

CLIMATE PROFILE

DUNGOG SHIRE COUNCIL LOCAL GOVERNMENT AREA

Introduction

The Dungog Shire Council Local Government Area (LGA) covers an area of 2,251 square kilometres and has a population of approximately 8,500 people. Traditionally a timber and agricultural area, the rich alluvial river flats of the Dungog Shire make it an ideal area for intensive agricultural production and grazing.

Dungog and the broader region is well known for its historic climate variability and extremes. Recent major storm and flooding events have had impact on the LGA. Events of this nature have significantly raised community awareness of climate variability and the potential impacts of climate change.

This climate profile has been developed to further increase understanding of existing and projected climate change as it relates to the Dungog Shire. The information it includes has been sourced from research recently completed by the University of Newcastle and Macquarie University on behalf of the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS).

The profile provides an overview of the key results that have been produced by this research and the process by which they were generated. In particular, it provides the results of analysis of both historical climate variability and projected climate change as it relates specifically to the Dungog Shire.



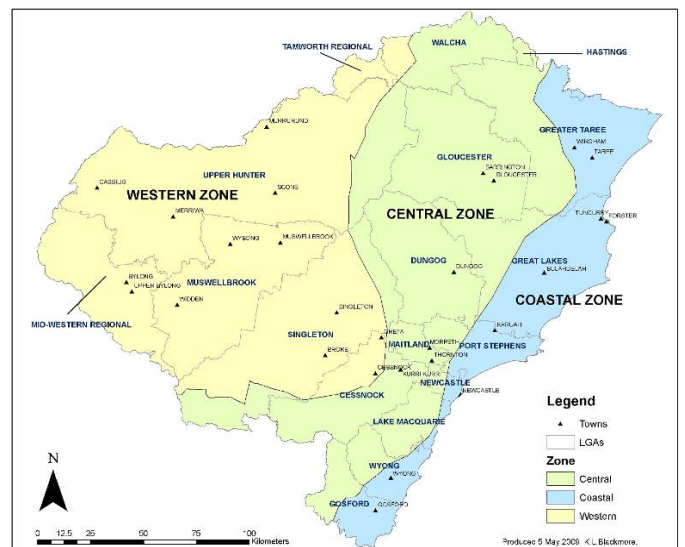
Climate Zones

A key element of the research was to identify three climate zones for the Hunter, Central and Lower North Coast region. This was achieved through a process known as climate zonation; a statistical process which divides a region into distinct sub-regions or zones where climatic similarity is maximised within zones and minimised between zones.

Twelve synoptic patterns that “drive” climate variability in the region were also identified and a comprehensive review of climate history and an analysis of this variability was completed. This confirmed a relationship between historic climate patterns and these synoptic ‘weather drivers’ in each climate zone.

The CSIRO Global Climate Model (Mk3.5) was then used to identify projected changes in the 12 synoptic types for time periods of 2020-2040, 2040-2060 and 2060-2080. Projections were based on the A2F1 emissions scenario. Because of the strong historical relationship that exists between these synoptic types and weather patterns in the region, these changes could then be used to project changes in climate for each of the three climate zones. Full details of the methodology used are available at www.hccrems.com.au.

The climate zones that have been identified for the region are shown below. The results generated for the central zone underpin this climate profile for the Dungog Shire.



Climate zones within the Region

Dungog Shire Council LGA

The Dungog Shire Council LGA lies entirely within the central climate zone. Projected changes in climate for this zone are therefore relevant to the area.



Climate zones - Dungog Shire Council LGA

Results

The following results provide both an historical analysis and future projections for a range of climate variables in the central climate zone. These include rainfall, temperature (minimum, maximum and average annual), humidity, pan evaporation, water balance, wind and extreme events.

Historic trends are analysed for significance using regression analysis. An asterisk (*) is used to identify trends that are found to be statistically significant. The length of historic data used to analyse trends varies according to data available for each variable.

