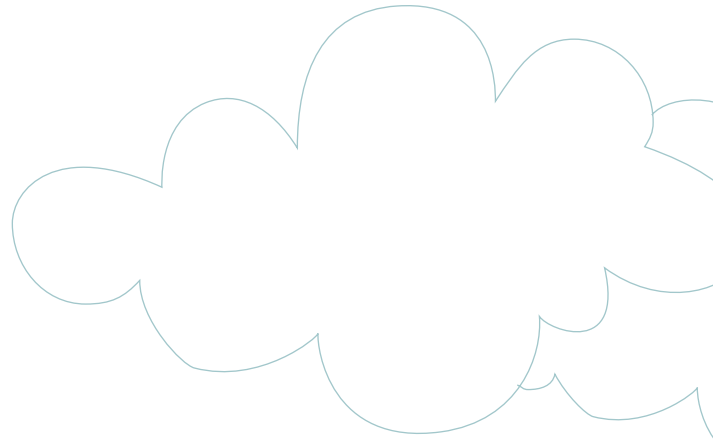


A public discussion paper prepared by the Queensland Government



Climate Smart Adaptation

What does climate change mean for you?



Officers of the Department of Natural Resources and Mines prepared this publication with contributions from the Environmental Protection Agency, Department of Energy, Queensland Health, Department of Housing, Department of the Premier and Cabinet, Department of Local Government, Planning, Sport and Recreation, Department of Primary Industries and Fisheries, Department of Public Works, Queensland Transport, Department of Emergency Services, Queensland Police Service, Department of State Development and Innovation, and the Department of Tourism, Fair Trading and Wine Industry Development.

It is for general information only, and does not purport to be either legal or expert advice. Readers are therefore warned against relying solely on this information when making decisions.

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Readers should be aware that some information might be superseded with further scientific studies and evolving technology and industry practices.

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QNRM05351
ISBN 1 921062 83 5

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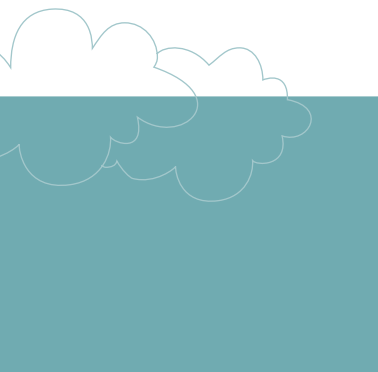
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Ministers' message

Queensland has an enviable lifestyle and economy, and a great natural environment—and much of it is due to our climate.

Our climate, however, is changing. Queensland has become hotter and drier, particularly since 1950, and science suggests this trend will continue, which may seriously affect this great State.

The changes observed over the last century cannot be explained by natural influences alone. Human activities are helping to change our climate. Increased levels of greenhouse gases in the atmosphere and other influences such as ozone depletion, dust, air pollution and land clearing all played a part.

Queensland's climate could be more variable and extreme in the future, with more droughts, heatwaves and heavy rainfall. Maximum temperatures and heavy downpours will probably be beyond our current experiences, which will make our State's climate different from the one we currently enjoy.

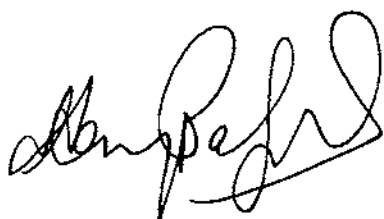
The Queensland Government released the *Queensland Greenhouse Strategy* in 2004 as a framework for reducing greenhouse gas emissions and managing climate change impacts. The objectives of the strategy are to:

- Foster greater knowledge and understanding of greenhouse issues and climate change impacts;
- Reduce greenhouse emissions throughout Queensland, and facilitate carbon sequestration; and
- Help Queenslanders adjust to the environmental, social and economic impacts that climate change might cause.

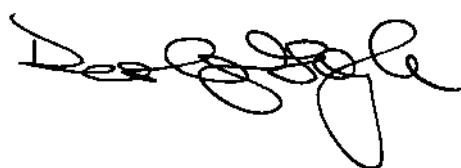
Greenhouse gas emissions and the impacts of climate change are worldwide problems that cannot be solved by government alone. We must all work together on this issue.

Through sensible adjustments we can maintain Queensland's lifestyle and ensure the State remains socially and economically prosperous. We can also exploit the opportunities presented by climate change, if we adopt an attitude that is open to change, creativity and innovation.

Climate Smart Adaptation is an opportunity for Queenslanders to share their views on how we should prepare ourselves for climate change. We encourage you to read this discussion paper and share your views and ideas so that our economy remains vibrant, and we preserve our State's great natural environment and enviable lifestyle for future generations.



Henry Palaszczuk MP
Minister for
Natural Resources and Mines



Desley Boyle MP
Minister for
Environment, Local Government, Planning and Women

Why was this paper released?

Climate is changing and the Queensland Government wants to work with Queenslanders to make the most of the opportunities it may present and reduce its negative impacts.

Climate Smart Adaptation is not Queensland Government policy and does not recommend specific solutions. It is the first step in working with Queenslanders to adjust to the social, economic and environmental impacts that climate change might cause.

Queensland's climate is one of the most variable in the world. Queenslanders often have to cope with droughts and floods, but changes have been observed since 1910—particularly since 1950—and these changes are expected to continue. The State's climate will remain highly variable and, if we implement responses that help us manage existing climate variability, we can benefit now, regardless of future climate change.

This discussion paper deals with climate change adaptation. It provides information about Queensland's future climate, and explores some of the possible impacts of climate change and some responses, but it does not deal with every possibility.

The Queensland Government would like feedback on how climate change might affect businesses, communities and individuals. It seeks ideas on what can be done to prepare for climate change, and how we can work together to benefit from it.

How can you get involved?

You can attend a climate change adaptation community meeting or lodge a submission with your views and ideas. There are some discussion points in this paper and on the response form; but you don't have to limit your comments to these. You can also comment on other adaptation issues that you consider important.

Your ideas will help shape the development of a Queensland climate change adaptation action plan during 2006. The action plan will complement the *Queensland Greenhouse Strategy*. It will focus on exploiting the opportunities created by climate change and include initiatives to help us adjust to the potential environmental, social and economic impacts of climate change. The action plan will be reviewed and updated as necessary because adaptation will be an ongoing process.

Details on where and when community meetings are being held, along with an electronic copy of this discussion paper and information on how to lodge a submission, can be found at: <www.getinvolved.qld.gov.au>.

If you do not have access to the internet you can call the Department of Natural Resources and Mines on (07) 3896 9742 and ask for a copy to be posted to you. You have until 3 March 2006 to lodge a submission.



How has Queensland's climate changed?

