University of Southern Queensland

Faculty of Engineering and Surveying

Weather Induced Changes on Domestic Water Consumption

A dissertation submitted by

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Courses ENG4111 and 4112 Research Project

towards the degree of

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ABSTRACT

The Australian Bureau of Meteorology defines seven zones; ranging from equatorial and tropical in the north, temperate in the south and desert in the centre; to describe the climate of Australia. Six of these seven zones can be found in the state of Queensland. The zones are characterised by weather based factors such as rainfall, temperatures, relative humidity and evaporation. The purpose to this project was to attempt to determine if these factors have an affect on the rate of demand for domestic water consumption by consumers.

The primary objective of this project was to produce a mathematical model; using these weather based variables; for use by Peak Downs Shire Council to aid in the prediction of the daily domestic water consumption in the township of Capella in Central Queensland, Australia. This objective was achieved with the consumption model, as detailed in Section 7.3.2 predicting 86 % of outside usage.

A broader objective of this project was to investigate and examine the differences and relationships between the variables applicable to Capella and those relevant to Barcaldine, in Western Queensland and Yeppoon on the Queensland Central Coast. The aim of this investigation was to develop a correlation between climate variations and the consumptions within these zones. T-test analysis of 2005 weather data failed to determine the existence of a significant relationship between the variable combinations tested. A correlation between climate variation and consumption within the regions could not be adequately completed due to the lack of complete and accurate records.

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I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

Kym Therese Downey

Student Number: 0010417944

Signature

Date

For my family

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CHAPTER 1 INTRODUCTION

Australia, the driest, inhabited continent on earth, is a country in which climate, rainfall and temperature ranges vary widely both geographically and seasonally.

The Australian Bureau of Meteorology defines weather as a description of the atmosphere at a particular time. Climate is the changes to this weather over a long period of time. Climate includes the seasons experienced in different regions and defines the most common conditions which will be experienced in each region

The climate across northern Australia may be classified as equatorial / tropical with hot humid summers, monsoonal rains and dry mild winters. In contrast to this region the climate in southern Australia is temperate with wet winters and low summer rainfall. The interior of the continent receives minimal rainfall, less than 200 mm/year on average, and is subject to hot summers and cold winters.

Average annual maximum temperatures range from 6 ^{0}C in southern Australia to 33 ^{0}C in the north with corresponding average annual minimums ranging from 0 ^{0}C to 21 ^{0}C. Average rainfall across Australia is 469 mm/year but this varies from an average annual rainfall of less than 200 mm/year in the interior to 3,200 mm/year on the north-eastern coast. This variability in rainfall totals is also reflected in the frequency of events of rainfall greater than 5 mm with more than 75% of the land mass having less than 40 days per annum.

These factors; climate, temperature range, average rainfall and frequency of rainfall; affect the rate of demand of consumers on the limited, perhaps failing, water resource.

It is reported in "*Australian Water Resource Assessment 2000 - surface and groundwater availability and quality*" that, on average, Australian water use increased by 65% between 1983/84 and 1996/97 with a corresponding 55% increase in urban/industrial use. This audit also reports that 26% of surface water management areas and 30% of groundwater management units are either close to or overused when compared with their estimated flow regime requirements or sustainable yields (NLWRA).

Perhaps the quantity of water available for use may be increased through strategic development and improvement of storage facilities but, to ensure that Australia's water resource remains adequate for our needs, there must be improvements in the ways in which it is used and the way in which it is managed. One way to improve this management involves the prediction of the demand on the systems, both existing and future, to ensure that supply is maintained and that it is available where and when it is needed.

1.1 AIMS & OBJECTIVES

The primary objective of this project was to produce a mathematical model for use by Peak Downs Shire Council to aid in the prediction of the daily domestic water consumption in the township of Capella in Central Queensland, Australia. The results of the model would then be compared with actual usage to determine the efficiency of the model.

This model is to be based on variables such as:

- Rainfall;
    - average annual rainfall,
    - frequency of rainfall,
    - duration of rainfall event
    - intensity of rainfall;
- Temperature;
    - maximum daily temperature;
    - minimum daily temperature
- Relative Humidity; and
- Evaporation

Variables such as those following will also be considered:

- Connections;
    - Number of metered connections per year
- Daily Consumption;
- Restrictions; and the
- Cost of water

A broader objective of this project was to investigate and examine the differences and relationships between the variables applicable to Capella and those relevant to Barcaldine, in

Western Queensland and Yeppoon on the Queensland Central Coast. The aim of this investigation was to develop a correlation between climate variations and the consumptions within these zones and to determine if the model produced for Capella can be applied to other areas.

CHAPTER 2 BACKGROUND

2.1 CAPELLA

Capella is a small community in rural central Queensland with a current estimated permanent population of 900. Historically the main industries in the area have been grain and cattle production but the discovery of coal has lead to nine coal mines now operating within Peak Downs Shire.

Water for the township of Capella is sourced from four bores, overland flows and harvesting of flood flows in Capella Creek. The harvested flows are stored in three earth dams which have a total capacity of 1,100 megalitres of water. In October 2003, this water supply failed and Peak Downs Shire Council had to transport water by tanker from the town of Tieri. The completion of the construction of 34.5 kilometres of pipeline from, the town of Tieri to Capella, in December 2003 added another source of water.

The water supply to Tieri is piped from the Bedford Weir storage system near Blackwater. The new pipeline should allow Peak Downs Shire Council to access this water for use by the Capella residents, should the existing water supply fail again.

Bedford Weir is part of the Nogoa-Mackenzie water storage system and is controlled by SunWater Queensland. Water from this system is available to consumers through an allocation system. These allocations may be short, medium or long term with the cost per megalitre decreasing with increases in term length. To obtain a water allocation for Capella, Peak Downs Shire Council must compete, against the mining companies in the region, on the open market.

As the value of coal on the world market increases the transient population of contractors servicing the coal industry in the area has increased dramatically. A large portion of this population resides in Capella resulting in a corresponding increase in the demand on the existing water service. Water is not cheap and to ensure “best service” to the rate payers of Peak Downs Shire, the Council must ensure that they purchase, through allocation, only as much water as is needed, without over- or under- assessing what is required.

Tools to aid in the prediction of short, medium and long term requirements will assist this process.

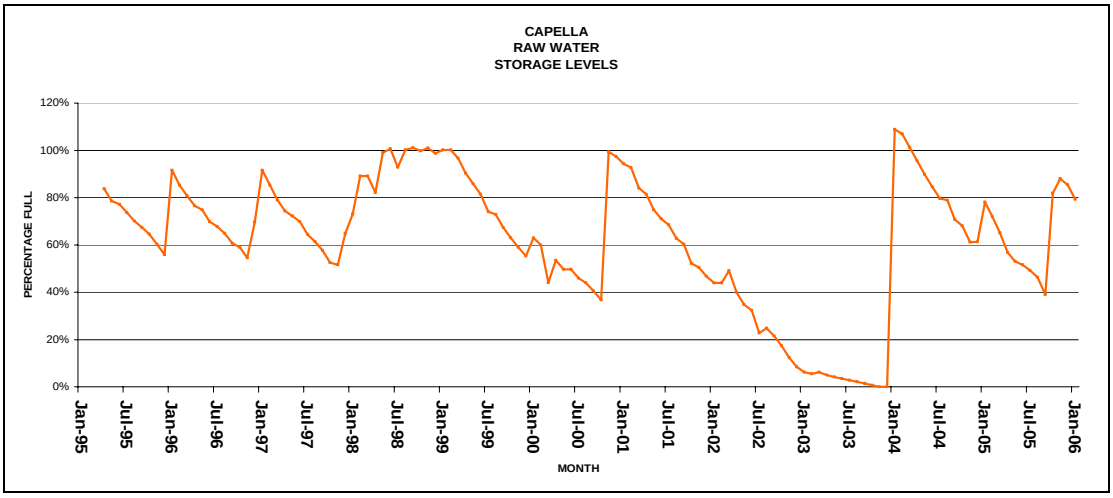

Figure 2-1: Graph – Raw Water Storage Levels

2.2 REGIONAL

The "Guidelines for Planning and Design of Urban Water Supply Schemes" (1989), produced by the then Water Corporation, notes that the average the average daily water consumption can vary from approximately 400 L/EP/day in the south-eastern region of Queensland to 800 L/EP/day in northern coastal towns. However the average daily consumption in dry western areas of Queensland can be in the order of 1500 L/EP/day.

These figures are used by designers to predict Average Day Demand, Peak Day Demand, Peak Hour Demand and Mean Day Maximum Month, data for use in the design of new water networks.

A comparison of weather and consumption data may confirm or disprove this hypothesis.

CHAPTER 3 LITERATURE REVIEW

As populations increase and demand on available water supplies increases more and more service providers are looking for ways to predict the actual demand. The development of models to predict this demand is not a new process with much work being carried out in the last 20 to 30 years. This work is happening on a world-wide basis as all countries and populations seek ways to better manage their water sources.

Models already developed vary in line with variations in the timeframe of prediction, the variables used and the mathematical processes used.

3.1 TIME FRAMES AND ZONES (LEVELS)

Models have been developed to predict usage on daily, weekly, monthly, annual basis and, in the case of Goodchild (2003) to predict how demand will be impacted by climate change in the future.

Protpapas et al (2000), Maidment et al (1986), Danielson (1979) Maidment et al (1985) and Zhou et al (2000) have all produced model to predict the daily demand for water at various sites around the world. Except for Danielson (1979) all of these models predicted the total use of the service as equivalent to the total volume of water pumped through the supply network. Danielson's model was based on the average daily water consumption per household within set regions. Maidment et al (1986) daily demand model also showed evidence of a weekly cycle of water use.

Maidment et al (1984) and Miaou (1990) created models to predict total usage on a monthly basis.

3.2 INPUT VARIABLES

As the timeframe of the predictions change so do the variables upon which the output of the model is based. The demand for water is dependent on climatic factors and factors of social and economic bases.

3.2.1 Climatic

Rainfall and temperature data, in various forms, played a dominant part in all models regardless of the timeframe of the usage predictions. Danielson (1979) incorporated average daily values both of these variables whilst other modellers used different forms of them. All modellers used daily quantity values of rainfall and Maidment et al (1985 and 1986) also included the length of the rainfall event and time lapse between rainfall events in their models. Miaou (1990) incorporated the number of days of rainfall per month into his study.

Maidment et al (1985) and (1986) produced a model incorporating both maximum daily temperature and normal air temperature as estimated from long term records. Protopapas (2000) used average, maximum and minimum values of temperature whilst Zhou focused on the maximum daily air temperature.

3.2.2 Socio-economic

Socioeconomic factors such as household income, water price, and household size all affect the demand for water but this effect varies slowly over time. Water price changes will produce a step function (6). Maidment et al (1984) used average effective buying income per household, real marginal water price, number of connections and population to account for the influence of these economic factors on the trends in water use. These variables were included in Danielson's (1979) study as it focused on the prediction of demand on a per household basis.

3.3 PROCESSES

3.3.1 Time series Analysis

Factors affecting the demand for water are made up of two components – those which change over time and do not repeat such as social factors such as number of connections to a water distribution system and; those which repeat during the time under study such as the climatic seasons of the year. The use of time series analysis techniques for modelling water demand enables both slow and fast changes to variables to be incorporated into the model.

Maidment et al (1985) used time series analysis to de-trend the effects of seasonal use on water consumption and created a non-linear function to relate air temperature to use to de-seasonalise the data series. Maidment et al (1984) produced a cascade model of four time-series analysis transformations to remove the effects of four variables from their model. The first transformation reduced the effect of trend causing variables, such as income per household and population; the second transformation eliminated the seasonal variations. The third transformation accounted to the autocorrelation of the data and the fourth transformation – Climatic Correlation – accounted for the dependence on rainfall, evaporation and air temperature.

3.3.2 Multiple regression

Multiple regression techniques establish a relationship between several independent variables and a dependent variable.

Maidment et al (1984) used multiple regressions to regress mean annual water use against trend-causing variables to produce a residual value to detrend water use in their time-series analysis cascades. Danielson (1979) used multiple regressions to relate economic and social variables to the water demand on a household basis.

Maidment & Parzen (1984) state that, when compared to multiple regression analysis, time series analysis is more applicable for monthly data in rapidly growing cities and for daily and weekly water use data.

3.4 CONCLUSIONS

Danielson (1979) concluded that in a daily per household basis for demand the size of the household explained the largest proportion of variation in data. He separated demand into winter demand (as used inside the household), total demand and sprinkler demand (as equal to total use minus winter demand) and concluded that sprinkler demand was highly responsive to changes in water price and climatic variables whilst winter demand was less so.

Maidment et al (1984) analysis of water demand concluded that the effect of rainfall is to cause and immediate drop in water use followed by gradual increases until the time that the rainfall event no longer has an effect. This conclusion was further expanded on in 1986 by

Maidment and Miaou to show that this response to rainfall is related to the magnitude of the event and, in rainless periods the use of water is dependent on a temperature threshold. They showed that above a threshold of 21^0C water use slowly increases until the temperature reaches a range of 29^0C – $32\ ^0$C after which the water demand increases more sharply.

In his study of efficiency of linear regression models and time series analysis for demand prediction Miaou (1990) concluded that non-linear models outperformed linear models. Comparisons showed that linear models underestimated high summer demand in dry years and overestimated demand in wet years.