Projections are provided for the period 2020-2040, 2040-2060 and 2060-2080. Where minimal change between these periods is identified, projections are provided for the entire 2020-2080 period. Projected values are relative to the average historic recorded values for each climate parameter. The length of the relative historic period is determined by the availability and quality of historic data.

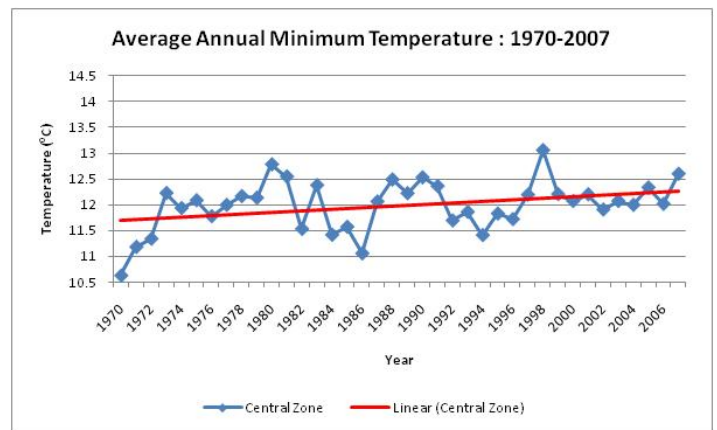
MINIMUM TEMPERATURE

Historical analysis: minimum temperature

Historically, the Dungog Shire has experienced a statistically significant annual increase in average minimum temperature of $\sim 0.6^{\circ}\text{C}$ in the central zone. More detailed seasonal changes are summarised below.

Minimum temperature (1970-2007)				
Zone	Summer	Autumn	Winter	Spring
Central	Warmer: $\sim 0.3^{\circ}\text{C}$ increase	Warmer: $\sim 0.5^{\circ}\text{C}$ increase	Warmer: $\sim 0.5^{\circ}\text{C}$ increase	Warmer: $\sim 0.9^{\circ}\text{C}^*$ increase

* Statistically significant



Trend in average minimum temperature

Projected changes: minimum temperature

Generally, it is projected that the Dungog Shire is likely to experience warmer average minimum temperatures during autumn and winter, with summer minimums expected to decrease along with a slight decrease during spring. Projected increases during autumn and winter are greater than the projected decreases for summer and spring and thus an overall increase in annual average minimum temperatures is projected.

Minimum temperature (2020-2080)				
<i>Projected changes are relative to the 1970-2007 period</i>				
Zone	Summer	Autumn	Winter	Spring
Central	Cooler: $\sim 0.8^{\circ}\text{C}$ decrease	Warmer: $\sim 1.5^{\circ}\text{C}$ increase	Warmer: $\sim 1.2^{\circ}\text{C}$ increase	Cooler: $\sim 0.2^{\circ}\text{C}$ decrease

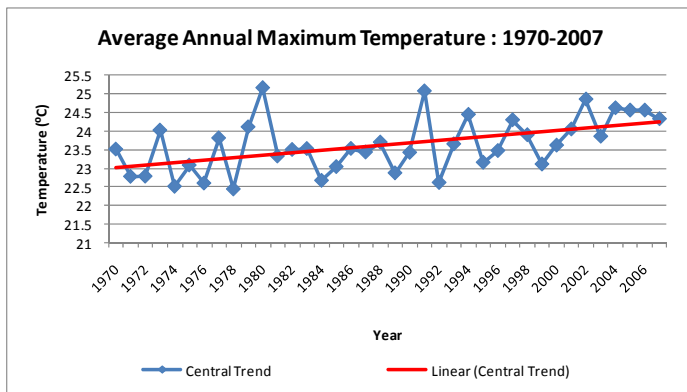
MAXIMUM TEMPERATURE

Historical analysis: maximum temperature

Historically, the Dungog Shire has experienced a statistically significant annual increase in average maximum temperatures of $\sim 1.2^{\circ}\text{C}$. More detailed seasonal changes are summarised below.