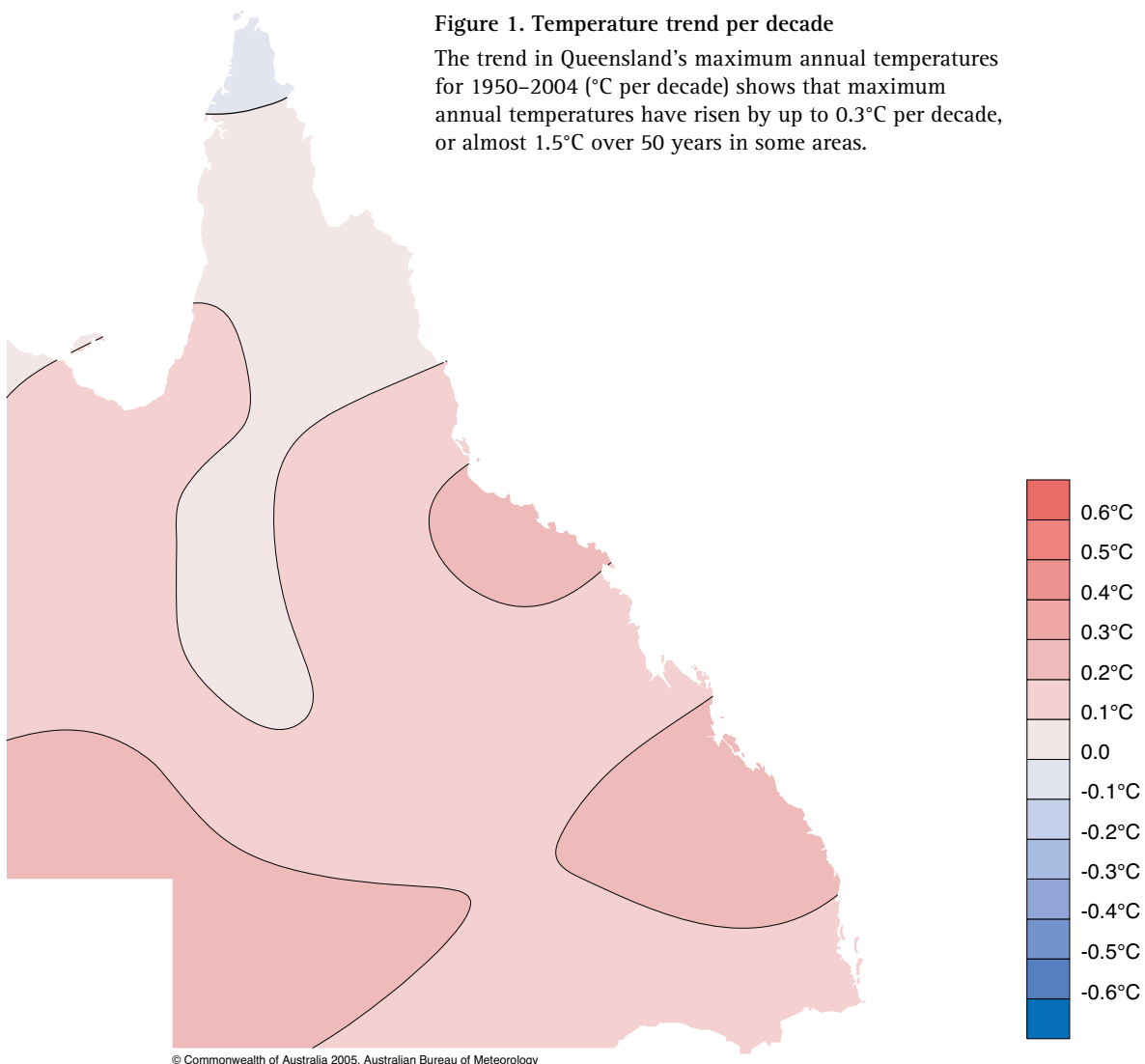
Queensland is getting hotter, and our temperatures are rising more rapidly than both the global and national averages.

Since 1950 annual average minimum and maximum temperatures have increased by 1.38 degrees Celsius (°C) and 0.8°C respectively in Queensland (figure 1). The difference between day and night temperatures has declined, and we are getting more extremely hot days (above 35°C) and fewer extremely cold nights (below 5°C).¹

We are getting less rain, especially in coastal areas south of Cairns. Coastal rainfall now falls in shorter, but more intense bursts. We are not getting as many tropical cyclones as we did in the past, but their intensity has increased slightly.

Figure 1. Temperature trend per decade

The trend in Queensland's maximum annual temperatures for 1950–2004 (°C per decade) shows that maximum temperatures have risen by up to 0.3°C per decade, or almost 1.5°C over 50 years in some areas.



© Commonwealth of Australia 2005, Australian Bureau of Meteorology

¹ Information about Queensland's climate trends is drawn from long-term observations collected by the Commonwealth Bureau of Meteorology

The changes observed over the past 50 years cannot be explained by natural influences alone, like the Sun's radiation and Earth's orbital changes. Science has found that increased levels of greenhouse gases in the atmosphere and other influences such as ozone depletion, dust, air pollution and land clearing all played a part.

The greenhouse effect is natural, but its influence on Queensland's climate will grow as global greenhouse gas emissions continue to rise.



For more on how Queensland's and Australia's climate has changed see:

[<www.bom.gov.au/silo/products/cli_chg>](http://www.bom.gov.au/silo/products/cli_chg)

Why is climate change important?

Climate change could make Queensland's climate more variable and extreme in the future, bringing more droughts, heatwaves and heavy rainfall. Our hot, dry years could be normal by 2030; maximum temperatures and heavy downpours will probably be beyond our current experiences.

Climate change directly and indirectly affects the natural environment, with flow-on effects to our social and economic systems. Our understanding of these relationships is still developing; but we do know that if current trends continue, it will affect more than the natural environment because many community and economic activities are climate sensitive.

Hotter summers and warmer winters will change cooling and heating requirements, which may mean that we will need to make homes and workplaces as energy efficient as possible (changing house designs and construction materials, adding insulation, planting trees for shade).

In a water-constrained future, increased water restrictions are also likely. Possible responses include using less water around the home and workplaces, and choosing water-efficient appliances.



For more about climate change see:

[<www.bom.gov.au/info/GreenhouseEffectAndClimateChange.pdf>](http://www.bom.gov.au/info/GreenhouseEffectAndClimateChange.pdf) or Commonwealth Bureau of Meteorology, 2003. *The Greenhouse Effect and Climate Change*; Canberra: Commonwealth of Australia

[<www.greenhouse.gov.au/science/faq>](http://www.greenhouse.gov.au/science/faq) or Australian Greenhouse Office, 2002. *Understanding Greenhouse Science: Frequently Asked Questions*; Canberra: Commonwealth of Australia

[<www.met-office.gov.uk/research/hadleycentre>](http://www.met-office.gov.uk/research/hadleycentre) (the Hadley Centre for Climate Prediction and Research)

[<www.ipcc.ch>](http://www.ipcc.ch) (the Intergovernmental Panel on Climate Change)

[<http://iri.columbia.edu>](http://iri.columbia.edu) (the International Research Institute for Climate Prediction)

What can we do about climate change?

Despite global efforts to reduce greenhouse gas emissions, some level of climate change is now inevitable and we will need to adapt the way we do things to maintain Queensland's lifestyle and ensure our social, economic and environmental wellbeing. Our first response must be to reduce greenhouse gas concentrations in the atmosphere because this is the only way we can lessen the rate and overall magnitude of future climate change. The State's approach to reducing greenhouse gas emissions is provided in the *Queensland Greenhouse Strategy*.

The second response is to learn to live in a changed climate—and that is the focus of this paper. This may involve adjusting our behaviour, and the design, location and delivery of social services and physical infrastructure. The way our environment is managed may also have to change. Adjustments could be made in response to change that has actually occurred, or in anticipation of a projected change in climate.

The *Queensland Greenhouse Strategy* defines climate change adaptation as:

... any adjustment activity to respond to anticipated or actual consequences associated with climate change; for example, a flood-mitigation plan.

Many Queenslanders already make adjustments in response to very hot, dry or wet conditions; adapting to climate change is an extension of this process. Our ability to manage a variable climate puts Queensland in a better position to manage climate change.

State Coastal Management Plan

The State Coastal Management Plan provides the direction for coastal management in Queensland. The plan identifies four target areas for climate change: avoidance of development on vulnerable areas; improved knowledge and understanding of climate change; assessments of impacts and vulnerability; and incorporating adaptation strategies into coastal planning and management.

Planning for the coast must address the potential impacts of climate change through the following hierarchy of approaches:

- Avoid—focus on locating new development in areas that are not vulnerable to the impacts of climate change;
- Planned retreat—focus on systematic abandonment of land, ecosystems and structures in vulnerable areas;
- Accommodate—focus on continued occupation of near-coastal areas; and
- Protect—focus on the defence of vulnerable areas, population centres, economic activities and coastal resources.



Managing climate-related risks is not new. Climate is often considered in decisions, and many Queensland businesses are experienced in managing climatic variability and extreme weather. Future climatic conditions, though, are likely to be well beyond our current experiences, so it is time for us all to start thinking about climate change. The way we currently do things and make decisions may no longer be suitable, and could cause costly problems in the future.

Adaptation includes seizing opportunities that arise from climate change. Queensland is well positioned to be a future exporter of climate change adaptation knowledge, skill and technologies. Innovators in service and technology-based industries might have an opportunity to develop and export new goods and services, especially in the areas of water, energy and resource efficiency.

All Queenslanders are responsible for adaptation. Some of us have already started to adapt to climate change by reducing water and energy use. Simple measures such as not irrigating or hosing in the heat of the day are adaptation responses that are easy and quick to introduce. Others such as decisions about regional water supply and storage are more complex and will take longer.



For more about Queensland's effort to reduce greenhouse gas emissions see:

www.epa.qld.gov.au/environmental_management/sustainability/greenhouse

Why should we act now?

If we don't plan for climate change, we will miss new opportunities—the chance to develop leading technology and the know-how to run sustainable businesses in a hotter and drier future.

If we put off taking action, we could affect our future ability to adapt to climate change. Early action will make us less vulnerable and help to limit the potentially higher costs of future climate change. Many adaptation actions can also benefit us now, regardless of future climate change.



How will Queensland's climate change?