The study carried out by Protopapas et al (2000) confirmed this conclusion.

CHAPTER 4 CLIMATIC ZONES & WEATHER

4.1 AUSTRALIAN CLIMATIC ZONES

The climate across northern Australia may be classified as equatorial / tropical with hot humid summers, monsoonal rains and dry mild winters. In contrast to this region the climate in southern Australia is temperate with wet winters and low summer rainfall. The interior of the continent receives minimal rainfall, less than 200 mm/year on average, and is subject to hot summers and cold winters.

The Australian Bureau of Meteorology uses two separate, but overlapping, systems to define climatic zones across Australia. The first is based on a modified Koeppen climatic classification system. The second system defines zones according to average temperature and humidity.

4.1.1 Koeppen Climate Zones

In the early 1900's Dr Wladimir Koeppen introduced a system to define climate regions across the world. These regions were generally aligned with world patterns of vegetation and soil type. Under the Koeppen classification system the climate of a region is defined by three letters. The letters, and applicable definitions, used in Koeppen's classification system have been tabulated in Table 4-1: "Koeppe Climate Classifications" below.

The first letter defines annual and monthly averages of temperature and precipitation, the second letter distinguishes specific seasonal characteristics of temperature and precipitation and the third letter is used to characterise variation in climate. .

1. ANNUAL AND MONTHLY AVERAGES OF TEMPERATURE AND PRECIPITATION	
A	**Moist Tropical Climates** - High temperatures; - High rainfall
B	**Dry Climates** - Little rain - High daily temperature range Further divisions of
S	Semiarid
W	Arid or desert
C	**Humid Middle Latitude Climates** - Warm dry summers - Cool, wet winters
D	**Continental Climates** - Found in interior regions of large land masses - Low precipitation - Seasonal temperatures vary
E	**Cold Climate** - Permanent ice and tundra always present
2. SEASONAL CHARACTERISTICS OF TEMPERATURE AND PRECIPITATION	
f	Moist with precipitation in all months - No dry season - Used with A, C & D climates
m	Rainforest climate - Only used with A
s	There is a dry season in the summer
w	There is a dry season in the winter
3. VARIATION IN CLIMATE	
a	Hot summers - Warmest month is over 22 ^{0}C - In C and D climates
b	Warm summers where warmest month is below 22 ^{0}C - In C and D climates
c	Cool short summers with less than 4 months over 10 ^{0}C - In C and D climates
d	Very cold winters with coldest month below -38 ^{0}C - In D climate only

3. VARIATION IN CLIMATE	
h	Dry hot with mean annual temperature over 18 ^{0}C - In B climates only
k	Dry-cold with mean annual temperature under 18 ^{0}C - In B climates only

Table 4-1: Koeppen Climate Classifications

In their paper "*Objective Classification of Australian Climates*" Harvey Stern, Graham de Hoedt and Jeneanne Ernst presented a modification to Koeppen's world climate classifications and applied these modified classifications to define climatic regions within Australia. The modifications adopted have been tabulated in Table 4-2: - "Modification of Koeppen's Classifications" below.

Köeppen's original scheme	**New scheme**
Tropical group	Divided into equatorial & tropical groups
Monsoon subdivision	Becomes rainforest (monsoonal) subdivision
Dry group	Divided into desert & grassland groups
Summer/winter drought subdivisions	Now requires 30+mm in wettest month
Temperate group	Divided into subtropical & temperate groups
Cold-snowy-forest group	Cold group
Dry summer/winter subdivisions	Moderately dry winter subdivision added
Polar group	Maritime subdivision added
Frequent fog subdivision	Applies now only to the desert group
Frequent fog subdivision	Becomes high humidity subdivision
High-sun dry season subdivision	Absorbed into other subdivisions
Autumn rainfall max subdivision	Absorbed into other subdivisions
Other minor subdivisions	Absorbed into other subdivisions

Table 4-2: Modifications to Koeppen's Classifications[1]

[1] OBJECTIVE CLASSIFICATION OF AUSTRALIAN CLIMATES, Harvey Stern*, Graham de Hoedt* and Jeneanne Ernst**

The Australian Bureau of Meteorology adopted this modified Koeppen classification system to depict the major climatic zones across Australia. These zones are:

- Equatorial;
- Tropical;
- Subtropical;
- Desert;
- Grassland;
- Temperate; and
- Polar.

The polar zone is not applicable to the Australian continent. These major zones can be viewed in Figure 4-1 below.

These seven regions are divided further to distinguish between zones of distinct seasonal variation within each region. This division results in twenty-seven distinct climatic zones, as shown in Figure 4-2 below, in Australia.

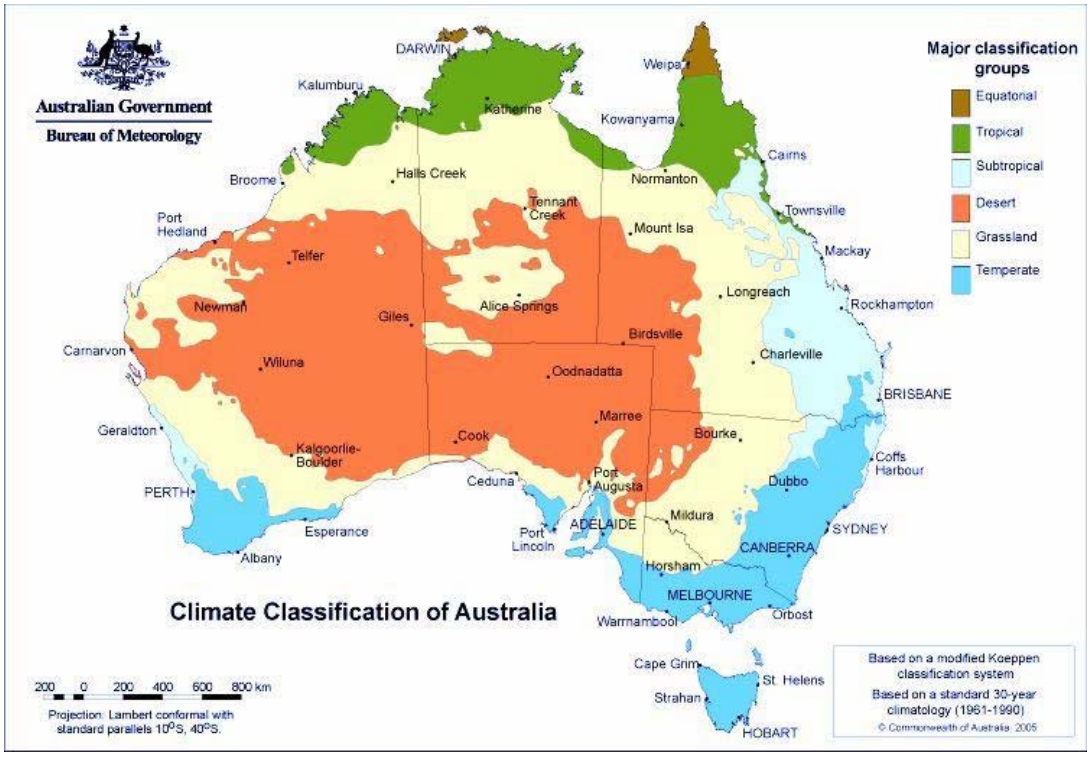

Figure 4-1: Modified Koeppen Climate Classification of Australia

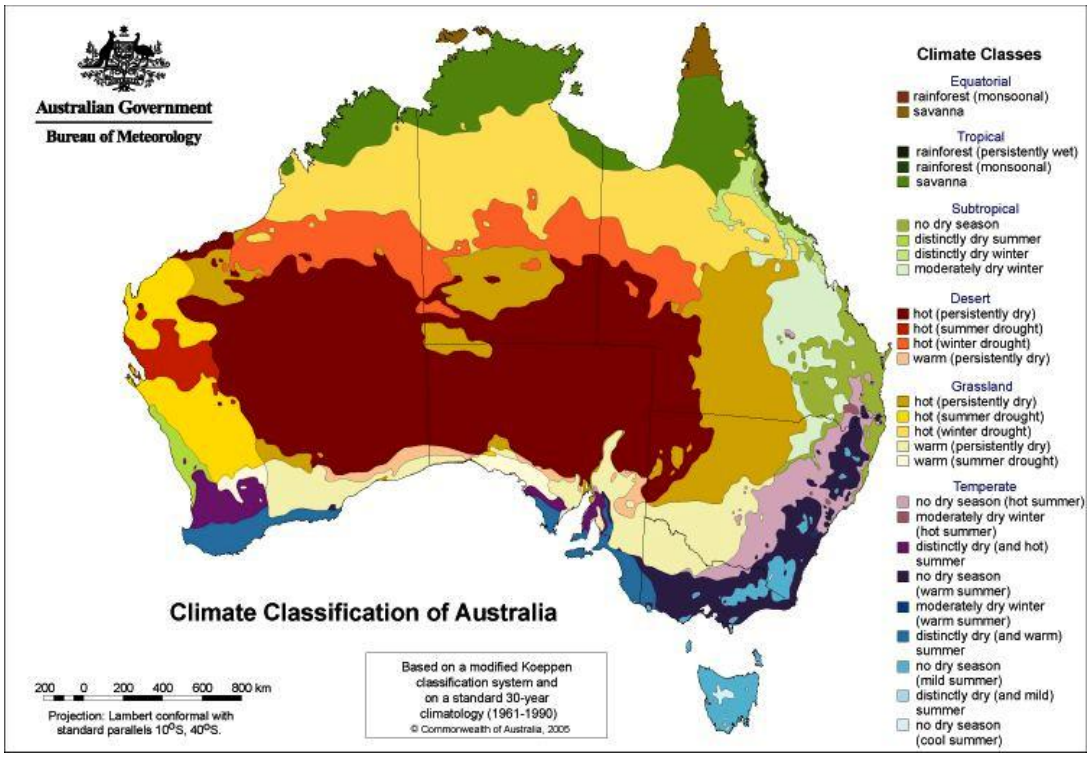

Figure 4-2: Climate Classification of Australia

4.1.2 Temperature & Humidity Zones

A broader climate classification system used by the Australian Bureau of Meteorology is based on the thermal comfort experienced within the region. This classification system uses limiting factors of a temperature of 30 ^{0}C and a water vapour pressure of 2.1 kPa as the upper limits for thermal comfort. Average monthly maximum and mean temperatures, water vapour pressures and average annual heating degree days are used to classify regions. A software package developed by the Centre for Research and Environmental Studies at the Australian National University was used to estimate climate data where records were not available.

The six regions and the parameters of them, defined within this system are tabulated in Table 4-3: “Temperature and Humidity of Climatic Zones”.

The application of these regions to Australia can be seen in Figure 4:3: “Climate Zones Based on Temperature & Humidity”.

ZONE	TEMPERATURE	HUMIDITY
Hot Humid Summer Warm Winter	• Average January maximum temperature ≥ 30 ^{0}C	• Average 3:00 pm January water vapour pressure ≥ 2.1 kPa
Warm Humid Summer Mild Winter	• Average January maximum temperature ≤ 30 ^{0}C	• Average 3:00 pm January water vapour pressure ≥ 2.1 kPa
Hot, Dry Summer Warm Winter	• Average January maximum temperature ≥ 30 ^{0}C • Average July mean temperature ≥ 14 ^{0}C	• Average 3:00 pm January water vapour pressure ≤ 2.1 kPa
Hot, Dry Zone Cool Winter	• Average January maximum temperature ≥ 30 ^{0}C • Average July mean temperature ≤ 14 ^{0}C	• Average 3:00 pm January water vapour pressure ≤ 2.1 kPa
Warm Summer Cool Winter **(Temperate Zone)**	• Average January maximum temperature ≤ 30 ^{0}C • Average annual heating degree days ≤ 2000, using base 18 ^{0}C	• Average 3:00 pm January water vapour pressure ≤ 2.1 kPa
Mild to Warm Summer Cold Winter **(Cool Temperate Zone)**	• Average January maximum temperature ≤ 30 ^{0}C • Average annual heating degree days ≥ 2000, using base 18 ^{0}C	• Average 3:00 pm January water vapour pressure ≤ 2.1 kPa

Table 4-3: Temperature and Humidity of Climatic Zones

Heating degree days are defined as the number of days where heating is required to raise the temperature to 19 ^{0}C.

