6.91)
Soil moisture (%)	-3.68 (-5.36 to 0.63)	-3.26 (-7.98 to -0.17)	-5.99 (-9.61 to -2.73)
Sea level (m)*+	0.12 (0.08 to 0.17)	0.32 (0.20 to 0.45)	0.39 (0.25 to 0.54)

* Sea level range shows 5th to 95th percentile
+Data for Williamstown, VIC

[56] Climate change projections in this data sheet have been generated by CSIRO on behalf of the Victorian Government, and are based on national projections released by CSIRO and the Bureau of Meteorology.

Appendix 6: Tree Canopy Cover

Benchmarking Australia's Urban Tree Canopy: An i-Tree Assessment

The report[57] aims to provide 139 Local Governments in urban and semi urban environments across Australia with an estimate of land surface cover in 2014.

Local Government	Tree Cover (%)
Wyndham	3.1
Brimbank	6.2
Melton	6.3
Maribyrnong	7.4
Hobsons Bay	7.6
Moonee Valley	11.9

Metropolitan monitoring and analysis of vegetation cover, heat and land use in 2018

This project is part of DELWP's work plan to facilitate adaptation through the planning system. The report shows canopy cover across Melbourne, broken down by municipality and land type (residential, open space, streets and so on). It shows that streets can be very significant contributors to canopy cover.

Tree Canopy Cover by local government

Local Government	Trees 3 to 10 m (ha)	Trees 10 to 15 m (ha)	Trees 15+ m (ha)	Total Trees (ha)	Trees 3 to 10 m (%)	Trees 10 to 15 m (%)	Trees 15+ m (%)	Total Trees (%)
Moonee Valley	326	62	21	**409**	7.6	1.4	0.5	**9.5**
Maribyrnong	191	34	14	**238**	6.1	1.1	0.4	**7.6**
Brimbank	549	135	104	**788**	4.4	1.1	0.8	**6.4**
Hobsons Bay	277	47	13	**337**	4.3	0.7	0.2	**5.2**
Melton	542	160	72	**774**	3.2	1.0	0.4	**4.6**
Wyndham	570	101	49	**720**	2.5	0.5	0.2	**3.2**

[57] Jacobs et al., 2014

Vegetation Area (ha) in Western Region

Land Use	Grass (ha)	Shrubs (ha)	Trees 3 to 10 m (ha)	Trees 0 to 15 m (ha)	Trees 15+ m (ha)	Total Trees (ha)	Total Vegetation (ha)	Total Land Area within Study (%)
Residential	1,934	1,124	821	79	20	920	79	17788
Commercial	65	21	31	11	4	46	11	1,125
Industrial	520	131	113	30	19	162	30	7,497
Parkland	1,457	404	333	122	82	537	122	6,956
Education	122	29	49	16	6	72	16	1,130
Hospital/Medical	3	2	2	0	0	3	0	54
Transport	74	20	16	3	1	20	3	668
Other	354	83	102	39	35	177	39	4,211
Water	6	2	1	0	1	2	0	149
Agricultural	1,421	544	510	149	74	733	149	17402
Linear Infrastructure	804	246	475	89	30	595	89	8,347
Total	**6,760**	**2,605**	**2,454**	**539**	**274**	**3,267**	**12632**	**65325**

Vegetation Cover (%) in Western Region

Land Use	Grass (%)	Shrubs (%)	Trees 3 to 10 m (%)	Trees 10 to 15 m (%)	Trees 15+ m (%)	Total Trees (%)	Total Vegetation (%)
Residential	10.9%	6.3%	4.6%	0.4%	0.1%	5.2%	22.4%
Commercial	5.8%	1.9%	4.1%	2.7%	1.0%	4.1%	11.8%
Industrial	6.9%	1.8%	2.2%	1.5%	0.4%	2.2%	10.8%
Parkland	20.9%	5.8%	7.7%	4.8%	1.8%	7.7%	34.5%
Education	10.8%	2.5%	6.4%	4.4%	1.4%	6.4%	19.7%
Hospital/Medical	4.9%	3.2%	5.5%	4.3%	0.8%	5.5%	13.6%
Transport	11.1%	2.9%	2.9%	2.3%	0.4%	2.9%	17.0%
Other	8.4%	2.0%	4.2%	2.4%	0.9%	4.2%	14.6%
Water	4.1%	1.5%	1.3%	0.5%	0.1%	1.3%	7.0%
Agricultural	8.2%	3.1%	4.2%	2.9%	0.9%	4.2%	15.5%
Linear Infrastructure	9.6%	2.9%	7.1%	5.7%	1.1%	7.1%	19.7%
Total	**10.3%**	**4.0%**	**3.8%**	**0.8%**	**0.4%**	**5.0%**	**19.3%**

Appendix 7: Calculating Land Surface Temperature

To calculate surface temperature within Hobsons Bay City Council, we calculated land surface temperature using NASA's LANDSAT satellite infrared band in QGIS. Land surface temperature (LST) estimates were produced from freely available Landsat 8 satellite data. Landsat 8 passes over each location approximately every 16 days; in Australia these overpasses occur at around midnight UTC (8am AWST, 9:30am ACST, 10am AEST). Thus for each location there were multiple opportunities for Landsat 8 to collect viable data within the target window (2013, 2015, and 2018). The amount of viable data actually collected varied with based on the effects of cloud cover.

The first step of the algorithm is the input of Band 10. After inputting band 10, in the background, the tool uses formulas taken from the USGS web page for retrieving the top of atmospheric (TOA) spectral radiance ($L\lambda$):

$$L\lambda = M_L * Q_{cal} + A_L - O_I,$$

where M_L represents the band-specific multiplicative rescaling factor, Q_{cal} is the Band 10 image, A_L is the band-specific additive rescaling factor, and O_I is the correction for Band 10.

After the digital numbers (DNs) are converted to reflection, the TIRS band data should be converted from spectral radiance to brightness temperature (BT) using the thermal constants provided in the metadata file. The following equation is used in the tool's algorithm to convert reflectance to BT:

$$BT = K_2 / (\ln[(K_1 / L\lambda) + 1] - 273.15$$

where K_1 and K_2 stand for the band-specific thermal conversion constants from the metadata.

For obtaining the results in Celsius, the radiant temperature is revised by adding the absolute zero (approx. −273.15°C).