Maximum temperature (1970-2007)				
Zone	Summer	Autumn	Winter	Spring
Central	Warmer: $\sim 1.6^{\circ}\text{C}$ increase	Warmer: $\sim 0.8^{\circ}\text{C}$ increase	Warmer: $\sim 1.0^{\circ}\text{C}^*$ increase	Warmer: $\sim 1.7^{\circ}\text{C}^*$ increase

* Statistically significant



Trend in annual average maximum temperature

Projected changes: maximum temperature

Maximum temperatures are projected to continue to increase in the Dungog Shire during autumn and winter. Similar or slightly cooler average maximum temperatures are projected to occur during summer and spring. More detailed seasonal projections are summarised below.

Maximum temperature (2020-2080)				
<i>Projected changes are relative to the 1970-2007 period</i>				
Zone	Summer	Autumn	Winter	Spring
Central	No significant change	Warmer: $\sim 1.8^{\circ}\text{C}$ increase	Warmer: $\sim 1.6^{\circ}\text{C}$ increase	Cooler: $\sim 1.3^{\circ}\text{C}$ decrease

More detailed seasonal projections are summarised below.

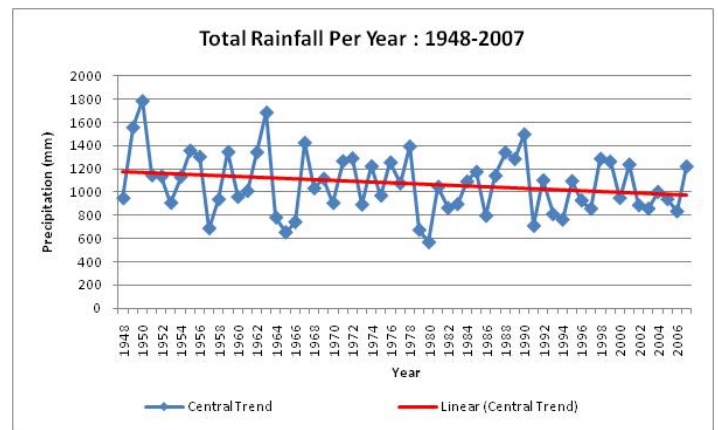
RAINFALL

Historical analysis: rainfall

Historically, the Dungog Shire has experienced a statistically insignificant decrease in annual rainfall of $\sim 196\text{mm}$ over the period from 1948-2007. More detailed seasonal changes are summarised below.

Rainfall (1948-2007)				
Zone	Summer	Autumn	Winter	Spring
Central	Drier: $\sim 43\text{mm}^*$ decrease	Wetter: $\sim 9\text{mm}$ increase	Drier: $\sim 43\text{mm}^*$ decrease	Wetter: $\sim 10\text{mm}$ increase

* Statistically significant

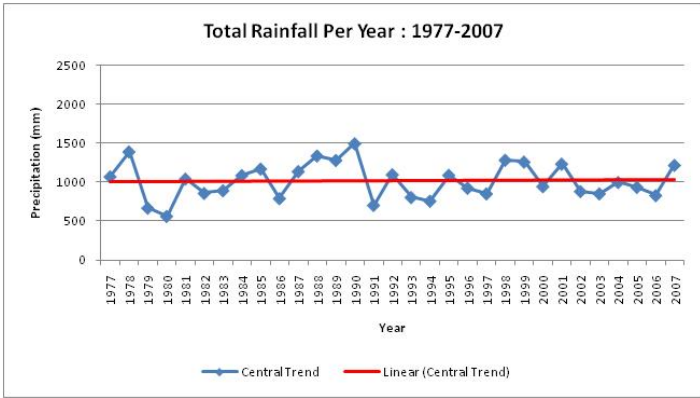
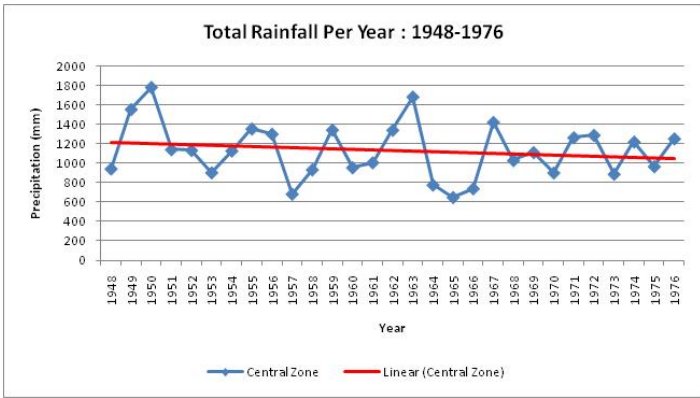