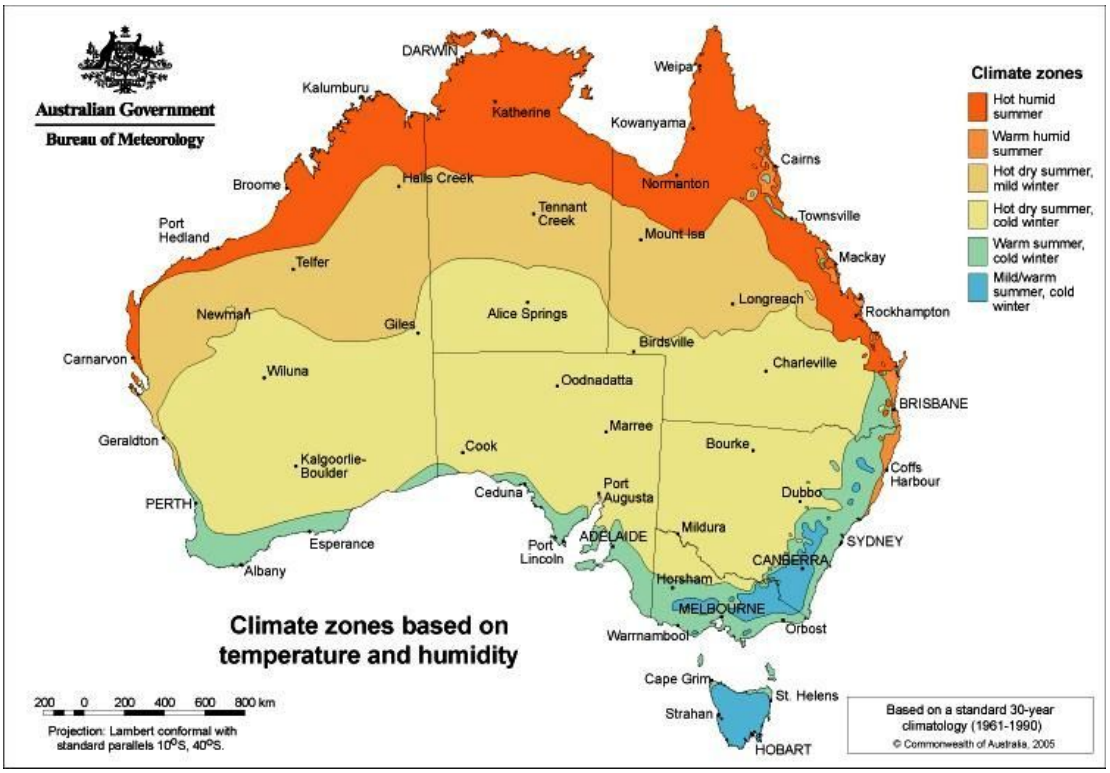

Figure 4-3: Climate Zones Based on Temperature & Humidity

4.2 QUEENSLAND WEATHER

With a total area of 1,730,648 square kilometres Queensland comprises approximately 22.5% of the Australian land mass. All of the major zones from the modified Koeppen classification system that the Australian Bureau pf Meteorology depicts across Australia are present within the state of Queensland. These zones are expanded to a total of thirteen regions. Five of the six temperature and humidity zones are also represented.

Queensland can be divided by the weather phenomena experienced as distinct from the long-term climate of the state. For the purpose of this project maps produced by the Australian Bureau of Meteorology will be used to investigate the average weather experienced within Queensland. The Bureau of Meteorology uses recorded data averaged over various time lengths, usually 30 years, to create these images.

4.2.1 Rainfall

Rainfall areas have been outlined with the use of total rainfall divisions ranging from 600 to 100 millimetres. The level of average annual rainfall across Queensland decreases as the distance from the north-eastern coast line increases. Average annual rainfall within Queensland varies from a range of 0 – 200 millimetres per year in the south-western corner to an extreme of more than 3,200 millimetres per year in the area surrounding Cairns and Innisfail in the north of the state. The Great Dividing Range effectively separates regions of high rainfall from those experiencing far less. More than one-third of the state receives an average annual rainfall of less than 800 millimetres per year.

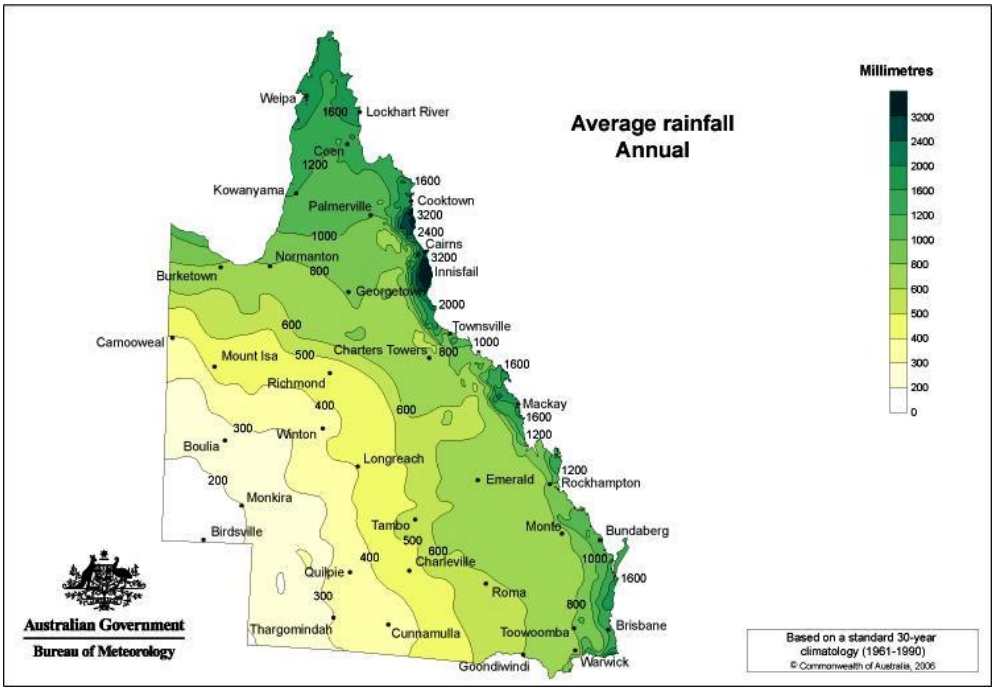

Figure 4-4: Average Annual Rainfall of Queensland

This range of rainfall trends is also reflected in the number of days of rainfall above various levels received across the expanse of the state. Coastal areas receive rainfall greater than 5 millimetres on more than 50 days per year, while the south-eastern corner has rainfall of this quantity on less than 10 days per year. In line with the highest annual average rainfall the area around Innisfail also experiences the most days, greater than ten, per annum during which more than 50 millimetres of rain falls. In contrast to this the vast majority of the state experiences these events on less than 5 occasions per year.

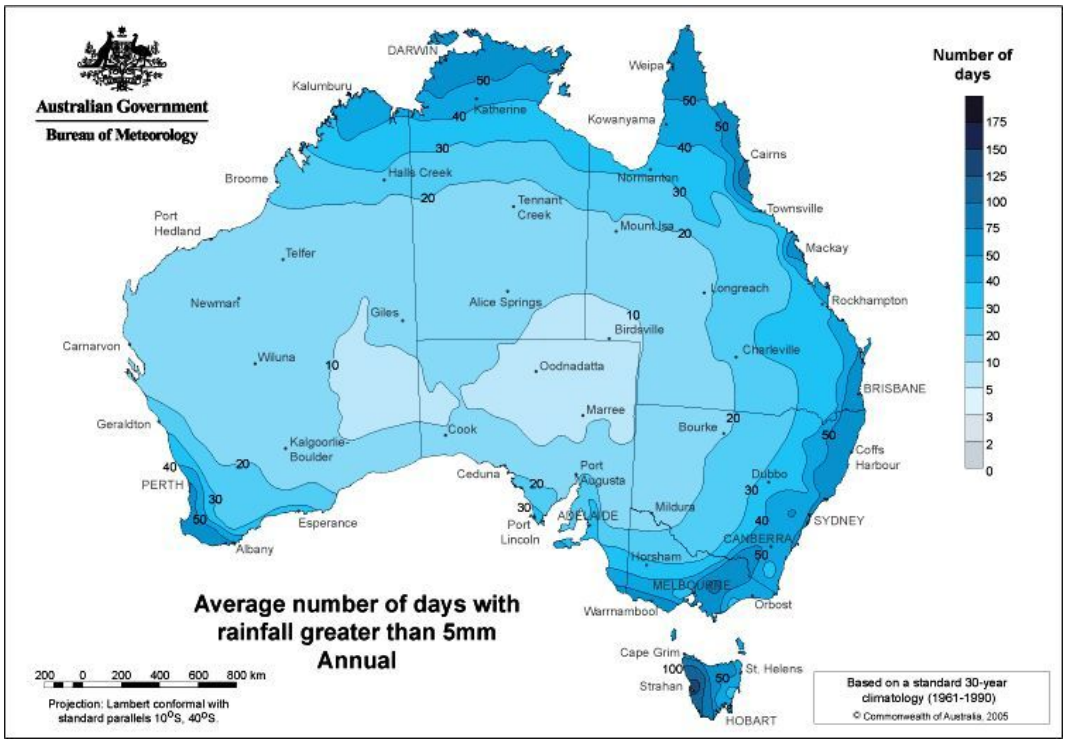

Figure 4-5: Average Number of Days per Annum with Rainfall more than 5mm

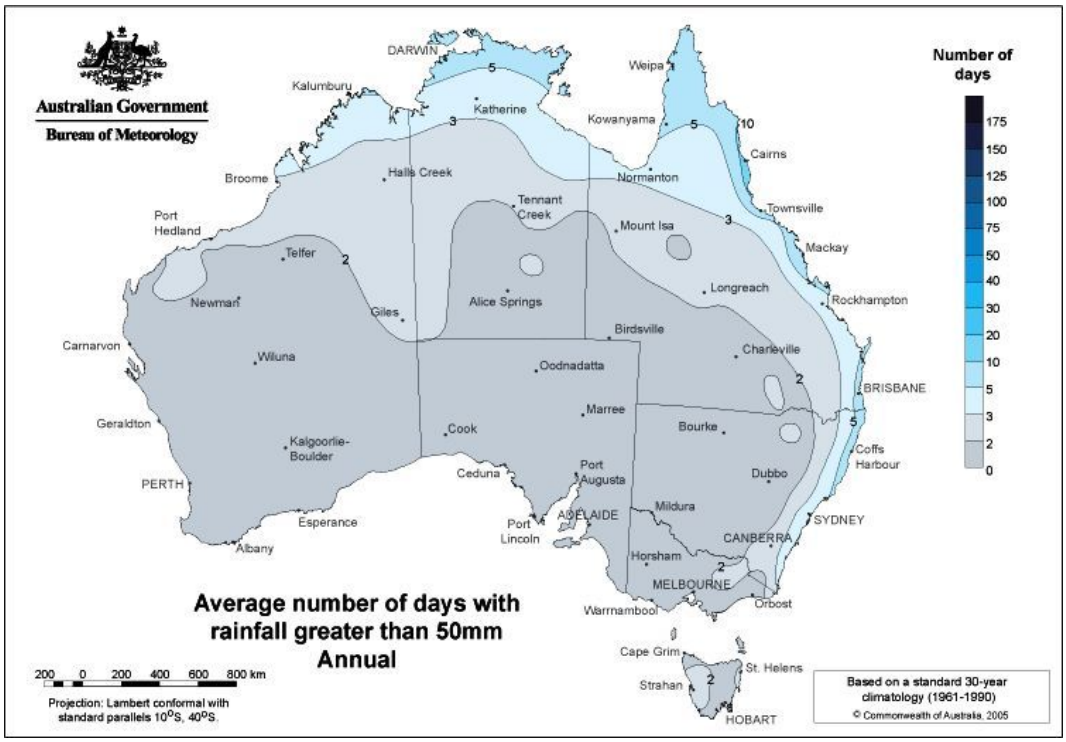

Figure 4-6: Average Number of Days per Annum with Rainfall More than 50mm

4.2.2 Average Maximum & Minimum Temperatures

Three Celsius degrees delineate the temperature ranges by which the Australian Bureau of Meteorology describes the average temperatures across regions of Australia.

The annual average maximum temperatures experienced within Queensland range from a minimum of 18 ^{0}C in the south-east corner of the state to a maximum of more than 33 ^{0}C in the north-west region. More than three-quarters of the state experiences an average maximum temperature in excess of 27 ^{0}C.

The range of annual average minimum temperatures experienced is similar to that of the annual average maximum temperature. Across the state of Queensland the annual average minimum temperature varies by as much as 12 ^{0}C with areas in the north recording annual average minimum readings of 21 ^{0}C and areas in the south-east recording 9 ^{0}C.

The regions defined within Queensland by the set temperature ranges are shown in Figure 4-7: "Average Annual Daily Maximum Temperature" and Figure 4-8: "Average Annual Daily Minimum Temperature".