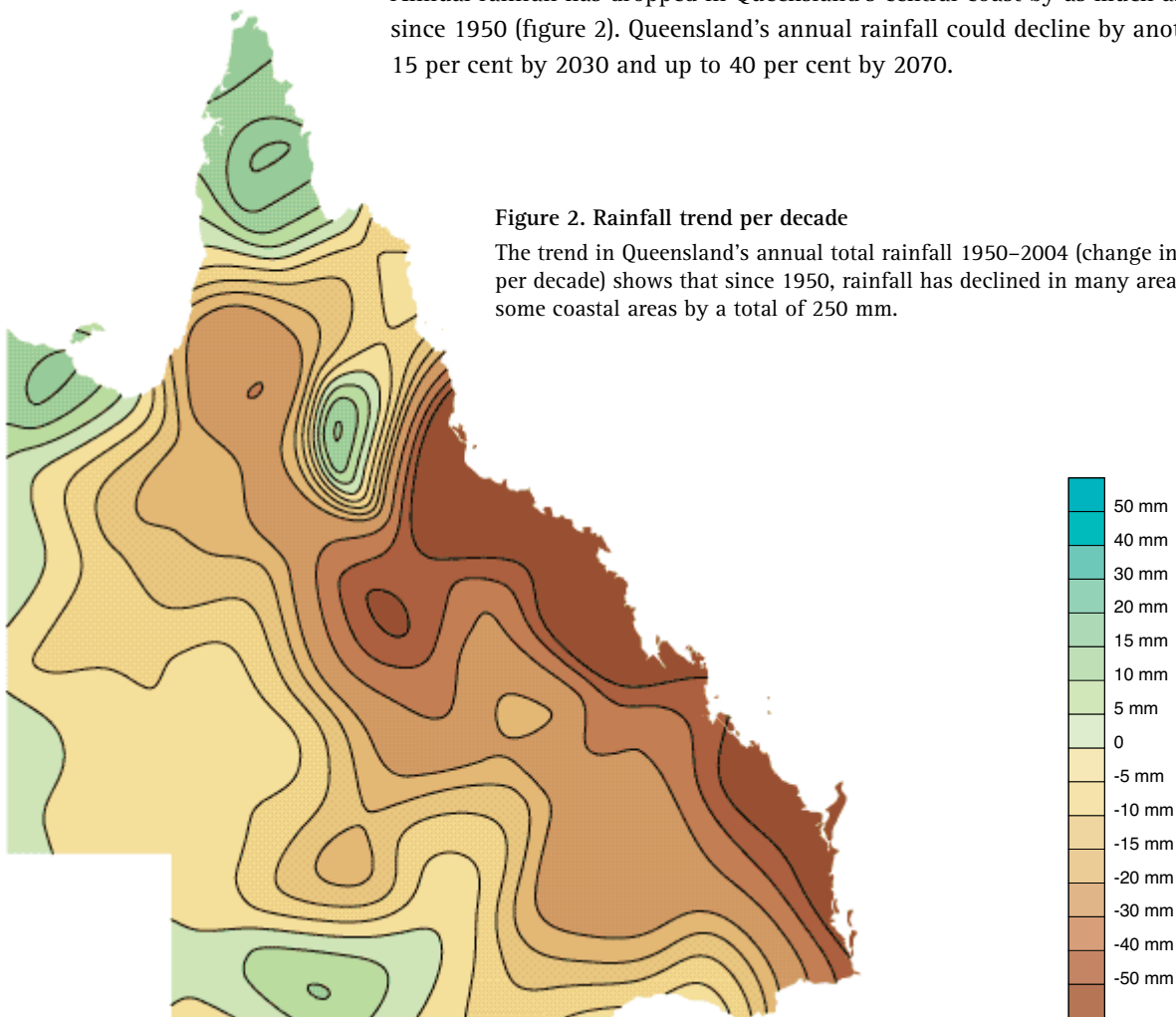
We expect our climate to continue to change throughout this century because the atmosphere already has elevated levels of greenhouse gases.

We know that Queensland is warmer and drier than 50 years ago. The latest projections suggest Queensland will get hotter, our nights will be warmer, and we will have fewer frosts.²

Annual average temperatures could increase up to 2°C by 2030 and up to 6°C by 2070. We are likely to have twice as many extremely hot days, longer hot spells (three or more days above 35°C), more heatwaves, and higher bushfire risk.

These changes may seem small, but change of this magnitude over what is a relatively short period of time is unprecedented.

Annual rainfall has dropped in Queensland's central coast by as much as 250 mm since 1950 (figure 2). Queensland's annual rainfall could decline by another 15 per cent by 2030 and up to 40 per cent by 2070.



© Commonwealth of Australia 2005, Australian Bureau of Meteorology

² Climate change projections for the State are prepared for the Queensland Government by CSIRO

As our rainfall declines and temperatures increase over the next 25 years, we may have more droughts. Hotter and windier conditions could increase evaporation by as much as 18 per cent, reducing soil moisture.

We could also have more bursts of heavy rainfall that can dump 900 mm of rain in a day instead of the 700 mm that can happen now. These extreme weather events would increase the risk of flash flooding, landslides and severe erosion.

There have been fewer tropical cyclones in the Australian region since 1960, but cyclone intensity has increased slightly. This trend could continue, possibly increasing maximum wind speeds by 5–10 per cent by 2050. More intense tropical cyclones and rising sea levels will increase storm surge risk along Queensland’s coast.

The result of these changes will mean that in the next 25 years Brisbane’s average climate will be more like that of Rockhampton, Mackay’s climate will be more like that of Townsville, and Longreach’s climate will be more like that of Winton.

Wave and storm-tide monitoring

The Queensland Government operates a network of wave and storm-tide monitoring systems along the Queensland coastline. The information from these monitoring systems is used to better understand and plan for future threats and impacts from extreme weather events such as tropical cyclones.



Extreme weather

Small changes in average conditions can have a big influence on the extremes. For example, the Rockhampton area has generally had four additional hot days a year (maximum above 35°C) since 1940 due to a small increase in average temperature (about 1°C since 1910). The average number of extremely cold nights per year (minimum below 5°C) has declined by 10 nights. These changes are most noticeable since 1970, and the trend is expected to continue across Queensland as shown in tables 1 and 2.

Table 1. Projected number of summer nights (Dec–Feb) with maximums above 35°C

	Brisbane	Townsville	Cairns	Barcaldine
Present	3	2	3	55
2030	3–6	2–9	3–8	57–69
2070	4–35	4–75	5–76	61–84

Table 2. Projected number of winter nights (Jun–Aug) with minimums below 0°C

	Dalby	Stanthorpe	Charleville	Tambo
Present	10	37	12	17
2030	3–7	24–33	4–10	7–14
2070	0–6	4–31	0–8	0–11



Certainty in projections

Climate change projections are developed from a range of computer-based models of global climate, and scenarios of future global greenhouse gas emissions. There are uncertainties in both of these, especially for 2070 because it is harder to predict global greenhouse gas emission rates that far into the future. Therefore, we are more certain about the projection range for 2030 than for 2070. Table 3 shows current levels of confidence in future climate projections.

Table 3. Climate change uncertainties

There is more confidence in temperature projections than rainfall projections because there is a direct relationship between atmospheric greenhouse gas concentrations and temperatures.

Very high confidence

- Higher temperatures and changes in extreme temperatures
- Global sea-level rise
- Declining soil moisture

High confidence

- Direction of rainfall change (decreasing)
- Increasing potential evaporation (actual depends on many factors)
- Increasing storm-surge heights and the risk along the east coast of Queensland
- Increasing cyclone intensity
- Increasing temperatures at the regional scale, including extremes

Medium to high confidence

- Increased risk of bushfire
- Increased incidence of extreme rainfall

Moderate confidence

- Overall amount of rainfall decline and seasonality of that change
- Changes in average stream flow
- Increased drought

Low confidence

- Abrupt or irreversible changes such as melting of polar ice sheets and changes in global ocean currents



For more about climate change projections for Queensland see:

www.longpaddock.qld.gov.au/ClimateChanges/pub/CSIRO2003.html

Regional differences

The nature, rate and extent of climate change will differ across the State. When combined with variations in population, development and natural resources, there will be regional differences in vulnerability to climate change.

Far North Queensland

The region is one of the most biodiverse in the country. Unique environments such as the World Heritage-listed Wet Tropics and Great Barrier Reef attract many tourists. These natural environments have evolved within a certain climatic range, and are sensitive to relatively small changes in temperature.

The far north coast is likely to experience an increase in rainfall intensity and the region may actually get more summer rain. Its major towns, infrastructure and resorts are in low-lying coastal areas that will become increasingly vulnerable with higher flood or storm-surge levels.