Trend in annual rainfall

Historic climate records are marked by both annual and interdecadal variability. Interdecadal variability within the Australasian and South West Pacific regions is associated with the Interdecadal Pacific Oscillation (IPO).

During the time period from 1948 to 2007 there have been two phases of this oscillation: IPO -ve phase (La Nina-like) from 1948 to 1976; and, IPO +ve phase (El Nino-like) from 1977 to 2007. Rainfall patterns within the region vary according to the IPO.

Although an overall decrease is evident from 1948-2007, a stepwise change occurs between IPO periods and there occurred no change in rainfall during the drier 1977-2007 period. The following graphs show annual rainfall patterns for the central zone during each IPO period.



Trend in annual rainfall for IPO periods

Projected changes: rainfall

Average annual rainfall patterns for the Dungog Shire are projected to stay within the boundaries of existing known natural variability. However, it is projected that rainfall patterns during 2020-2080 will return to the generally wetter (than the 1977-2007 period) and more variable conditions experienced during the 1948-1976 period, which are associated with the negative 'La Nina'-like phase of the Interdecadal Pacific Oscillation. Projected seasonal changes in rainfall are summarised in the following table.

Rainfall (2020 – 2080)				
<i>Projected changes are relative to the 1948-1976 period (ie La Nina -ve phase)</i>				
Zone	Summer	Autumn	Winter	Spring
Central	No significant change	No significant change	Drier: ~12% decrease	Wetter: ~11% increase

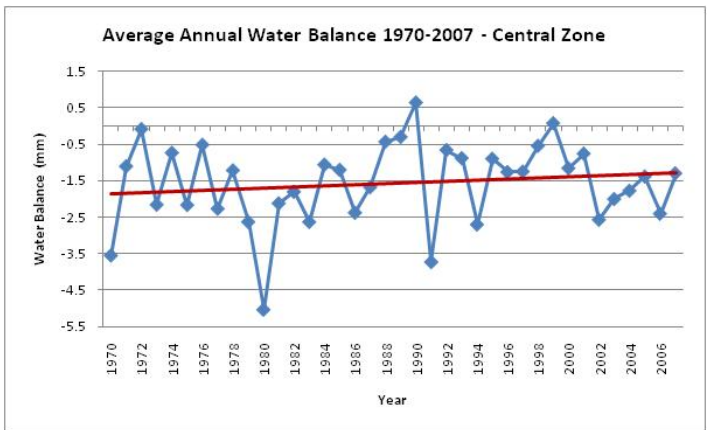
WATER BALANCE

Historical analysis: water balance

Water balance refers to the excess of precipitation over evaporation. It is affected by both the level of precipitation and prevailing temperature conditions.

Historically, the Dungog Shire has experienced a total increase in annual average water balance of 0.3mm per day between 1973-2007. More detailed seasonal changes are summarised below.

Water balance (1973-2007)				
Zone	Summer	Autumn	Winter	Spring
Central	Wetter: ~0.6mm/d increase	Wetter: ~0.3mm/d increase	Wetter: ~1.1mm/d increase	Wetter: ~0.9mm/d increase



Central zone trend in annual water balance

Projected changes: water balance

Seasonal shifts in the central zone balance out to produce no projected overall annual change. Projected seasonal shifts in water balance are summarised below.