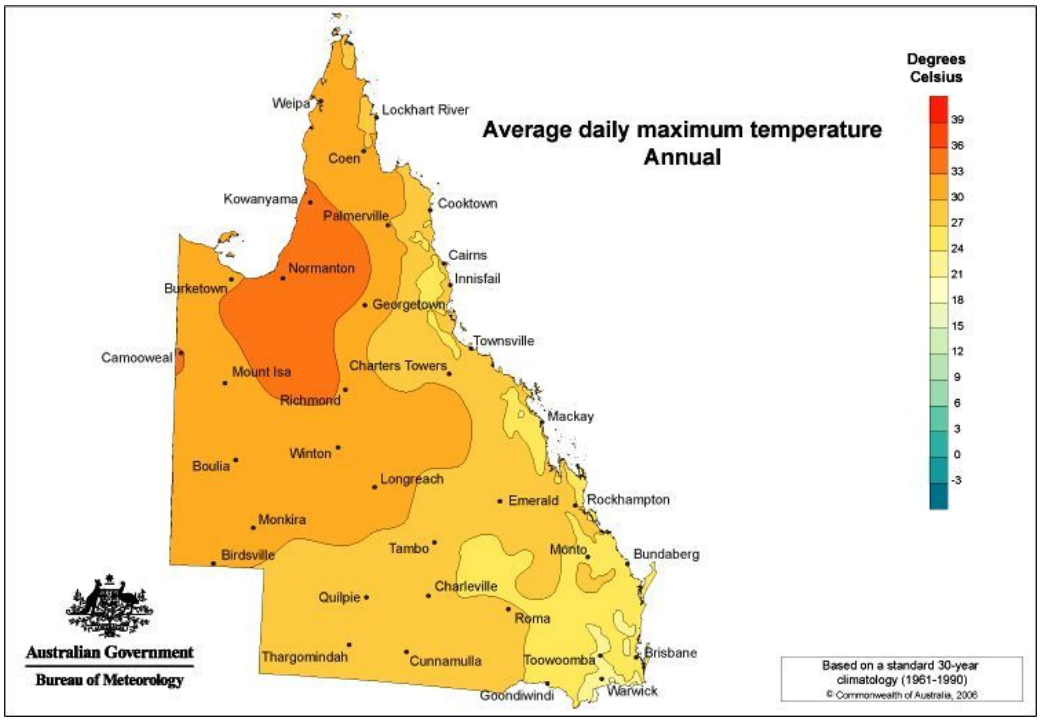

Figure 4-7: Average Annual Daily Maximum Temperature

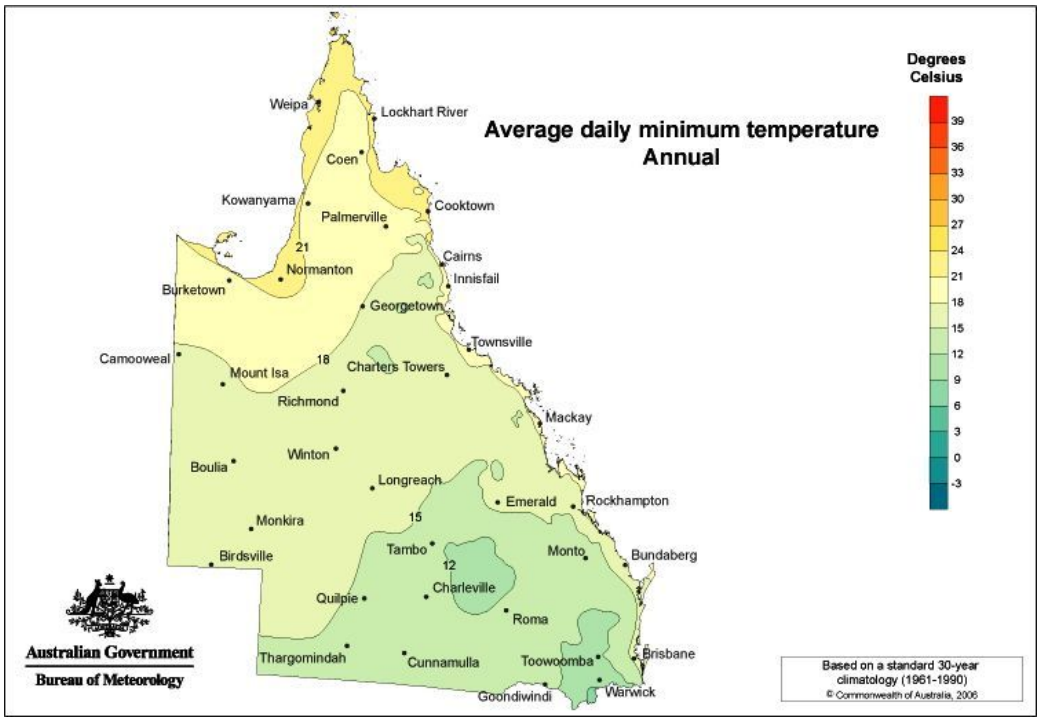

Figure 4-8: Average Annual Daily Minimum Temperature

4.2.3 Evaporation

The Australian Bureau of Meteorology has used ranges of varying widths to define evaporation regions across Australia. For higher total values a range of 400 millimetres is used. This range size reduces to 200 millimetres as the total evaporation falls below 2,000 millimetres per annum. The array of average annual rainfall previously discussed is reflected in the scope of recorded average annual evaporation. The areas with the minimum average annual rainfall are the areas with the maximum average annual evaporation, in excess of 3,200 millimetres per year, whilst the areas of maximum average annual rainfall are the areas with the minimum average annual evaporation – 1,400 millimetres per annum.

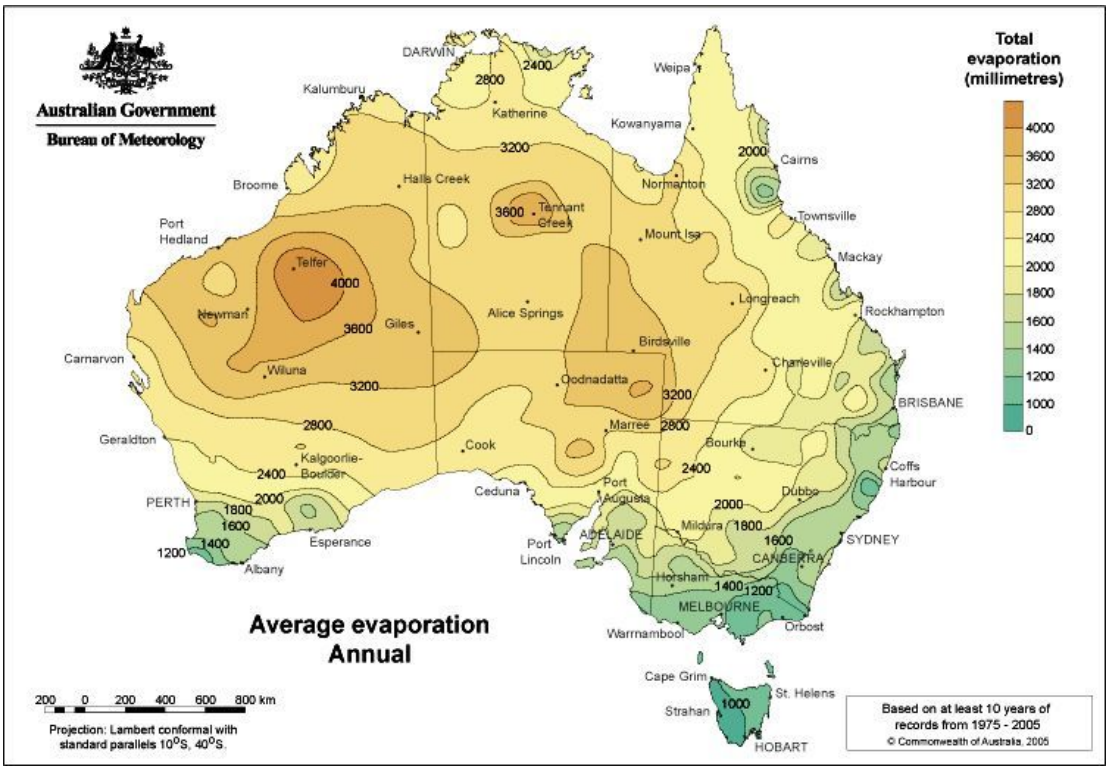

Figure 4-9: Average Annual Evaporation

4.2.4 Relative Humidity

Ranges based on 10% variations in relative humidity are used to identify different regions across Australia. The average annual relative humidity at 9:00 am varies from 50 % in the hotter, drier area of western Queensland to an average of 80% experienced in the area surrounding Innisfail and at the very north of the state. This range of 30 % is also reflected in the average annual relative humidity at 3:00 pm with each approximate zone recording decreases of 20%. At 3:00 pm the relative humidity in western Queensland is less than 30% while that in the coastal areas is 60%.

These regions are depicted in Figure 4-10: Average Annual Daily 9:00 am Relative Humidity and Figure 4-11: "Average Annual Daily 3:00 pm Relative Humidity".

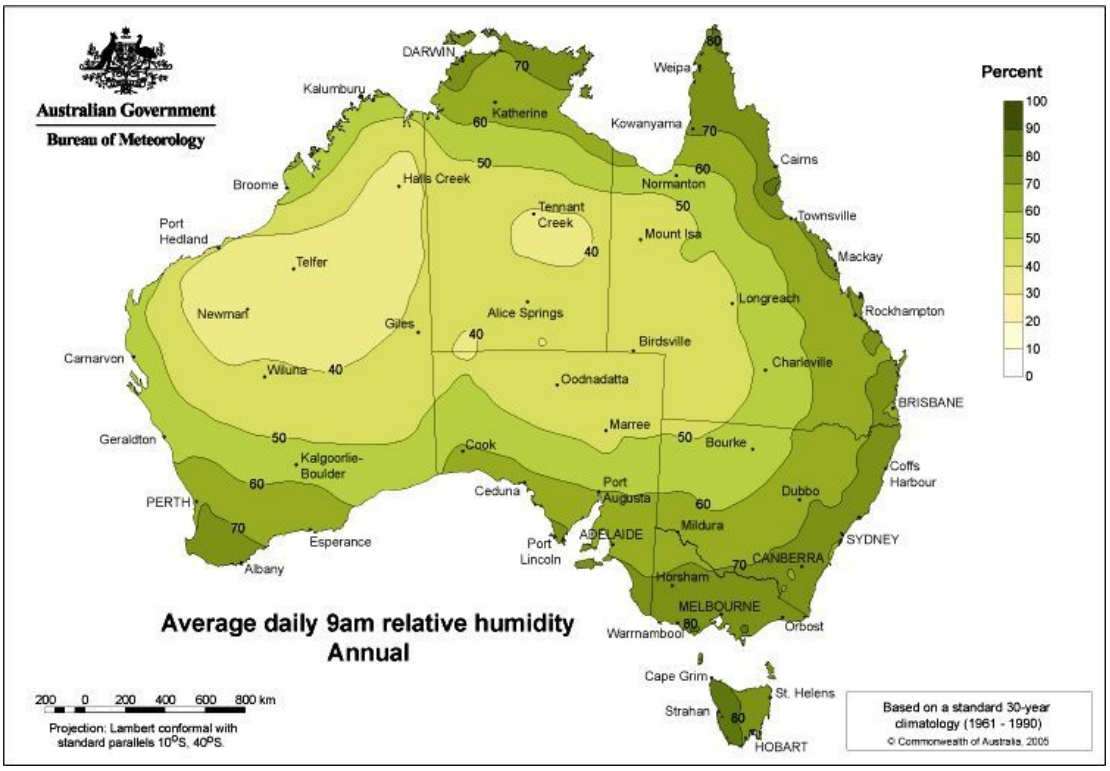

Figure 4-10: Average Annual Daily 9:00 am Relative Humidity

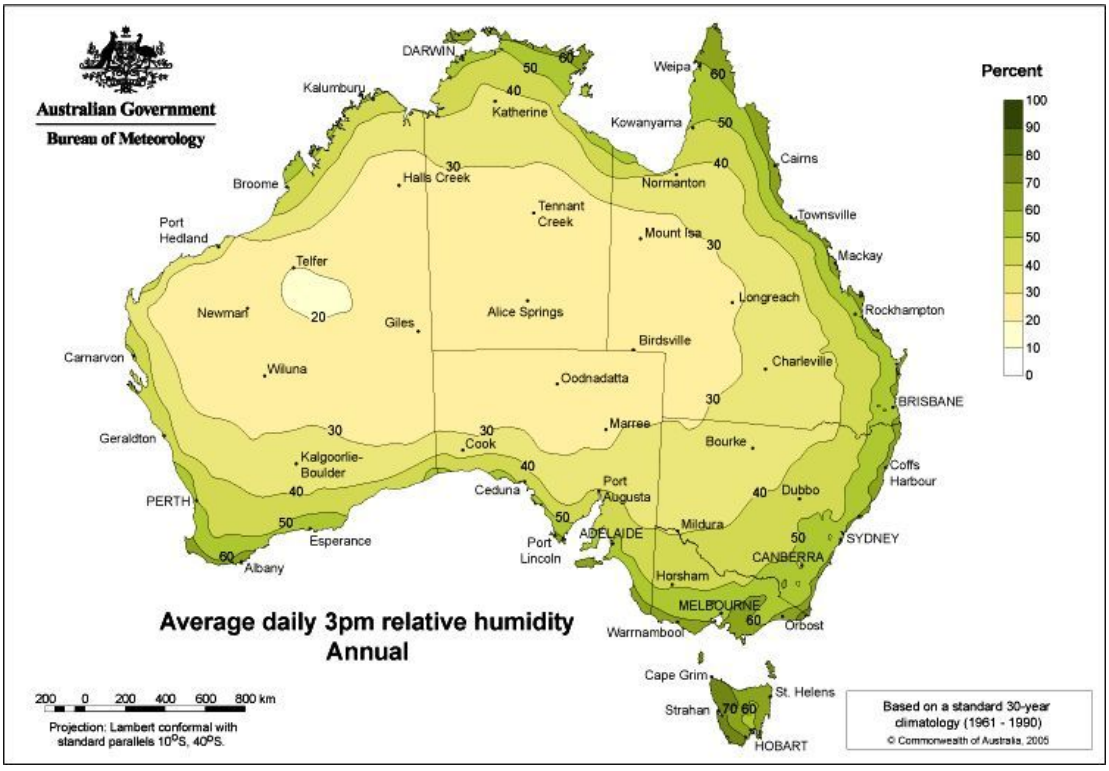

Figure 4-11: Average Annual Daily 3:00 pm Relative Humidity

4.3 WEATHER OF LOCALITIES

The towns chosen for inclusion in this project are Capella, Barcaldine and Yeppoon. These three towns are separated by a latitude difference of less than one-half of a degree while both Barcaldine and Yeppoon are separated from Capella by approximately 2.7 degrees of longitude with Yeppoon being the most easterly situated on the Capricorn Coast region of Queensland.