Increased incidences of extreme weather and flooding could make isolated communities in the far north and Torres Strait inaccessible more often. This situation would disrupt the supply of essential services and the ability to quickly restore infrastructure. Changes in rainfall and hotter temperatures could also increase the risk of water, food and vector-borne diseases. Due to their isolation, some adaptation responses or technologies may not be available.

Regional assessment for Cairns–Great Barrier Reef

A potential regional-scale assessment of the Cairns–Great Barrier Reef area will examine the impacts of climate change and other drivers of social, economic and environmental change. Possible adaptation responses would be part of the assessment. The Australian Greenhouse Office, CSIRO, Australian Institute of Marine Science, James Cook University, the Great Barrier Reef Marine Park Authority, and the Queensland Government are exploring partnership options.



Central Queensland

This part of the State has experienced the strongest drying trend over the past 50 years, and it is projected to continue. A strong decline in rainfall and increased evaporation will affect soil moisture and the availability and quality of water. Much of the State's agricultural, industrial and mining activity is located in central Queensland, and these activities depend on water.

Emerald irrigation system improved

SunWater is lining a 22-kilometre stretch of an Emerald irrigation channel with high-density black plastic to reduce the amount of water lost through seepage. It will save up to 7500 megalitres of water a year. The water saved will be available to SunWater customers through trading, and the revenue generated will help pay for the project. SunWater is also introducing computer technology to more accurately and efficiently manage water distribution.



Western Queensland

Warming is projected to be the strongest in this region, particularly in the southwestern part of the State. A strong decline in rainfall and increased evaporation will affect water quality and its availability, as well as soil moisture. There may be more severe droughts and heatwaves and, when rain does fall, more flooding. These will potentially affect the region's productivity and social cohesion.

Settlement is scattered, populations are declining, and the region largely depends on agricultural activities. Some communities depend on natural resources that are already managed near their sustainable limit. Roads and other transport services are crucial to western Queensland's social and economic wellbeing. More intense rainfall events will periodically cut off provisions and services, and hinder restoration of damaged infrastructure.

Making rural Queensland more resilient

Blueprint for the Bush is a partnership between AgForce and the Queensland Government to develop a 10-year plan that helps rural and remote communities and industries manage change and bolster the strength and resilience of rural Queensland. Resilient communities will be more able to adapt to the environmental, social and economic impacts that climate change might cause.



Southeast Queensland

Southeast Queensland has experienced a marked drying trend since the 1950s and also an increase in intense rainfall events, which is consistent with projections for the future. The number of days over 35°C is expected to increase in future, and this will affect peak energy demand.

More than a quarter of all population growth in Australia over the next 25 years is expected to be in this corner of Queensland. The combined effects of rapid population growth and climate change will be a major challenge. There will be pressure to develop in areas prone to natural hazards, such as low-lying coastal areas.

The design, location and delivery of services and infrastructure to support this population and associated economic growth will need to factor in climate conditions over the next 70 to 80 years. Adaptation responses will need to consider energy and water supply and demand, and housing that is more sustainable and better suited to changed climatic conditions.

Planning for Southeast Queensland

The Southeast Queensland Regional Plan 2005–2026 provides the framework for the State and local governments to work together to manage population growth and development in the region, including a specific requirement to consider climate change. Many of the approaches promoted in the plan will better position the region for climate change, and respond to a broad range of social, economic and environmental challenges facing the region.

The Southeast Queensland Infrastructure Plan and Program 2005–2026 supports the Regional Plan. It identifies a need to diversify water supplies and more efficient management and use of water as regional priorities for climate variability, climate change and other supply risks.



How will climate change affect Queensland?

The potential impacts of climate change are far-reaching because it is a global issue that will affect economies and societies everywhere—not just Queensland.

Many of Queensland's community and economic activities, and much of the State's natural environment are climate sensitive. How climate change affects you will depend on where you live and work and how you spend your spare time.

As Queensland becomes hotter and drier, with more extreme weather events, we will need to make adjustments to the way we do things. Housing types, crops and fisheries management, business hours and operating practices, and the timing and venues for sports activities and holidays may need to be adjusted.

Changes in the frequency and intensity of severe weather are expected to be more important than changes in average conditions. As well, if climate change occurs faster than we are able to adapt, our vulnerability to the impacts of climate change will increase. There is also a possibility of 'surprises' because climate systems are complex and change does not occur in a steady or linear way. We are also still learning how social, economic, physical and biological systems are likely to respond.

The implications of climate change for our built and natural environments depend on their vulnerability—that is, how sensitive they are to even small changes, how exposed they are, and whether they can adapt.

Some places will be more exposed than others. Low-lying coastal areas will be more vulnerable to sea-level rises, storm surges, flooding and erosion during extreme rainfall. Activities that occur over large areas and have long life spans will become more vulnerable as the climate changes. Pipes, drains, power lines, bridges and other major facilities for towns and suburbs are built to last a long time. They may not be at risk now, but they might need to withstand more extreme weather in the future.

Some parts of the natural environment may not be able to cope with climate change. The natural environment will be less able to adapt if it is polluted and fragmented. The new climate may not suit some ecosystems, and species that are climate-sensitive may disappear.

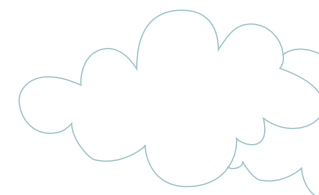


Farm sustainability and profitability

The Queensland Farmers' Federation and the Queensland Government are working together on a Farm Management Systems (FMS) approach for the intensive farming sector. This approach will help individual property owners to integrate business and natural resource management practices so that farming enterprises become more sustainable and more profitable. FMS involves identifying risks, including environmental risks such as climate change and variability, implementing appropriate management practices, and monitoring performance. In this way farmers will be better prepared to adjust to climate change.



Activities that rely on the sensitive natural environments such as dry-land agriculture, grazing on native pastures, and ecotourism operations will be more vulnerable to climate change. In agricultural areas, farmers may have to adjust what they produce and how they produce it. This could affect rural communities and the economy.



Human activities are generally more able to adapt to a changing climate, and science and technology can help.

Trends such as population growth, an aging community, pollution, increasing demand for resources, and world trade and market fluctuations can compound the impact of climate change. But some trends will bring benefits; for example, a shift in the global demand for goods and services could favour Queensland and improve our terms of trade.

To create opportunity from climate change we need a clear understanding of some of the opportunities and challenges presented by climate change. The following sections provide an overview of climate change vulnerabilities, likely impacts and possible responses.

Many actions that are being implemented now are already preparing Queensland for climate change, even if they are not branded as adaptation responses.



For more about climate change impacts see:

www.greenhouse.gov.au/science/guide

www.longpaddock.qld.gov.au/ClimateChanges/pub

http://climatechange.unep.net/index.cfm?issue=climate_intro



People

Increases in the intensity of extreme climatic events such as heatwaves, storms and tropical cyclones will increase the risk of personal injury, particularly in major population centres. The buildings we live and work in and the cost and availability of services and goods could change due to the flow-on effects of climate change.

Extreme heat

Additional days that are very hot, particularly consecutive days when nights stay hot will increase heat-related stress and illness.

The Queensland Government has a *Queensland Heatwave Response Plan* to help us cope with extreme heat events. It is a multi-agency emergency medical response plan targeted at community members at greatest risk, including the elderly living in their own homes, residents of nursing homes, residential care providers, and educators and school children. Information is also available about managing heat stress and illness in the workplace.

Hotter days will challenge school students, teachers and programs. The Queensland Government is committed to implementing new and innovative school designs that improve staff and student comfort. Schools already have some strategies to manage the heat, like rescheduling or postponing outdoor activities.



Managing heat stress at sports events

Sports Medicine Australia provides information to sporting organisations about preventing injury and possible death from heat illness in sport. It has helped many Queensland sporting organisations to implement extreme heat policies. The Bureau of Meteorology also assists by providing information on its website to calculate a Heat Index for Sport.

Disaster management

Natural disasters are a significant and rising expense for the Queensland community, costing about \$240 million per year. Areas prone to natural hazards (e.g. the coast and waterways, bushland and steep slopes) are being developed because of population growth and changing lifestyles. Additional development in the State's coastal zone will increase the vulnerability of many areas to inundation.

The projected increases in rainfall and tropical cyclone intensity have implications for personal injury, property damage, community services and infrastructure provision, and for



local emergency planning and response. Those most at risk from extreme events are remote communities that have limited services and infrastructure, and which can become inaccessible in bad weather.