Water Balance (2020-2080)		
<i>Changes are reported in average mm per day relative to 1970-2007.</i>		
Season	Decrease	Increase
Summer		~1.3 mm Central Zone
Autumn	~1.9 mm Central Zone	
Winter	~0.5 mm Central Zone	
Spring		~1.3 mm Central Zone

WIND SPEED

Historical analysis: wind speed

Historically, the Dungog Shire has experienced a statistically significant decrease in annual average wind speed of ~6.5km/hr. More detailed seasonal changes are summarised below.

Wind speed (1970-2007)				
Zone	Summer	Autumn	Winter	Spring
Central	Calmer: ~5.2km/hr* decrease	Calmer: ~5.8km/hr* decrease	Calmer: ~7.8km/hr* decrease	Calmer: ~7.2km/hr* decrease

Projected changes: wind speed

Seasonal shifts in the central zone balance out to produce no projected change on an annual basis. Projected seasonal shifts in wind speed during the period 2020-2080 are summarised below.

Wind Speed (2020-2080)		
<i>Changes are reported in average km/hr relative to 1970-2007.</i>		
Season	Decrease	Increase
Summer	~0.1km/hr Central Zone	
Autumn		~1.2km/hr Central Zone
Winter	~0.2km/hr Central Zone	
Spring	~0.8km/hr Central Zone	

* Statistically significant

EXTREME EVENTS

Projected changes: extreme events

Extreme weather events such as major storms, flooding rains or extreme temperature days, are a key concern for the community. Their occurrence is a significant source of risk, whether in terms of personal injury, loss of life, economic damage, social disruption or environmental damage. Accordingly, extreme events in the 95th percentile (that is, events in the top 5%) at individual Bureau of Meteorology recording stations have been analysed to project likely changes in their future occurrence.

This analysis has found that the projected frequency of weather patterns responsible for extreme storm events along the NSW coast are likely to increase, suggesting a higher probability of east coast low formation during autumn/winter.

There are also projected changes in the frequency of occurrence of synoptic patterns associated with high rainfall events. An increase in the frequency of occurrence of high

rainfall events in summer and autumn are projected in the central climate zone. A corresponding decrease in extreme rainfall events during winter and spring is also projected.

Projected increases in the synoptic pattern linked to high maximum temperatures during summer and autumn is likely to result in an increased frequency of extreme heat days in the Dungog Shire during the period from 2020-2080. This has a variety of implications including human health and bush fire risk.

A summary of projected changes in the nature and occurrence of extreme events relevant to the Dungog Shire for the period 2020 – 2080 are shown below.

Extreme Event	Projected Change
Extreme storms	Increased frequency during autumn & winter storms
High rainfall events	Increased frequency during summer and autumn. This is matched by a decrease during winter and spring to produce no overall annual change
Extreme Heat Days	Increased frequency during summer and autumn
Frost	No change in winter frost events projected, however increases in autumn and spring are projected for the central climate zone.

How can the results be used?

The climate change projections included in this LGA Climate Profile provide the next order of detail and insight over previous CSIRO (2007) projections available for the Hunter, Central and Lower North Coast region. These projections now make it possible for Dungog Shire Council, government agencies, industry and the community to more accurately assess and prepare for the potential risks posed by climate change in the Dungog Local Government Area.

More information

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References & Further Reading

- ◆ Blackmore, K.L. & Goodwin, I.D (2008). Report 2: Climate Variability of the Hunter, Lower North Coast and Central Coast Region of NSW. A report prepared for the Hunter and Central Coast Regional Environmental Management Strategy, NSW.
- ◆ Blackmore, K.L. & Goodwin, I.D (2009). Report 3: Climatic Change Impact for the Hunter, Lower North Coast and Central Coast Region of NSW. A report prepared for the Hunter and Central Coast Regional Environmental Management Strategy, NSW.
- ◆ HCCREMS (2009). Fact Sheet—Research Methodology & Findings. Hunter Councils Inc, NSW.
- ◆ Verdon, D & Goodwin, I.D. (2007). Progress Report 1 to HCCREMS on Stage 1 of the Regional Climate Change Study. A report prepared for the Hunter and Central Coast Regional Environmental Management Strategy, NSW.

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