The longitude and longitude values for each town, as recorded by the Australian Bureau of Meteorology for the relevant weather and rainfall stations, are shown in Table 4-4: "Location of Towns". Figure 4-12: Locality Map defines relative locations within the state of Queensland.

TOWN	LATITUDE	LONGITUDE
Barcaldine	- 23.5544	145.2883
Capella	- 23.0856	148.0236
Yeppoon	- 23.0967	150.7342

Table 4-4: Location of Towns

4.3.1 Barcaldine

Barcaldine is the most westerly township described within this project. It falls within the Grassland (Hot, Persistently Dry) zone of the expanded modified Koeppen climate classification system depicted in Figure 4.1.

An average annual rainfall of 400 – 800 millimetres, average annual maximum temperature of 30 ^{0}C and an average annual minimum temperature of 15 ^{0}C place Barcaldine within the Hot Dry Summer, Mild Winter zone of the thermal comfort classification system.

On average Barcaldine experiences only 2 – 3 days per year when the quantity of rainfall received in that day exceeds 50 millimetres. Daily rainfall in excess of 5 millimetres occurs on 20 – 30 days per year.

The calculated average annual evaporation ranges from 2,800 – 3,200 millimetres while the relative humidity at 9:00 am and 3:00 pm are 50 – 60 % and 30 – 40 % respectively.

4.3.2 Capella

Capella is located with the Subtropical (Moderately Dry Winter) climatic zone as defined by the expanded modified Koeppen classification system used by the Australian Bureau of Meteorology. Residents of Capella experience hot, dry summers and cold winters - with an average maximum temperature of 27 ^{0}C and an average minimum of 12 ^{0}C.

The average annual total rainfall is within the range of 600 – 800 millimetres whilst the annual total evaporation averages approximately three times this. The rainfall pattern at Capella is similar to that of Barcaldine with only 2 – 3 days per year with rainfall in excess of 50 millimetres. At 9:00 am the relative humidity ranges from 60 – 70 % while at 3:00 pm this percentage drops to 30 – 40%.

4.3.3 Yeppoon

Yeppoon, like Capella, is located within the Subtropical zone of the modified Koeppen classification system however it falls within the No Dry Season expansion of this zone. Yeppoon receives the highest annual rainfall of the three towns: 800 – 1000 millimetres per annum; and receives rain in excess of 50 millimetres on an average of 40 – 50 days per year. The thermal comfort zone for Yeppoon is Hot Humid Summer.

The annual average temperature ranges from a minimum of 15 ^{0}C to a maximum of 24 ^{0}C and the total evaporation recorded per year averages 1,800 to 2,000 millimetres. The relative humidity of the area varies by 20 % falling within the 70 – 80 % range at 9:00 am and the 60 – 70% range at 3:00 pm.

4.4 Summary of Locality Weather

The details of the weather experienced at each of the three towns described above have been tabulated in Table 4-5: “Summary of Climate and Weather for Localities”.

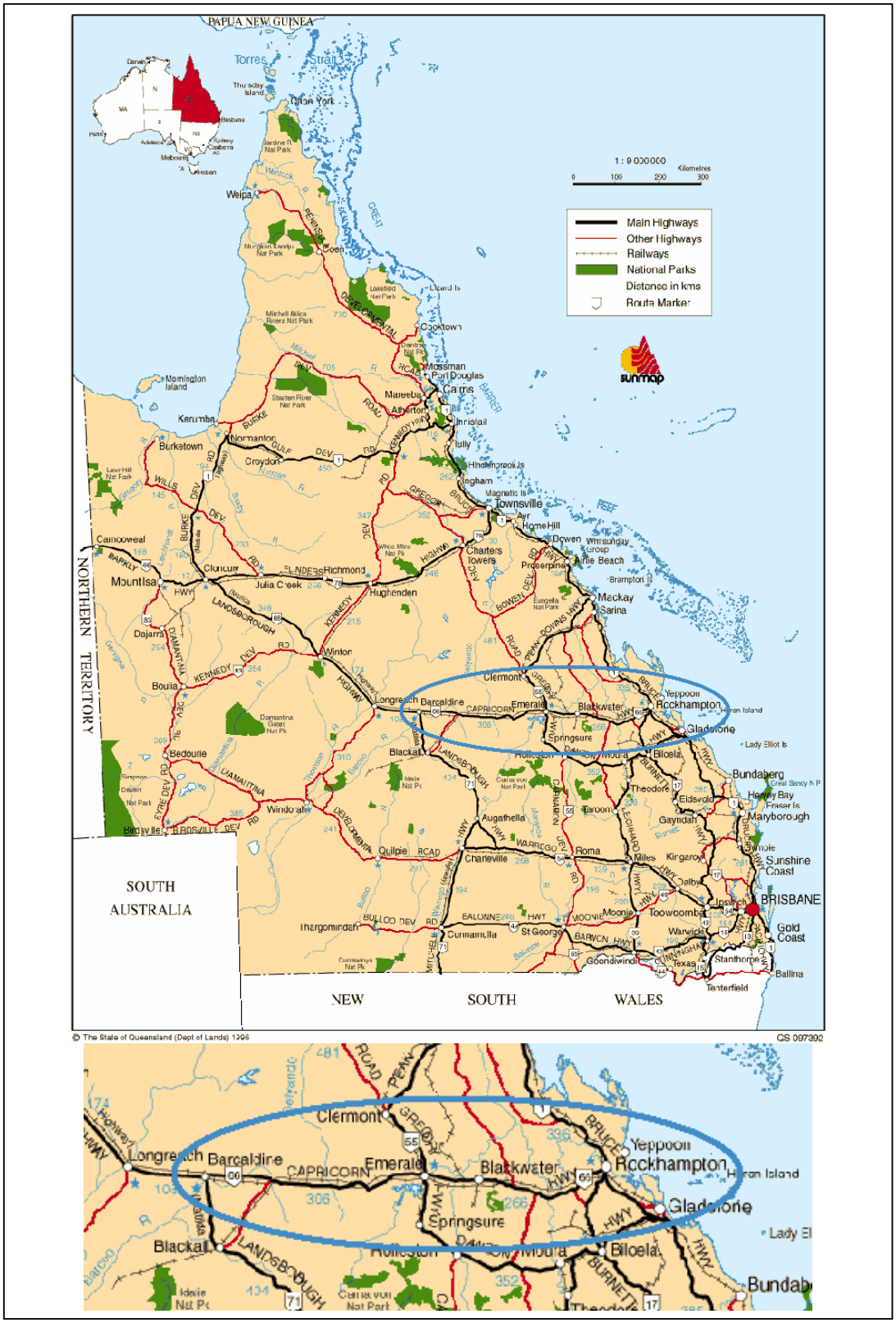

Figure 4-12: Locality Map

TOWN	BARCALDINE	CAPELLA	YEPOON
CLIMATE CLASSIFICATION (Modified Koeppen Classification)	GRASSLAND	SUBTROPICAL	SUBTROPICAL
CLIMATE CLASSIFICATION (Expanded Modified Koeppen Classification)	GRASSLAND (Hot, persistently dry)	SUBTROPICAL (moderately dry winter)	SUBTROPICAL (no dry season)
CLIMATE ZONES BASED ON TEMPERATURE AND HUMIDITY	HOT DRY SUMMER, MILD WINTER	HOT DRY SUMMER, COLD WINTER	HOT HUMID SUMMER
AVERAGE ANNUAL RAINFALL	400 – 500 mm	600 – 800 mm	800 – 1,000 mm
AVERAGE NUMBER OF DAYS WITH RAINFALL GREATER THAN 5 MM	20 – 30	20 – 30	40 - 50
AVERAGE NUMBER OF DAYS WITH RAINFALL GREATER THAN 50 MM	2 – 3	2 – 3	3 - 5
AVERAGE ANNUAL MAXIMUM TEMPERATURE	30 ^{0}C	27 ^{0}C	24 ^{0}C
AVERAGE ANNUAL MINIMUM TEMPERATURE	15 ^{0}C	12 ^{0}C	15 ^{0}C
AVERAGE EVAPORATION	2,800 – 3,200 mm	2,000- 2,400 mm	1,800 – 2,000 mm
AVERAGE DAILY 9 AM RELATIVE HUMIDITY - ANNUAL	50 – 60 %	60 – 70 %	70 – 80 %
AVERAGE DAILY 3 PM RELATIVE HUMIDITY - ANNUAL	30 – 40 %	30 – 40 %	60 – 70 %

Table 4-5: Summary of Climate and Weather for Localities

CHAPTER 5 METHODOLOGY

The model developed in this project will be based on weather based variables such as rainfall frequency and intensity, air temperatures, evaporation, relative humidity and recorded consumption.

Factors affecting the trend in water demand in Capella include growth in the number of connections and, more significantly, the imposition of water restrictions. Capella water consumers are subject to water restrictions at all times – it is only the severity of the restrictions that has varied in the timeframe being studied. In the three months prior to the failure of the Capella water supply Peak Downs Shire Council banned the use of water for any purpose other than that necessary within a house. This ban included the use of evaporative air conditioners. As Capella is a small rural town the steps in the number of metered water connections are very small. The total number of connections has increased from 367 in November 2004 to 381 in June 2005. The model will not predict consumption on a per connection basis but will provide for total outside flow.

The performance of the models produced will be evaluated with use of R^2 and F-test and T-test statistics. The final model produced will be an empirical model that assumes that future patterns will be similar to recent historical patterns. The effectiveness of the produced model will be assessed through comparison of predicted usage with actual measured usage.

5.1 VARIABLES

Any mathematical model is based on two categories of variables – known values and unknown. The domestic water consumption model will use known values, in this case weather based parameters, to predict an unknown value, water consumption.

Weather based variables include:

- rainfall;
- temperature;
- evaporation; and
- relative humidity.

Non-weather based variables included:

- number of water connections;
- daily water consumption;
- number of sewer connections;
- daily sewerage flow; and
- imposed level of restriction to water usage.

These broad categories of variables used are expanded further depending on the variable.

5.1.1 Weather Based Parameters

Weather is defined as the daily changes in the atmosphere and includes rainfall, temperature ranges, evaporation and relative humidity.

All data for weather based variables were drawn from data supplied by the Australian Bureau of Meteorology.

5.1.1.1 Rainfall

Total rainfall received, measured in millimetres, in the past twenty-four hours is recorded on a daily basis. This data will provide the base for the following variables:

- range of quantity of rainfall received;
- days since rainfall (days);
- occurrence of a rainfall event (as a binary code – 0 or 1);
- median of total rainfall of previous 3, 5 & 7 days (mm); and
- average of total rainfall of previous 3, 5 & 7 days (mm).

5.1.1.2 Temperature

Both the maximum and minimum temperatures, measured in degrees Celsius (^{0}C), occurring each day are recorded. Other variables which will be considered include:

- maximum daily temperature;
- minimum daily temperature;
- daily temperature range (maximum minus minimum);
- average daily temperature;

- variation of maximum temperature from monthly mean;
- number of days of maximum temperature above monthly mean, 25^0C, 30^0C and 40^0C;
- median value of maximum and minimum temperature of previous 3, 5 and 7 days;
- average value of maximum and minimum temperature of previous 3, 5 and 7 days; and
- maximum temperature of previous day.

5.1.1.3 Evaporation

The Australian Bureau of Meteorology use a Class A evaporation pan to measure evaporation. Total daily evaporation, measured in millimetres, is calculated following the addition of a known amount of water to the pan. This data will be used to provide data for the following variables:

- median value of total evaporation of previous 3, 5 and 7 days;
- average value of total evaporation of previous 3, 5 & 7 days; and
- quantity range of daily total evaporation.

5.1.1.4 Relative Humidity

Relative humidity is a measure of the amount of moisture in the air as a percentage of the total moisture the air can hold. The daily average relative humidity will be used for this model with the following variables also considered:

- median value of average relative humidity of previous 3, 5 and 7 days;
- average value of average relative humidity of previous 3, 5 & 7 days; and
- quantity range of daily average relative humidity.

5.1.2 Non-Weather Based Parameters

All data for non-weather based variables, for the town of Capella, is taken from records supplied by Peak Downs Shire Council.

5.1.2.1 Number of Water Connections

The total number of water connections is derived from both records of actual connection date and water units charged by the local authority. Industrial, commercial and other non-domestic connections have been converted to equivalent domestic connections.

5.1.2.2 Daily Water Consumption

The total daily water consumption for the town of Capella is measured in kilolitres (kL) and is recorded as the total flow from the Capella Water Treatment Plant. Consumption per equivalent household is calculated from total daily flow divided by total number of equivalent household connections. This daily equivalent household consumption data will be manipulated to provide the following data:

- median value of previous 3, 5 and 7 days;
- average value of previous 3, 5 & 7 days; and
- previous day's consumption

5.1.2.3 Number of Sewerage Connections

The total number of connections to Capella's sewerage network is derived from both records of actual connection date and sewerage units charged by the local authority. Industrial, commercial and other non-domestic connections have been converted to equivalent domestic connections.