There may be a greater risk of damage and service interruptions from extreme events, especially if a house is in a flood, storm surge or bushfire hazard area. Possible responses include good house and garden maintenance to limit wind damage, and regularly clearing leaf litter from gutters and drains. Uncertainties about the future risk of storms and hail make it difficult to develop appropriate adaptation responses for these events.

The Council of Australian Governments (COAG) reviewed natural disaster relief and mitigation in 2001–2002 and came up with a five-year reform agenda to better prepare Australia, build community resilience, and reduce the human and economic costs of natural disasters. Agreed mitigation measures include risk assessment, better land-use planning and development approval regimes, adding disaster resilience to infrastructure development, further research into building material and design features that withstand natural disasters, and improved public education, awareness and warning systems.

Natural hazard mitigation

State Planning Policy 1/03 (*Mitigating the adverse impacts of flood, bushfire and landslide*) seeks to influence land-use planning and development decisions to create, in the long term, settlement patterns that reduce community vulnerability. It guides local government decision-making about development applications in areas subject to natural hazards, and may require local government planning schemes to:

- Identify hazard-prone areas;
- Develop appropriate desired environmental outcomes and performance criteria for these areas;
- Apply appropriate development policies and standards to hazard-prone areas; and
- Identify and manage risks associated with natural disasters.



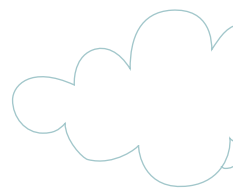
Diseases

Hotter weather increases the risk of food-related sicknesses. With less rain and runoff, water quality will decline and there will be a greater risk of water-borne diseases.

Changing temperature and rainfall patterns are likely to shift populations of mosquitoes and other vectors. This could change the incidence and location of existing vector-borne diseases (Dengue fever, Ross River virus and Japanese encephalitis) and increase the risk of new ones.

The incidence of these diseases can be minimised through an active community education program and by expanding current management services into new areas. Possible responses include better food hygiene, stopping water from pooling in the yard, screening the house, and using insect protection while outside.

Remote communities with limited infrastructure and access to health services are most at risk. Coastal and low-lying areas and communities not previously exposed to the diseases will also be vulnerable. The physical and social disruptions caused by these diseases (and extreme events) may affect community mental health.



Built environment

We generally spend more time in our homes and workplaces than outdoors, so changes to the built environment will be one of the most noticeable adaptations.

Rising temperatures, increases in extreme weather events and a decrease in available water will affect the built environment. Sustainable buildings are water and energy efficient, minimise waste, and are designed for safety and security. They are also more comfortable and cheaper to maintain and will be of benefit now as well as for future climate change.

The Queensland Government is working with research organisations to improve the sustainability of the built environment. Focus areas include indoor air quality, energy and water efficiency, improved materials and construction methods, climate-sensitive design, and reductions in greenhouse gas emissions.

Healthy home

The Healthy Home is a privately owned, water- and energy-efficient home at the Gold Coast. The house is designed to catch cooling breezes and has wide eaves to reduce sunlight on its walls. With solar hot water and a photovoltaic electricity generating system, the Healthy Home uses about half of the mains electricity needed to run an average Gold Coast home.

By 2030 the number of houses in the State will double, so the Queensland Government is moving to make new homes more sustainable. Stage one of the Queensland Government's *Sustainable Housing Policy* will be implemented by March 2006. This policy mandates the use of a range of energy- and water-efficient appliances and fixtures in new houses, units and townhouses and in some renovations. It also has a code that gives local government an option to require the installation of rainwater tanks in new houses. Stage two of the policy will examine a broader range of social and environmental issues.

Resource-efficient building design

William McCormack Place in Cairns is the first building in Queensland to receive a five-star energy rating. The Queensland Government worked with architects to maximise the energy, water and resource efficiency. The air-conditioning and electrical systems deliver maximum energy efficiency while being highly flexible and simple. The building is sealed to minimise leakage of conditioned air, saving about 360 tonnes of greenhouse gases a year. Energy efficient buildings not only reduce emissions, but also reduce electricity demand, which is expected to increase with higher temperatures. Water-efficient buildings are of benefit now in our variable climate but will be increasingly important in a water-restricted future.

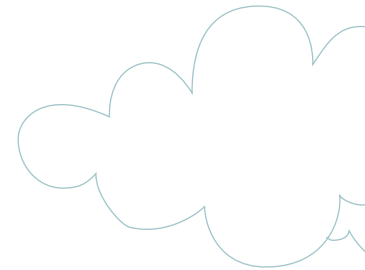


Industry and economy

Climate change can potentially affect many of the State's businesses, industries and economic growth. But it is also an opportunity to position the State as an exporter and world leader in climate change adaptation knowledge, skills and innovative technologies.

Climate- and weather-sensitive industries such as agriculture, tourism, mining and insurance will be most directly affected in the medium term, but over the longer term most industries will feel the effects. The reliability and cost of energy and water could change in the future, with vulnerability increasing in areas where there are competing demands. Changes in extreme events could increase interruptions to the supply of raw materials and the transport of products.

Climate change may influence the cost of doing business, change the attractiveness of the State for some industries, and affect regional development. Climate change is a global issue, so adaptation decisions and emerging opportunities will need to be built on an understanding of how Queensland businesses and industries are affected compared to what is happening around Australia and the rest of the world.



Exporting skills in water efficiency

Wide Bay Water Corporation is helping the city of Da Nang in Vietnam to improve its water reticulation network and save 13 million cubic metres of water being lost from Da Nang's water treatment plants (equivalent volume of 5200 Olympic swimming pools). It finished a detailed feasibility study in April 2005 and is about to trial a pressure reduction and leakage control program encompassing up to 5000 properties. Wide Bay Water Corporation also provides expert services and advice to more than 20 water authorities in Australia, China and South Africa.

Actions that businesses can implement include:

- Working to reduce greenhouse gas emissions across the full lifecycle of goods, products and services;
- Decreasing water use;
- Incorporating climate change considerations into business planning and decisions;
- Considering water efficiency and energy when leasing, building or renovating premises;
- Developing services, products and technologies that promote adaptation, such as water-use efficiencies; and
- Exploring new business opportunities.

Adaptation options will depend on local circumstances as well as changes in national and international demand for goods and services. Innovative and flexible management will enable business people to quickly adjust and make the most of emerging opportunities.



Agriculture

Agricultural industries are highly sensitive to climate variability. Enterprises most vulnerable to climate change will be those dependent on natural resources that are already being managed near their sustainable limit.

Hotter weather, less rainfall and carbon-dioxide fertilisation will affect plant growth and productivity, and may change native and cultivated pastures. There could be a shift in the distribution of existing pests, diseases and weeds, and new ones may appear.

Changes in growing periods, and the composition and quality of pastures and other feed such as grain, will affect animal production. Crops and horticulture will also be affected, and in some places the suitability of growing conditions for certain varieties may change.

Less rain and more evaporation will reduce available water and soil moisture, and the projected increases in extreme rainfall events will increase the risk of soil erosion. If hail increases in frequency, stone fruit and grape growers and the enterprises that depend on these fruits would be affected. On the flipside, a decline in frosts will present opportunities to plant better priced and more frost-sensitive horticultural crops. Hotter and drier summers could benefit the wine industry. The *Wine Industry Development Strategy* has factored in climate change to reduce the industry's vulnerability.



For more information on the Wine Industry Development Strategy see:

www.dtftwid.qld.gov.au/Wine/Wine+Strategy/Wine+Strategy.html

Adaptation will require changes in animal husbandry and animal-health management, crop choices, planting times, irrigation practices, and soil-cover management.

Soil cover will be increasingly important in minimising soil loss with the projected increase in heavy rainfall. Water use can be minimised by changing crops or growing varieties that use less water. Minimum till, soil mulching, drip irrigation and covering dams also cut water use. Providing shade will reduce heat stress in livestock.

Farmers work with Government on climate and water use

Queensland Government scientists are working with farmers to better manage the challenges of Queensland's highly variable climate. Work is focusing on predicting future stream flows and runoff based on the latest developments in climate forecasting. The project could result in improved drought management, more effective use of water resources for production, better planning for environmental management, and easy access to stream flow and runoff information for analysing risks in property and water management planning activities. This work is positioning the agricultural sector to better manage future climate conditions.





Tourism

Changes to the natural environment, extreme weather and health risks will affect tourism.

The most vulnerable parts of the industry will be those that rely on natural environments that exist in a narrow climatic range and are sensitive to relatively small changes in temperature—for example, reefs and tropical rainforests.