5.1.2.4 Daily Sewerage Flows

Daily sewerage flows are recorded in kilolitres and are derived from recordings of pump hours. Flow per equivalent household is calculated from total daily flow divided by total number of equivalent household connections.

Only actual daily flow is used in this model to calculate base flow from household

5.1.2.5 Imposed Level of Restrictions

Residents of Capella are subject to water restrictions at all times. Peak Downs Shire Council restricts sprinkler usage to times at which evaporation etc are minimised. The imposed level of restriction is recorded as a percentage of normal restricted time.

5.1.2.6 Water Price

The cost of water to consumers will not be considered in this model. Peak Downs Shire Council does not use a stepped tariff for the sale of water. The biannual levy for water services is based on a set price for a set allocation. Water costs are levied on units of 100 kilolitres with domestic dwellings being charged for 6 units, 600 kilolitres, per year. The allocation for other level connections; schools, industrial, commercial etc; are based on an equivalent person calculation where the number of users for each connection is determined and converted to equivalent household numbers. This system is based on a factor of 2.9 equivalent persons per equivalent household. Each financial year he cost per unit of water allocation is increased in line with the consumer price index. The cost per kilolitre of water used above the set allocation is set at $1.25 / kL. This charge has not increased over the timeframe covered by this project.

5.2 PROCESSES

All calculations, modelling and analysis for this project will be carried out using the Microsoft Office spreadsheet program Excel. This program is readily available and includes a suite of processes known as Statistical Analysis Tools. Within this pack there is the capability to perform linear regression, correlation, ANOVA, F-test and t-test analyses.

5.2.1 Linear Regression Analysis

The regression process is used to determine how a dependent variable is affected to one or more other variables. Excel uses a “least squares” method to fit a line to a set of observations.

5.2.1.1 Formula

The analysis is based on the formula:

Equation 5-1: Linear Regression

$$\mathbf{y = m_1 x_1 + m_2 x_2 + ... + m_n x_n + b}$$

Where:

y = the dependent variable

x = the independent variables

m = coefficients of x variables

b = a constant value

The calculation of m and b are based on the following formulas:

Equation 5-2: Slope of line

$$m = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

Where

m = slope of line

$\bar{x}$ = mean of x variables; and

$\bar{y}$ = mean of y variables

Equation 5-3: Line Intercept

$$b = \bar{y} - m\bar{x}$$

Where:

b = intercept of line

5.2.1.2 Results

Use of the Regression alibility of the Data Analysis system produces regression statistic such as Pearson's correlation coefficient r, R^2 and values for standard errors. Pearson's correlation coefficient is discussed in Section 5.2.2: Correlation. The values of R and R^2 resulting from this analysis give an indication of the variability of the residual values from the regression line. This variability is relative to the overall variability of the results. R^2 will have a value between 0 and 1 where a value closer to 1 indicates that most of the variability within the variables used is accounted for.

5.2.2 Correlation

The correlation coefficients produced with use of the regression suite are produced using the following formula:

Equation 5-4: Correlation Coefficient

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

Where:

x = independent variables
y = dependent variables
$\bar{x}$ = average of all x variables
$\bar{y}$ = average of all y variables

5.2.3 Variance

Variance is a measure of the variability of a sample. Excel uses the following formula to calculate sample variance:

Equation 5-5: Variance

$$V = \frac{\sum (x - \bar{x})^2}{(n - 1)}$$

Where:

n = size of sample

and other values are as defined previously.

5.3 TESTING OF MODEL

The performance of the models produced will be evaluated using F-tests and t-tests. The final model produced will be an empirical model that assumes that future patterns will be similar to recent historical patterns. The effectiveness of the produced model will be assessed through comparison of predicted usage with actual measured usage.

5.3.1 Analysis of Variance (ANOVA)

Two analysis systems are used to determine the variance in the means of sample groups. An F-test will be used where there is more than two groups, while a T-test will be used when there is only two. Both of these tests can be carried out using Microsoft Excel.

5.3.1.1 F-Test

The F-test provides a measure of the variance between two or more groups by the comparison of a calculated F value, F_{calc}, with a predetermined critical F value, F_{crit}. The analysis is the ratio of the variance of group one to the variance of group two.

Equation 5-6: F-Test

$$F = \frac{V_1}{V_2}$$

Where:

V_1 = variance of group 1

V_2 = variance of group 2

5.3.1.2 T-Test

The formula for a t-test is the ratio of the difference in the group means to the difference in variance of the groups. This is shown by the following formula:

Equation 5-7: t – Test

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\left(V_1 / n_1\right) + \left(V_2 / n_2\right)}}$$

Where:

$\bar{x}_1$ = mean of group 1

$\bar{x}_2$ = mean of group 2

V_1 = variance of group 1

V_2 = variance of group 2

n_1 = sample size of group 1

n_2 = sample size of group 2

The t-test is used to determine if two groups a statistically different from each other. The result of this calculation, $t_{statistic,}$ is compared to a $t_{critical}$ value. When the Excel t-test ability is used the programme also calculates this $t_{critcial}$ value. An absolute value of $t_{statistic}$ which is significantly higher than the $t_{critical}$ value is an indication that there is a significant relationship between the groups.

CHAPTER 6 DATA - CAPELLA

6.1 DATA SOURCES

6.1.1 Daily Water Consumption

The data used for the modelling of daily water consumption for the town of Capella has been sourced from Peak Downs Shire Council records. Peak Downs Shire Council records daily water usage, as pumped from the Capella Water Treatment Plant, on a written spreadsheet for each month. This form of recorded data is available from 1993. The records were readily available, however not all daily information was recorded and some gaps were found in several early years. The data from the monthly sheets needed to be transferred to an electronic format. This process was used as a check of accuracy of calculations made and enabled the correction of simple errors in addition and subtraction.

6.1.2 Daily Sewerage Flows

In a fashion similar to the recording of daily water consumption Peak Downs Shire Council also records daily sewerage flows. As with the water records, this practice commenced in 1993. This flow was not metered until the installation of a flowmeter onto the main influent line in October 2005. Prior to the installation and calibration of this meter daily flow was calculated through calculation from pump hours.

6.1.3 Daily Weather & Rainfall Records

The Australian Bureau of Meteorology has a rainfall recording station at the Capella Post Office. The records from this location are readily available through internet access to the bureau's website and in an electronic format direct from the Bureau of Meteorology. This station only records rain and not other weather data.

The Bureau of Meteorology operates full weather stations at both Emerald and Clermont, towns located within 55 kilometres of Capella. The data available from these stations

includes daily minimum and maximum temperature, rainfall, strongest wind gust, evaporation, and sunshine, together with values at 9am and 3pm of temperature, humidity, wind, cloud and pressure

Peak Downs Shire Council installed a weather station at the Capella Water Storage facilities in February 2003. This station recorded maximum and minimum temperature, rainfall, wind speed and direction, humidity and radiation. The data recorded by the Capella weather station has many gaps and is not of a time length comparable to the length of records of other variables. For this reason the Capella data was compared to that of the Emerald and Clermont data to determine which of the other sources was most suitable for use in this project. This data is readily available from the same source as the rainfall data. The results of this correlation analysis are shown in Table 6-1 below. The full set of the data used in this process is included in Appendix B.

Weather Record	**Correlation Coefficient**		
	Capella	**Clermont**	**Emerald**
Precipitation in the 24 hours before 9am (local time) in mm	0.9911	0.2407	0.3039
Evaporation in 24 hours before 9am (local time) in mm		0.8501	
Maximum temperature in 24 hours after 9am (local time) in Degrees C		0.8360	0.7771
Minimum temperature in 24 hours before 9am (local time) in Degrees C		0.9693	0.9605
Average daily temperature (All Readings)		0.9560	0.9408
Average daily temperature {(max + min)/2}		0.9479	0.9358
Average Relative Humidity		0.8406	0.8213
Maximum Relative Humidity		0.7576	0.7623
Minimum Relative Humidity		0.6574	0.7305
Average Correlation Coefficient		**0.85185**	**0.84689**

Table 6-1: Correlation of Data – Capella, Emerald & Clermont

6.1.4 Connections to Services

Records of connections to metered water services in the town of Capella are readily available from Peak Downs Shire Council. These water services connections can be separated into domestic and commercial/industrial connections based on the number of service units charged.

CHAPTER 7 MODELLING CAPELLA

Analysis of all data available revealed the year from 1 July 1999 to 30 June 2000 as the only period for which a full data set of each variable is available. During this timeframe the residents were only under Level 1 water restrictions. For this reason this data has been used to produce this model.

The final model will aid in the prediction of total daily consumption for town of Capella without the imposition of water restrictions. The effect of restrictions can be calculated by applying a percentage of normal watering hours to the final model.

7.1 DOMESTIC WATER CONSUMPTION

Total domestic water consumption is made up of base flow and outside flow. Before modelling of consumption these two flows must be defined and separated.

7.1.1 Base Flow

Base flow is defined as the water consumed within a household. A comparison of total monthly wastewater flow per household and total monthly water consumption per household, as shown in Figure 7-1: "Graph – Wastewater and Water", for the period from July 1999 to June 2005 shows that during the period from March 2003 to December 2003 the flows are very similar. During this period Peak Downs Shire Council enforced full bans of outside water usage. Analysis shows a correlation of 0.879 for this data in this timeframe. This correlation forms the basis for the use of wastewater flow per equivalent sewer network connection as the base flow for the model.

Equation 7-1: Total Base Flow

$$\textbf{Total Base Flow} = \left(\frac{\textbf{Total Wastewater Flow}}{\textbf{Number of Sewer Connections}} \right) \textbf{x Number of Water Connections}$$

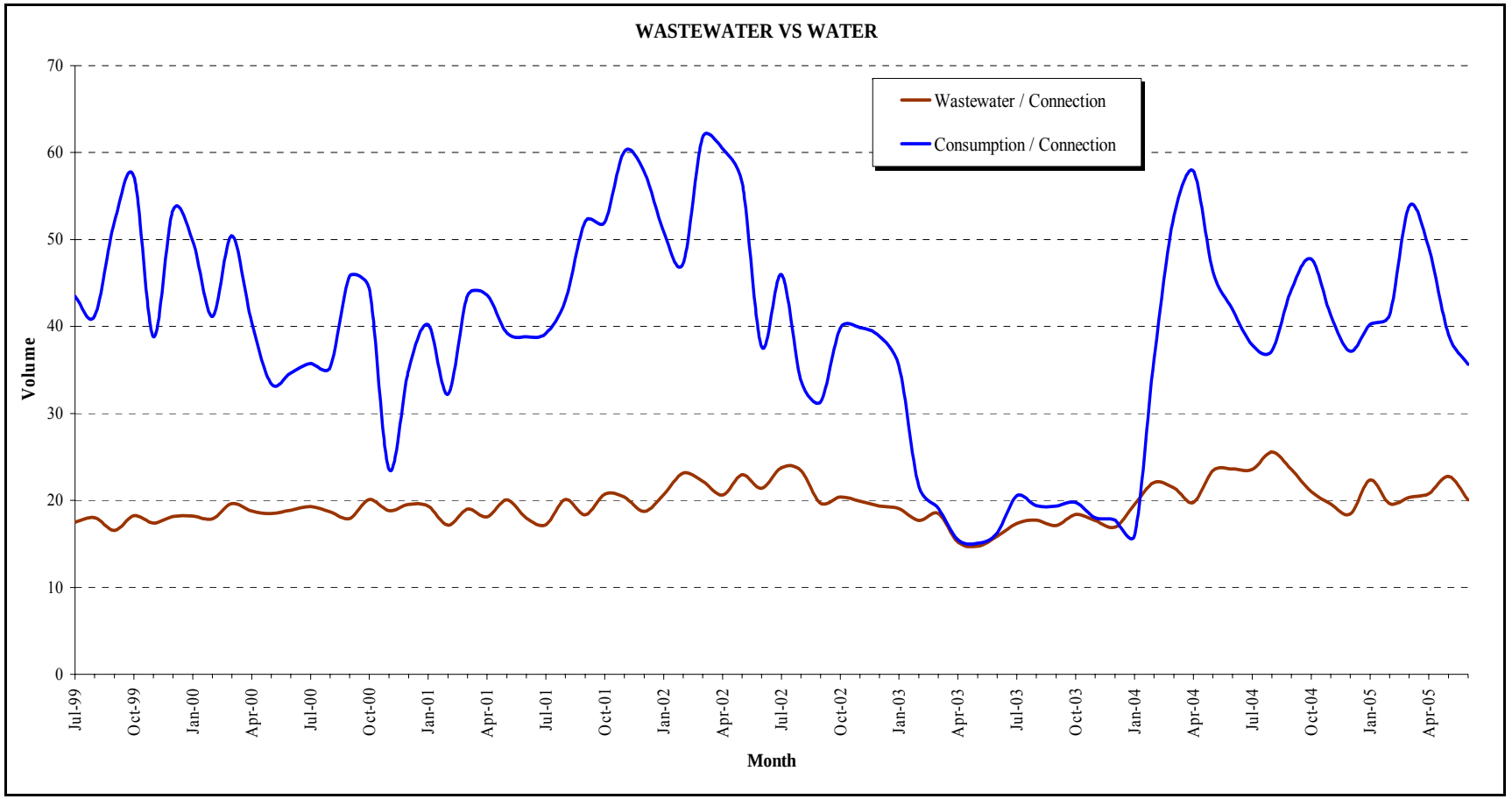

Figure 7-1: Graph - Wastewater and Water

In the period of this model Capella had 356.33 equivalent households connected to the sewer network and 485.5 equivalent households accessing the town's water supply. To ensure the correct value for base flow the total daily sewerage flow was divided by the number of sewer connections to find the average flow per connection. This value was then multiplied by the total number of water connections to calculate the total base flow for all water connections.