Coral bleaching on the Great Barrier Reef has forced some marine tourism operators to relocate to the less-affected outer reefs. The frequency of bleaching events is expected to increase, and tourism operators would need to increasingly use these outer reefs, which will affect trip timetables, costs and possibly their viability. At some dive sites one operator is testing the use of shade to reduce water temperature and bleaching.

The impact of climate change on land-based operations is less clear, with patchy knowledge about how it will affect various attractions and how quickly changes might occur. For example, the appeal of a particular forest might change if hotter, drier conditions result in changes to the ecosystem.

Increased water restrictions have implications for water supply, visitors' water use, and for how parks are maintained. While an increase in the number of dry days will help keep a steady flow of visitors, an increase in extreme rainfall events could mean greater disruptions to visitor numbers when these events occur.

There is not yet enough information on flood risk to know the implications for transport, accommodation and some attractions. But an increase in storm-surge risk and rising sea levels will put waterfront infrastructure (boat ramps and jetties, restaurants, accommodation and other buildings) at greater risk. Designs for hotels and visitor centres that create shade and cool buildings will be increasingly important in the hotter times ahead.

Ecotourism operations may be more vulnerable because they rely on the natural environment, which cannot quickly adapt to climate change. But ecotourism has the potential to lead the development of adaptation strategies with its underlying principles of sustainable technologies and better water and energy use. These could be applied to the broader tourism industry and the built environment.

Insurance

Climate change may affect the cost and availability of insurance. Population growth and development in areas that are increasingly prone to flooding or storm surge, and buildings no longer able to withstand increasing wind strength, add to the vulnerability of the insurance industry. This will affect householders and the community directly, and indirectly as businesses incorporate changed premiums into their costs.



'The international insurance industry has been confronted in recent decades with a dramatic increase in weather-related and climate-related catastrophe losses. If we compare the 1960s with the period between 1993 and 2002, we see that the number of major natural catastrophes (not including earthquakes) has increased by a factor of over three-and-a-half. After being adjusted for inflation, economic losses have increased by a factor of about six and insured losses by a factor of no less than ten.' (Munich Re – www.munichre.com)

Adaptation options include planning and building standards that reduce exposure to climate-related disasters, such as avoiding development in flood-prone areas, and ensuring buildings are rated for damaging wind speeds.

Mining

Mineral processing requires a reliable water supply so the main climate change issue for Queensland's mining industry will be a drier climate with less available water. Many mines are in central Queensland, which has had the strongest drying trends over the past 50 years—and this trend is projected to continue.

To ensure the mining industry remains viable in these areas, it will need to reuse and recycle and generally increase water-use efficiency. Its ability to manage decreasing water supplies may present opportunities to develop innovative, water-efficient mining technologies for export.

Expected increases in rainfall intensities increase the risk of mine site flooding and possible damage to the structural integrity of tailings dams and other water stores.

Planning and development

Queensland's mechanisms for managing land use (regional planning frameworks, State planning policies, local government planning schemes and development assessment codes) can be used to address climate change. State planning policy 1/03 (*Mitigating the adverse impacts of flood, bushfire and landslide*) and State and regional coastal management plans require local governments to consider climate change in new planning schemes and amendments, and in development decisions.

Local government planning schemes can identify high-risk areas and specify controls for flood, storm surge, bushfire and landslides. Management approaches can include:

- Avoiding—locate new development in areas not vulnerable to climate change impacts;
- Planning retreat—abandon land, ecosystems and structures in vulnerable areas;
- Accommodating—make adjustments in vulnerable areas, such as altered building design; and
- Protecting—defend vulnerable areas, population centres, economic activities and resources.



To do this, the boundaries of vulnerable areas need to be identified and relevant development standards determined. This will require information on regional climate change impacts.

Urban developments that minimise their impact on the natural environment and reduce greenhouse gas emissions promote adaptation. Sustainable developments are water-sensitive and public transport oriented, and they can range from individual allotments, streetscapes and precincts to master-planned suburbs.

Master-planned community saves water

Pimpama Coomera is a young town of 5000 people where the population is expected to increase 30-fold by 2050. The town has various initiatives to reduce the demand for drinking-quality water by 84 per cent. These include water-sensitive features such as rainwater tanks and back-up trickle feed. Household wastewater will be pumped off-site to be treated to the highest quality before being pumped back for toilet flushing and garden irrigation. The initiatives will cost users about the same as standard water services.



Infrastructure

Hotter temperatures, declining rainfall and more intense rainfall and tropical cyclones will affect Queensland's water, transport and energy services. New or refurbished infrastructure must suit future climatic conditions because it has a life span of 50 or more years. Care should be taken with its location (e.g. avoiding low-lying areas vulnerable to flooding, storm surges and sea-level rise) and with its design and construction so that it can be adapted in future.



Water

Water availability in the future is one of Queensland's major climate change vulnerabilities. It is essential for our economic, social and environmental prosperity.

Queensland will need more water due to population growth and economic development, at the same time as rainfall is declining and becoming more variable. Limited knowledge about how climate change will affect rainfall and stream flow at the catchment level increases this vulnerability.

We will face stricter water-use laws and probably pay much more for the water we use if we don't act now to save water and diversify water sources.



The Queensland Government has various initiatives to improve water management in a hotter and drier future. It has adopted a regional approach that draws on research into climate change impacts on stream flows and water quality to determine the long-term needs of humans and the environment and to allocate water to them. This includes consideration of alternative water sources (stormwater harvesting, wastewater reuse, desalination and aquifer storage) to reduce dependency on vulnerable supply options and to improve water security.

To ensure communities can cope with restricted water supplies during potentially more severe drought, water-service providers have to prepare drought contingency plans and there are water-sharing rules.

The efficient use of water is encouraged through pricing which reflects the cost of supply. Water-allocation trading is also allowed to provide access to water and to encourage higher-value use.

Local governments are now required to adopt total water cycle management principles, reduce water loss, and adopt consumption targets to qualify for Government infrastructure subsidies. Legislation has been introduced to allow use of recycled water in residential developments and public spaces, and domestic greywater in sewerred areas for irrigating gardens and lawns.

The Queensland Government also supports community education about using water more efficiently and provides incentives to install water-efficient devices, recycle water and, in rural areas, adopt better water and irrigation practices and technologies.

The Government is a signatory to the National Water Initiative that provides an agreed national approach to managing water when there may be less available due to natural events such as drought, bushfires and climate change.



For more about how Queensland manages water see:

www.nrm.qld.gov.au/water/queensland_water_plan.html

(the Queensland Water Plan 2005–2010)

Transport

Roads, railways, bridges, airports, seaports, and pipelines are vulnerable to climate change. Increases in storm surge, flooding and sea levels could affect them, particularly if they are in low-lying or coastal areas. Drier and hotter conditions may alter their long-term performance and durability (e.g. deform pavements and buckle railway tracks).



The Queensland Government is addressing the impacts of climate change on transport infrastructure by:

- Considering climate change impacts in the location of new major infrastructure;
- Ensuring that all new bridges are designed to allow for likely climate change effects, in particular sea-level rises and change in flood severity and wind conditions;
- Adding climate change to the terms of reference for regional plans and project impact assessments;
- Based on the most up-to-date climate projections, progressively reviewing all transport infrastructure as well as design and maintenance standards;
- Assessing potential climate change impacts and prioritising the implementation of adaptation measures on a location-specific basis; and
- Requiring an allowance for sea-level rise of 0.3 metres in seawall design.

Energy

Climate change is expected to affect energy demand, generation and transmission.

- Hotter temperatures will increase energy demand for cooling and reduce the efficiency of energy generation and transmission.
- Heavier rainfall and stronger winds will increase the risk of transmission and distribution failures and affect accessibility for maintenance and repairs, particularly in remote areas.
- Reduced water availability will affect power generation (water is required for cooling).
- Changes in water availability and wind may affect renewable energy generation, including existing hydroelectric generation.
- Longer periods between rainfall events could exacerbate shorting out of dusty transmission lines when rain does occur.

Strong population growth combined with growth in per capita energy consumption increases vulnerability to climate change, particularly in Queensland's southeast corner. Designing buildings appropriate for the climate can substantially reduce energy use and help smooth the demand spikes that are expensive to supply.

Energy services are fundamental to quality of life in remote communities. Current climatic conditions, including intense wet seasons and extreme weather events such as cyclones, already make the provision of reliable energy in remote areas a costly and technically difficult exercise. The current cost to taxpayers of providing electricity to the State's remote communities is around \$40 million per year.