7.1.2 Outside Flow

Outside flow includes all water used outside of the building including that used for gardening, external cleaning, car washing and by evaporative air conditioners. All flow which is not base flow in classified as outside flow.

Equation 7-2: Total Outside Flow

$$\textbf{Total Outside Flow} = \textbf{Total Consumption - Total Base Flow}$$

7.2 PRELIMINARY ASSESSMENT OF WEATHER PARAMETERS

Data for six weather based variables was used for the calculation of this model. This base data was expanded further to produce a total of 75 different variables. This many variables can be assembled into more than two thousand combinations for use in the model. To reduce the number of variables to only those with the highest coefficient of correlation when related to total outside flow the 75 variables were assessed individually. The single initial variables were assessed to determine the correlation strength of each then the expanded variables were assessed in the same way.

7.2.1 Single Parameters

The initial variable values available were:

- Temperature;
  - maximum daily;
  - daily minimum;
  - average daily;
- rainfall;

- relative humidity; and
- evaporation

Linear regression analysis was carried out on these individual parameters to determine the strength of correlation between the recorded outside flow and single parameters. The results of these calculations are shown in Table 7-1: "Strength of Correlation – Single Parameters" and Figure 7-1: "Graph – Coefficients" below.

Variable	Coefficient	Intercept	R^2	F_{calc}	$F_{critical}$	Rank
Maximum Temperature	19.7546	-145.5015	0.2848	1486.8856	3.8542	3
Minimum Temperature	6.2511	324.1856	0.0278	1587.0125	3.8542	6
Average Temperature	15.7358	72.6490	0.1502	1536.7581	3.8542	4
Rainfall	-10.1205	436.0546	0.0714	1702.8021	3.8542	5
Relative Humidity	-10.2772	1113.1488	0.3785	1208.0926	3.8542	2
Evaporation	55.2271	150.1086	0.4272	1675.0657	3.8542	1

Table 7-1: Strength of Correlation - Single Parameters

These results show that, taken singly, outside flow and total evaporation have the highest correlation, R^2 equal to 0.4272, whilst minimum temperature has the least. This table also shows that, as expected, rainfall and relative humidity have negative variable coefficients. This negativity indicates that as these two variables increase outside flow will decrease.

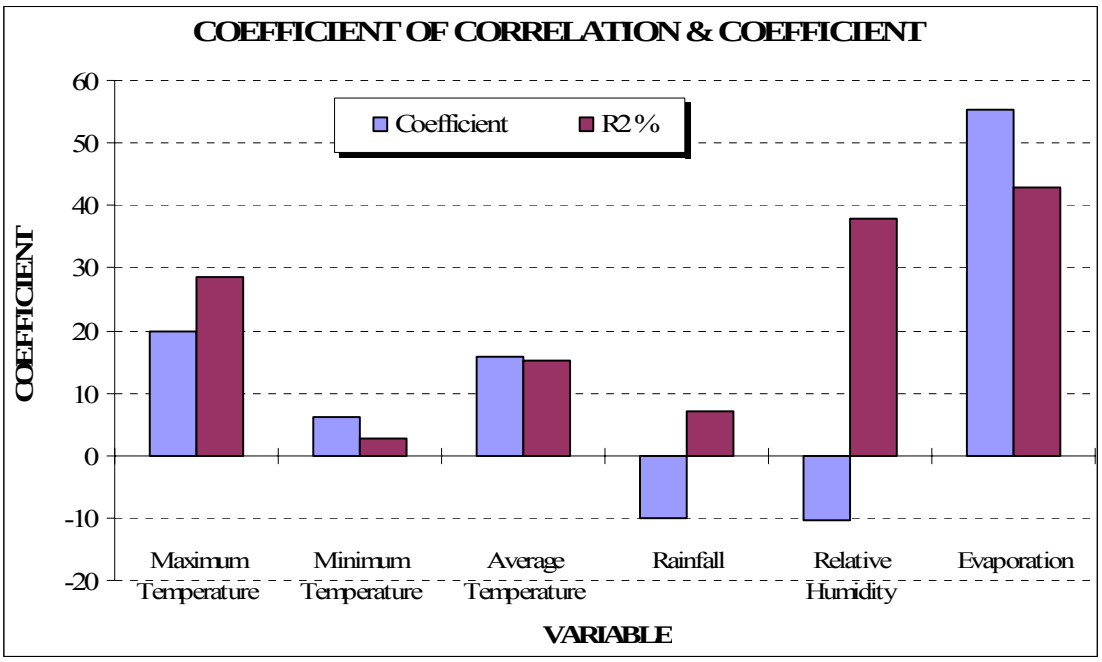

Figure 7-2: Graph – Coefficients

7.2.2 Expansion of Parameters

7.2.2.1 Temperature

The single temperature variables; daily maximum temperature, daily minimum temperature and daily average temperature; were expanded based on quantity, range, median and average values of 7, 5 and three days and previous day recordings. This manipulation produced a total of 33 expanded variables which were regressed against outside flow. The results of this process are shown in Table 7-2: "Regression Results – Temperature".

	OUTSIDE FLOW	Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
1	**Max Temp**	19.755	-145.502	0.285	8	1486.886	YES
2	**Min Temp**	6.251	324.186	0.028	25	1587.013	YES
3	**Ave Temp - R**	17.035	43.272	0.180	11	1536.510	YES
4	**Ave Temp - C**	15.736	72.649	0.150	19	1536.758	YES
5	**Range**	17.135	198.804	0.163	15	1608.146	YES

	OUTSIDE FLOW		Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
6	DEVIATION FROM MONTHLY AVER	Max	21.909	441.963	0.161	16	1719.951	YES
7		Average - C	15.844	423.869	0.041	24	1713.748	YES
8	DAYS MAXIMUM ABOVE	Average	20.754	380.872	0.103	22	1696.672	YES
9		25 ^{0}C	4.558	332.445	0.245	10	1538.687	YES
10		30 ^{0}C	15.252	362.483	0.260	9	1679.677	YES
11		35 ^{0}C	47.570	410.106	0.056	23	1711.128	YES
12		40 ^{0}C	76.660	421.066	0.003	33	1713.121	YES
13	MAXIMUM TEMPERATURE	med - 7	22.740	-235.682	0.310	7	1485.634	YES
14		med - 5	23.114	-245.107	0.342	5	1486.028	YES
15		med -3	23.097	-242.580	0.372	2	1486.616	YES
16		aver - 7	23.522	-253.854	0.323	6	1487.082	YES
17		aver - 5	24.060	-269.438	0.357	4	1486.999	YES
18		aver - 3	23.573	-255.440	0.367	3	1486.934	YES
19		PREV DAY	22.647	-228.821	0.374	1	1486.834	YES
20	MINIMUM TEMPERATURE	med - 7	5.484	336.235	0.018	32	1587.147	YES
21		med - 5	5.532	335.446	0.019	31	1587.066	YES
22		med -3	5.470	336.429	0.019	30	1587.054	YES
23		aver - 7	5.825	330.647	0.019	29	1586.910	YES
24		aver - 5	5.764	331.621	0.020	28	1586.900	YES
25		aver - 3	5.824	330.742	0.021	26	1586.924	YES
26		PREV DAY	5.451	336.563	0.020	27	1586.777	YES
27	AVERAGE TEMPERATURE (CALC)	med - 7	16.162	62.153	0.142	20	1536.380	YES
28		med - 5	16.658	50.996	0.154	18	1536.305	YES
29		med -3	16.878	47.005	0.167	13	1536.672	YES
30		aver - 7	16.217	61.626	0.141	21	1536.709	YES
31		aver - 5	16.841	47.718	0.156	17	1536.682	YES
32		aver - 3	17.075	42.605	0.167	14	1536.688	YES
33		PREV DAY	17.064	42.780	0.175	12	1536.615	YES

Table 7-2: Regression Results - Temperature

These results show that the maximum temperature variables have the highest correlation with outside flow and that of the previous day is the strongest. A scatter plot of outside flow and the previous day's maximum temperature is shown in Figure 7-3.

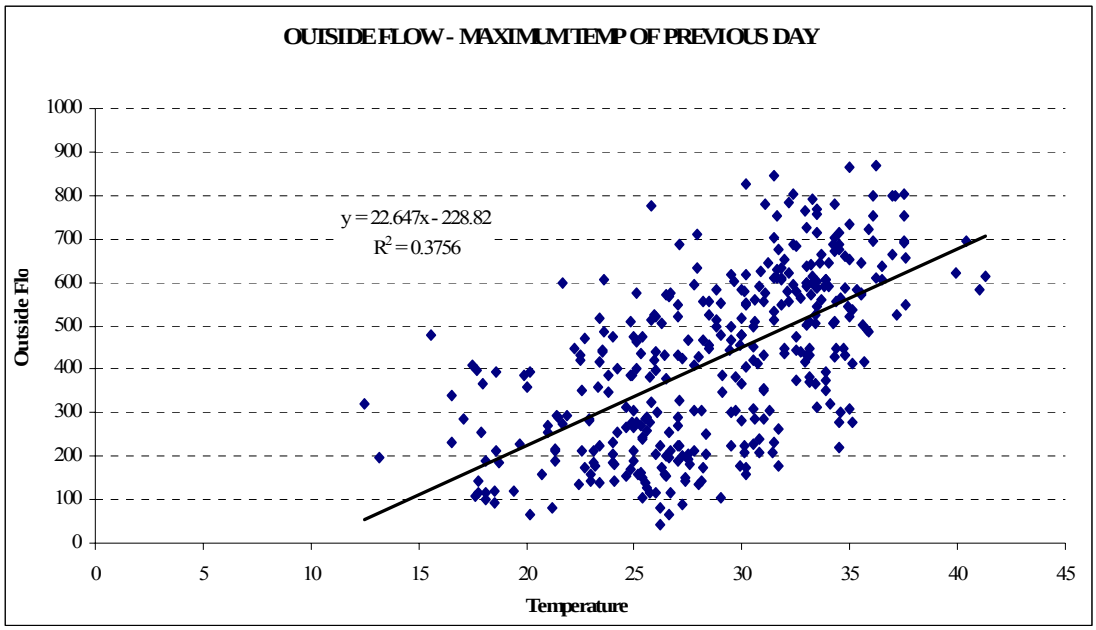

Figure 7-3: Graph - Outside Flow Vs Maximum Temperature (Previous Day)

7.2.2.2 Rainfall

The expansion of the rainfall data included calculation of days since rain, occurrence of a rain event and ranges of rainfall quantity. When combined with median and average calculations over 7, 5 and 3, and previous day's recordings 13 variables were produced.

The occurrence of a rainfall event, defined as a quantity greater than 0.2 millimetres, was recorded as a binary code where a value of 1 was accorded to days of rain and a value of 0 is given to days without rain.

Three levels of rainfall quantity were tested. The ranges of quantity used in each expansion are detailed in Table 7-3: "Quantity Ranges – Rainfall" where q is the total rainfall received measured in millimetres.

	Value				
Quantity	**0**	**1**	**2**	**3**	**4**
a	q < 1	1 < q ≥ 5	5 < q ≥ 15	15 < q ≥ 25	25 < q
b	q < 1	1 < q ≥ 10	10 < q ≥ 25	25 < q	
c	q < 3	3 < q ≥ 10	10 < q		

Table 7-3: Quantity Ranges – Rainfall

The results of the linear regression of the expanded variables against total outside flow are shown in Table 7-4: "Regression Results – Rainfall". These results show that the average rainfall received over seven days has the strongest correlation with total outside flow. The coefficient of correlation between these two sets of data is 0.223.

The negative variable coefficient and a scatter plot of these two variables, as shown in Figure 7-3: "Graph – Outside Flow Vs Average Seven Day Rainfall", shows that as rainfall increases outside flow decreases.