Reduced accessibility during the wet season presents a particular challenge for ensuring reliable fuel supplies, maintenance and repair. Expected climatic extremes for populations living in the State's remote areas will significantly increase the costs of maintaining viable energy services. These cost increases provide an opportunity to assess the merits of alternative energy sources.



Natural environment

The natural environment is highly vulnerable to climate change, especially if the changes in climate are rapid.

Many social and economic activities and much of the State's prosperity are tied to the natural environment. We need to reduce environmental stresses (such as air and water pollution, loss and change of habitat, and pests and weeds) to give our natural environment a good chance to adapt to climate change.

Biodiversity

Climate change is expected to have a serious, long-term impact on biodiversity in Australia. It will affect everything from individual species to whole ecosystems and the economic activities like fisheries that rely on them.

Some species and ecosystems that are already threatened will come under further stress, and landscape dynamics will change. Upland rainforests, the Great Barrier Reef, arid and semi-arid habitats, and aquatic ecosystems will be particularly vulnerable to higher temperatures and less rainfall. The geographic range of many species will change; some will move locations; others could change the timing of their lifecycles. These changes will provide an opportunity for invasive weeds and other pests to move into new areas.

Rising sea levels will alter coastal and estuarine habitats. Their ability to adapt will depend on coastal development, shape of the land, and wind and wave patterns.

The *Queensland Biodiversity Policy Framework* draws many Queensland Government programs together with a set of principles and directions for enhancing the resilience of natural systems. Actions include:

- Implementing Queensland's sustainable vegetation management framework;
- Protecting the Great Barrier Reef from land-based pollutants via the Reef Water Quality Protection Plan;
- Reviewing policies governing the administration of leasehold land arrangements; and
- Responding to the National Action Plan for Salinity and Water Quality.



National Biodiversity and Climate Change Action Plan 2004–2007

The Queensland Government has endorsed the National Biodiversity Climate Change Action Plan 2004–2007 and is contributing to the national implementation program. The Action Plan has seven objectives aimed at gathering knowledge and incorporating various actions into natural resource and land-use management, to minimise the impact of climate change on biodiversity.

Water resources

Water quality and quantity are expected to decline in some areas due to higher temperatures, increased evaporation and lower rainfall. These conditions may suit algal blooms. When it does rain, heavy downpours will increase the risk of soil erosion and the sediment and nutrient loads in waterways. The amount of water available for ecosystem functioning (referred to as environmental flows) is also likely to decline.

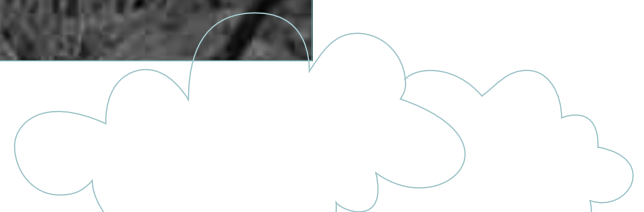
The *Environmental Protection Act 1994* allows water-quality targets to be set for the State's waterways. By managing pollution, runoff, soil erosion and other factors that degrade water quality, we can boost the resilience of aquatic and downstream marine environments. This will get them in a healthier condition to cope with climate change.

The Queensland Government recently released for public comment, draft water-quality objectives and environmental values for key areas of the State (Moreton Bay/southeast Queensland, Mary River Basin/Great Sandy Region and Douglas Shire). With the Australian Government it has developed the Reef Water Quality Protection Plan to rehabilitate and conserve important wetland and riparian (river bank) areas that filter water-borne pollutants.

Marine

As temperatures continue to rise, the Great Barrier Reef will experience more regular bleaching events. By 2050 such events could occur annually. International research indicates that our oceans may become more acidic, affecting the growth of many marine species.

The Queensland Government recently announced the Great Barrier Reef Coast Marine Park and Zoning Plan, which complements the Commonwealth zoning plan. This action, together with the Reef Water Quality Protection Plan, should improve the reef's water quality and its resilience to climate change.





Queensland fisheries will be affected by changes to streamflow and to habitat and breeding areas such as reefs, mangroves and seagrass beds. We have limited information, however, about the likely impacts, which increases the vulnerability of these systems and the industries that rely on them.

Fishing has already made some species vulnerable to any change in their environment. Measures to protect the Great Barrier Reef, the creation of marine parks and reserves, increased environmental flows, and improved fish stock management will all give marine areas a better chance to cope with climate change.

The aquaculture industry is growing in response to declining fish stocks. The production of tropical species such as barramundi may thrive on increasing temperatures, but temperate species that like cooler waters may be at risk.

Land

Fire, flood and drought regimes, and the composition and distribution of plant, animal and insect species are expected to be different in the future. These changes will affect grazing lands and stock carrying capacity, which will require different farming practices. Changes in land use, vegetation cover and weeds will affect native vegetation.

The Queensland Government has various initiatives and policies in place to protect the State's natural grazing lands and rich biodiversity, and to reduce the spread of pests and weeds. These actions help remove non-climatic stresses and increase resilience.

One initiative is to phase out broad-scale clearing of remnant vegetation by December 2006. Programs under the new vegetation management regime, such as the Vegetation Incentives Program, should encourage vegetation regrowth on private land and increase 'vegetation sinks'. Landholders directly affected by the new laws are offered financial assistance of up to \$100 000 to restructure their farm enterprises or exit the industry.

Other initiatives like AussieGRASS (Australian Grassland and Rangeland Assessment by Spatial Simulation), SLATS (Statewide Land-cover And Trees Study) and property level planning aim to maintain the economic value of grazing lands (\$2 billion annually) and to reduce problems downstream for areas such as the Great Barrier Reef.

The Government also researches and prepares management plans to control the spread of pests and weeds. It maps pest distribution, supports plague eradication and provides reference materials for pest and weed management.





Discussion points

1. The discussion paper highlights some of the State's climate change vulnerabilities. Which of these should receive priority attention and why?
2. Are there any Queensland climate change vulnerabilities that have not been identified and how should they be addressed?
3. A range of possible adaptation responses is outlined in the discussion paper. What other responses could be used in Queensland to adapt to climate change?
4. Are you working on any adaptation actions that you would like included in a climate change adaptation action plan?



How can Queensland adapt to climate change?



Climate change provides new opportunities for Queenslanders. But it is also a challenge. The adjustments we need to make will depend on where we live, what we do for a job and how we spend our spare time.

Preparing for climate change is not something that Government can do alone. It is a shared responsibility, and will require partnerships across the community so that households, community groups, businesses and Government can make the necessary changes effectively and efficiently. Our future lifestyle and our social, economic and environmental health will depend on how well we collectively adjust to changed climatic conditions.

Being prepared to look at how things are done and to do things differently will be the key to making the most of climate change. As one of the few developed regions in the tropics with strong connections to Asia, Queensland is well positioned to be an exporter and world leader in climate change adaptation knowledge, skills and technologies. We can use the State's competitive advantage to seek out new products and service-industry opportunities.

The Queensland Government's *Smart State* vision provides the framework for promoting innovation in Queensland. Adapting to climate change will be one way for the vision to unfold, and for Queenslanders to gain some benefit from climate change. The planned development of an Ecosciences Precinct at the former Boggo Road Gaol site in Brisbane will position Queensland at the forefront of climate change and sustainability research.



For more about the *Smart State* strategy see:

www.smartstate.qld.gov.au



Discussion points

5. What will best motivate individuals, community groups and businesses to think about how to adapt to climate change?
6. How might climate change affect you? What would help you adapt to climate change?
7. What opportunities will be created by climate change, and what needs to be done to help Queenslanders take advantage of them?



Adaptation principles and process

To be effective, adaptation responses need to be tailored to individual circumstances. There is also benefit in people working together so that ideas and innovations can be shared across the community and everybody has an opportunity to benefit from climate change.

Common adaptation principles will allow different groups to more easily work together; these could include:

- Building your ability to adapt to climate change by identifying what is stopping you, and working to overcome these issues;
- Considering climate change in decisions by weighing up the possible social, economic and environmental (including the impact on greenhouse gas emissions) costs of inaction compared to the benefits of taking action;
- Looking for actions that are of benefit now and that deliver (whatever the extent of climate change) social, economic and environmental benefits beyond their costs;
- Implementing cost-effective adaptation responses now to reduce the future impacts of climate change and to ensure social, economic and environmental impacts of climate change do not increase over time; and
- Using partnerships to transfer knowledge and experiences and to avoid duplication and unintended impacts on other communities or sectors.

Adaptation is a continuous process (see figure 3) built on the principles stated above. By following this process we will better understand the potential impacts of climate change. It ensures that we include climate change impacts in our planning and decisions, and that we also regularly check whether our adaptation responses are succeeding.

Practical tool to assess climate change impacts

The Australian Greenhouse Office is funding a project to develop a practical tool to assess the risk of climate change impacts and potential adaptation measures, using well-established risk-management approaches. Project partners include the Queensland Department of Primary Industries and Fisheries, Water Corporation (Western Australia), Fitzroy City Council, and United Energy, who will test the risk management guidance tool on actual organisations. When completed, there will be courses to train a broad range of stakeholders in using the tool.



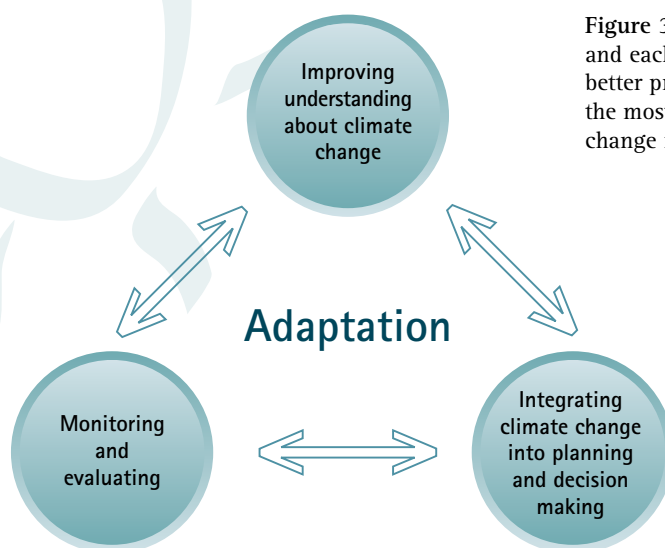


Figure 3. The adaptation process is continuous and each part is interrelated. Effort in any part will better prepare Queensland for climate change, but the most effective way to adapt to future climate change is to work on each part at the same time.



Discussion points

8. Are the proposed adaptation principles adequate for action? Why or why not?
9. What are the barriers to adaptation in Queensland? What needs to be done to remove these barriers?
10. What is the most effective way to encourage partnerships to address adaptation? Are there any existing partnership arrangements that would be suitable to use as a model?
11. How do current Government policies and regulations either promote or limit adaptation?

Improving understanding

We need to understand the effects of climate change and the range of possible responses before making decisions about when, where and how we should adapt. But there are gaps in knowledge about the social, economic and environmental impacts of climate change. As well, climate change projections come from various sources that undergo different degrees of scientific rigor, and not all are updated as new science emerges.

The *Queensland Greenhouse Strategy* includes a commitment to provide up-to-date climate change projections based on rigorous science. To meet this commitment, further research is required on:

- Which climate elements will change—e.g. ocean levels, weather patterns, temperature;
- How much change is likely—e.g. rainfall decline of 15 mm or 50 mm;
- Where changes are likely to occur—e.g. statewide, regionally or locally;
- When the changes will happen—e.g. 2010, 2030, 2050 or 2070; and
- How often and over what time—e.g. the regularity and extent of extreme weather events like droughts, heatwaves, floods and hail.



Storm-surge statistics updated

To improve Queensland's readiness for natural disasters, storm surge statistics along the east coast were recalculated in a collaborative science project involving the Commonwealth Bureau of Meteorology, James Cook University, the Reef Cooperative Research Centre, Systems Engineering Australia and the Queensland Government. The project also assessed the vulnerability of houses in Cairns, Townsville and Mackay to extreme winds associated with tropical cyclones. The result of this work can be found at:

<www.longpaddock.qld.gov.au/ClimateChanges/pub/OceanHazardsMenu.html>

Discussion points

12. What knowledge gaps stop you adapting to climate change?
13. What are the roles of Government, business and community groups in improving our understanding of climate change and its potential impacts?

Planning and decision making

Wherever possible, adaptation decisions should be integrated into existing public and private decision making. If climate change is considered in isolation, it may be given too much significance relative to other challenges Queensland is facing or not sufficiently taken into account. Greenhouse gas emissions reduction should also be considered in adaptation responses to ensure the two responses do not work against each other, especially where the effects of a decision will last 30 years or more.

New community adopts water recycling

Springfield is a 2850 hectare residential development located between Brisbane and Ipswich. The development will eventually have 18 000 homes and 60 000 people. At Springfield, four recycling technologies are being used by the local government, developers, contractors and the community: irrigation of public open spaces, dual reticulation to individual houses, school irrigation projects, and urban stormwater harvesting.

Likely climate conditions in 50–100 years' time should be considered in infrastructure reviews and upgrades, and in major investment and planning decisions. Preparing for more extreme conditions now will generally be less expensive and less disruptive than later remedial action. It will also assist in the management of current climatic extremes.



Business operators, growers, graziers, ecotourism operators and others already routinely adjust their business practices in response to very hot, dry or wet conditions. Adapting to climate change is an extension of this process. The way business operators manage climate variability provides a useful starting point for climate change adaptation. Like these operators, we can benefit now if we implement responses that aid the management of existing climatic variability, regardless of future climate change.

Response options will vary in their nature, timing, cost and ease of implementation. Cost-effective options that are of benefit now irrespective of the level of future climate change should be implemented first. Adaptation is generally promoted by:

- Using the latest information on climate change when developing responses—deciding to take action or to ‘wait and see’ requires a good understanding of the nature and timing of climate change, its potential impacts and adaptation options.
- Improving the ability to withstand climate change—infrastructure such as roads, bridges and buildings should be designed to cope with future climatic conditions (e.g. stormwater drains may need to be larger to reduce the risk of flash flooding).
- Improving community resilience to cope better with severe weather events (e.g. training carers of the sick, elderly and young on how to help vulnerable people during heatwaves).
- Enhancing the health of vulnerable natural environments—activities should focus on reducing non-climatic stresses, such as air and water pollution, habitat loss and fragmentation to enhance natural resilience.
- Avoiding decisions that make it harder to adapt or that increase vulnerability in the future to climate change impacts such as flood, storm surge, bushfires and landslides (e.g. deciding not to develop flood-prone lands).
- Increasing flexibility to reduce vulnerability—meet resource demands in alternative and innovative ways, such as reuse and recycling options and technologies.



Improving water quality entering reef

The State and federal governments developed the Reef Water Quality Protection Plan to reduce pollutants (land-based nutrients, chemicals and sediment) from entering the Great Barrier Reef, and to rehabilitate and conserve areas of the reef catchment (such as wetlands) that help remove water-borne pollutants. The focus is to encourage good planning and the adoption of best management practices that are both profitable and environmentally sustainable. Minimising the stresses caused by pollution will help the reef cope with the stress of climate change.



Discussion point

14. What is the best way to encourage climate change being considered in existing public and private planning and decision making?

Monitoring and evaluation

Adaptation is not a one-off exercise. Adaptation needs will change over time because of the uncertainties in climate change projections and impacts, and technological and societal developments.

Adaptation should be viewed as a continuous improvement process. Monitoring and evaluation are therefore crucial to determining how successful adaptation actions have been. This part of the process should guide decisions on future research needs and whether a change in approach is required.

Adaptation responses must be reviewed regularly to ensure they remain appropriate and in proportion to the projected climate changes and other socioeconomic pressures.



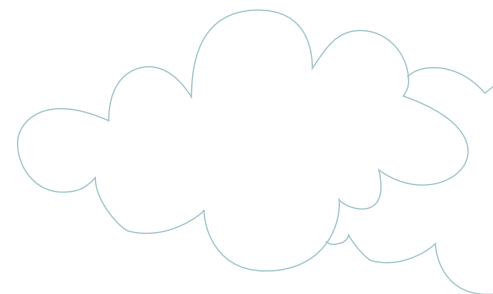
Discussion point

15. How should we measure government, business and community progress in adapting to climate change?



For more about adapting to climate change see:

<www.pewclimate.org/global-warming-in-depth/all_reports/adaptation>
<www.ukcip.org.uk>
<http://adaptation.nrcan.gc.ca/home_e.asp>
<www.greenhouse.gov.au/impacts/publications/risk-vulnerability.html>
<www.greenhouse.gov.au/impacts/overview>



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Your feedback will be disclosed to relevant staff from the Department, and may also be disclosed to staff from other relevant government agencies. Personal information (as defined in the Queensland Government's *Information Standard 42*) will be disclosed only in accordance with that Standard.

The feedback will be retained as required by the *Public Records Act 2002* and other relevant Acts and Regulations, and is subject to the *Freedom of Information Act 1992*.



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