	OUTSIDE FLOW		**Coefficient**	**Intercept**	**R^2**	**Rank**	**F_{CALC}**	**ACCEPT**
1	**Total**		-10.121	436.055	0.071	11	1702.802	YES
2	**QUANTITY**	**A**	-94.578	446.019	0.124	5	1713.032	YES
3		**B**	-129.973	443.197	0.116	7	1713.777	YES
4		**C**	-153.004	443.984	0.120	6	1713.935	YES
5	**DAYS SINCE RAIN**		7.651	362.879	0.100	8	1649.740	YES
6	**RAIN EVENT**		-206.143	454.350	0.145	4	1713.827	YES

	OUTSIDE FLOW		Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
7	MEDIAN	7 DAYS	-68.499	430.817	0.054	13	1714.061	YES
8		5 DAYS	-21.720	431.871	0.060	12	1711.272	YES
9		3 DAYS	-19.238	436.311	0.086	9	1708.754	YES
10	AVERAGE	7 DAYS	-35.036	470.161	0.223	1	1703.693	YES
11		5 DAYS	-28.304	460.928	0.193	2	1703.598	YES
12		3 DAYS	-20.423	450.112	0.149	3	1703.415	YES
13	PREV DAY		-10.844	437.041	0.085	10	1702.802	YES

Table 7-4: Regression Results – Rainfall

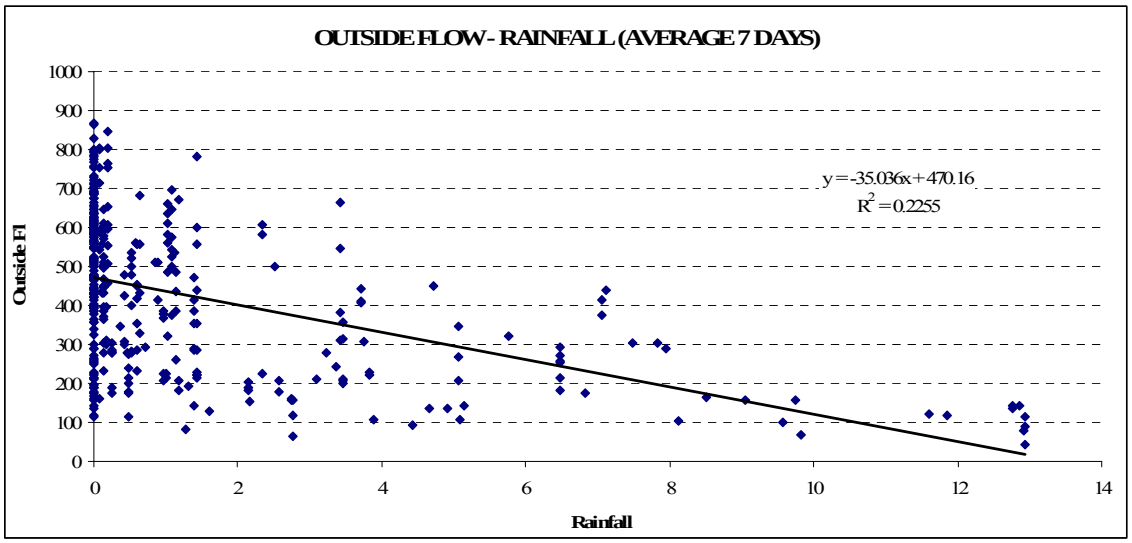

Figure 7-4: Graph - Outside Flow Vs Average 7 Day Rainfall

7.2.2.3 Relative Humidity

The relative humidity data was expanded in a similar manner to that of rainfall. The quantity ranges used are detailed in Table 7-5: "Quantity Ranges – Relative Humidity" where "RH" is relative humidity measured as a percentage.

	Value				
Quantity	**0**	**1**	**2**	**3**	**4**
a	RH < 20	20 < RH ≥ 40	40 < RH ≥ 60	60 < RH ≥ 80	80 < RH ≥ 100
b	RH < 10	10 < RH ≥ 25	25 < RH ≥ 50	50 < RH	
c	RH < 50	50 < RH			

Table 7-5: Quantity Ranges - Relative Humidity

	OUTSIDE FLOW		Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
1	Total		-10.277	1113.149	0.379	6	1208.093	YES
2	QUANTITY	A	-159.914	873.151	0.282	9	1692.250	YES
3		B	-122.278	778.053	0.032	11	1691.537	YES
4		C	-128.144	539.186	0.032	10	1707.689	YES
5	MEDIAN	7 DAYS	-13.357	1323.506	0.373	7	1208.236	YES
6		5 DAYS	-12.615	1273.118	0.385	4	1207.949	YES
7		3 DAYS	-11.432	1193.714	0.379	5	1206.901	YES
8	AVERAGE	7 DAYS	-14.097	1371.233	0.395	3	1209.347	YES
9		5 DAYS	-13.524	1332.641	0.412	1	1208.961	YES
10		3 DAYS	-12.259	1247.243	0.408	2	1208.391	YES
11	PREV DAY		-9.094	1034.467	0.300	8	1207.427	YES

Table 7-6: Regression Results - Relative Humidity

The average of relative humidity recorded over 5 days has the highest coefficient of correlation, 0.412; while the actual humidity of the day was ranked in the middle of the variables.

As with rainfall the scatter plot of this data, Figure 7-5: "Graph – Outside Flow Vs Average 5 Day Relative Humidity", and the negative variable coefficient confirms that as relative humidity increases outside flow decreases.

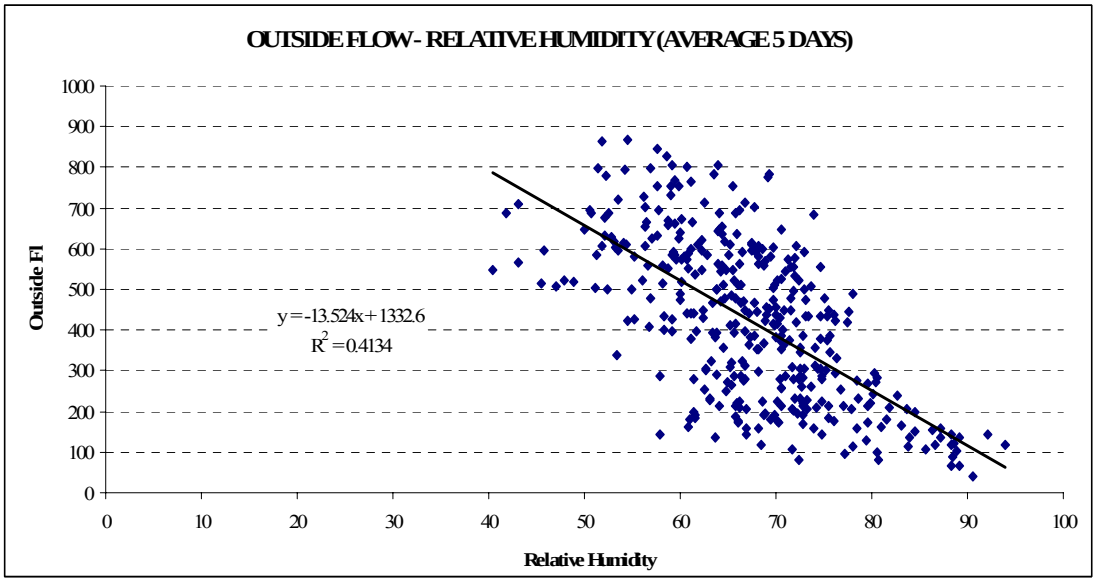

Figure 7-5: Graph - Outside Flow Vs Average 5 Day Relative Humidity

7.2.2.4 Evaporation

Median and average values over 7, 5 and three days were calculated from the total evaporation data. Three stepped ranges, from 0 to 10 mm, were used to determine affect of quantity of evaporation. These ranges are detailed in Table 7-7: "Quantity Ranges – Evaporation" where "E" is evaporation recorded in millimetres.

	Value					
Quantity	**0**	**1**	**2**	**3**	**4**	**5**
a	E < 1	1 < E ≥ 2.5	2.5 < E ≥ 5	5 < E ≥ 7.5	7.5 < E ≥ 10	10 < E
b	E < 1	1 < E ≥ 5	5 < E ≥ 10	10 < E		
c	E < 5	5 < E ≥ 10	10 < E			

Table 7-7: Quantity Ranges – Evaporation

Inspection of Table 7-8: "Regression Results – Evaporation" shows that the average of three days of evaporation is most closely correlated with outside flow with an R^2 value of 0.432. This value is only slightly higher than that of actual evaporation.

	OUTSIDE FLOW		Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
1	Total		55.227	150.109	0.427	2	1675.066	YES
2	QUANTITY	A	124.136	138.699	0.392	5	1696.549	YES
3		B	220.116	114.324	0.353	9	1703.740	YES
4		C	226.034	328.373	0.332	11	1711.715	YES
5	MEDIAN	7 DAYS	54.803	146.630	0.340	10	1674.286	YES
6		5 DAYS	55.707	144.470	0.367	6	1674.622	YES
7		3 DAYS	58.087	136.553	0.426	3	1675.172	YES
8	AVERAGE	7 DAYS	61.205	120.761	0.364	7	1675.151	YES
9		5 DAYS	61.944	117.191	0.401	4	1675.148	YES
10		3 DAYS	61.246	120.607	0.432	1	1675.139	YES
11	PREV DAY		50.346	174.406	0.356	8	1675.104	YES

Table 7-8: Regression Results – Evaporation

The scatter plot, Figure 7-6, of these two variables, outside flow and 5 day average evaporation, shows that outside flow increases as evaporation increases.

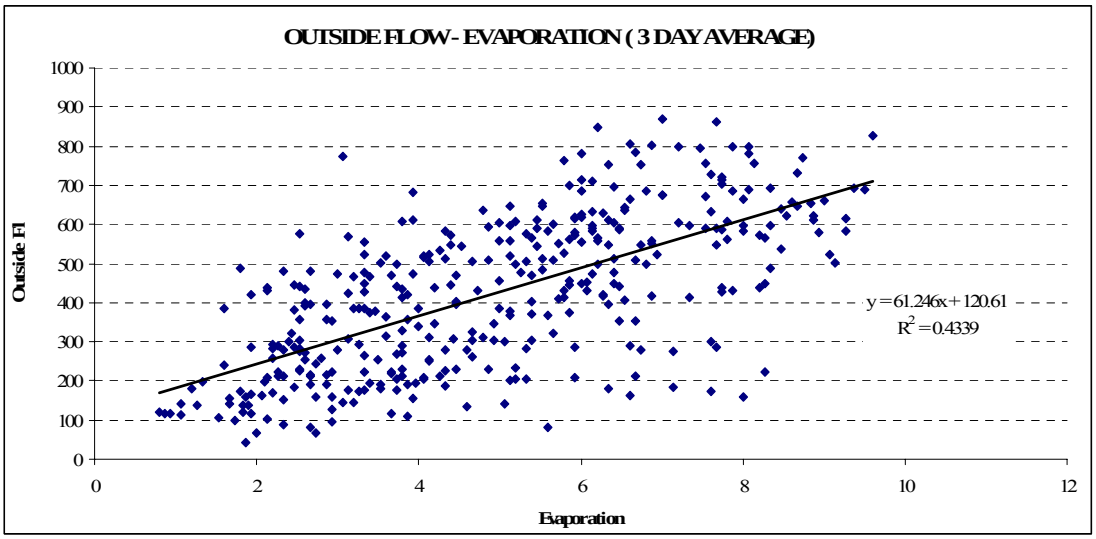

Figure 7-6: Graph - Outside Flow Vs Average 3 Day Evaporation

7.2.2.5 Outside Flow

Seven, five and three day median and average values of outside flow were also calculated. These values have a strong autocorrelation with actual daily outside flow when linearly regressed on an individual basis, but may be significant when combined with other weather based variables.

The results of these regressions are tabled in Table 7-9: "Regression Results – Outside Flow" and show that the average of three day outside flow has the highest correlation coefficient. The $F_{calculated}$ values for these regression were less than the $F_{critical}$ so direct regression results should be rejected.

	OUTSIDE FLOW		Coefficient	Intercept	R^2	Rank	F_{CALC}	ACCEPT
1	MEDIAN	7 DAYS	0.811	77.485	0.528	7	0.068	NO
2		5 DAYS	0.856	61.362	0.622	5	0.000	NO
3		3 DAYS	0.939	26.242	0.791	2	0.000	NO
4	AVERAGE	7 DAYS	0.926	30.319	0.588	6	0.018	NO
5		5 DAYS	0.953	19.194	0.686	3	0.007	NO
6		3 DAYS	0.988	4.913	0.822	1	0.002	NO
7	PREV DAY		0.799	84.773	0.638	4	0.000	NO

Table 7-9: Regression Results - Outside Flow

7.3 TOTAL MODELS

Two total consumption models were produced by using the variable from each section which had the highest coefficient of correlation. These variables and their R^2 values are tabulated in Table 7-10: "Regression Results – Total Model". As the $F_{calculated}$ values for the comparison of the outside flows were less than the $F_{critical}$ values, and there is a strong autocorrelation between values, models were produced with and without this variable for comparison.

Variable	Model		Linear Regression Results				
	No	Expansion	Coefficient	Intercept	R^2	Rank	F_{CALC}
Evaporation	10	Average - 3 Days	61.246	120.60	0.432	2	1675.13
Relative Humidity	9	Average - 5 Days	-13.524	1332.64	0.412	3	1208.96
Rainfall	10	Average - 7 Days	-35.036	470.16	0.223	5	1703.69
Temperature	19	Maximum - Prev Day	22.647	-228.82	0.374	4	1486.83
Outside Flow	6	Average - 3 Days	0.988	4.91	0.822	1	0.002

Table 7-10: Regression Results - Total Model

7.3.1 Without Outside Flow

Completing a linear regression analysis of only the weather based variables produced the results as tabulated in Table 7-11: "Regression Results – Total Model 1".

Variable		Coefficient
Evaporation	**Average- 3 Days**	9.1458
Relative Humidity	**Average- 5 Days**	-7.1471
Rainfall	**Average- 7 Days**	-13.9123
Temperature	**Maximum- Prev Day**	13.8437
Intercept		479.4033
R^2		0.5978
$F_{calculated}$		1540.0550
F_{critic}		2.3768

Table 7-11: Regression Results - Total Model 1

Figure 7-7: Graph – Actual Vs Predicted Results – No Outside Flow" shows the error resulting from this analysis.

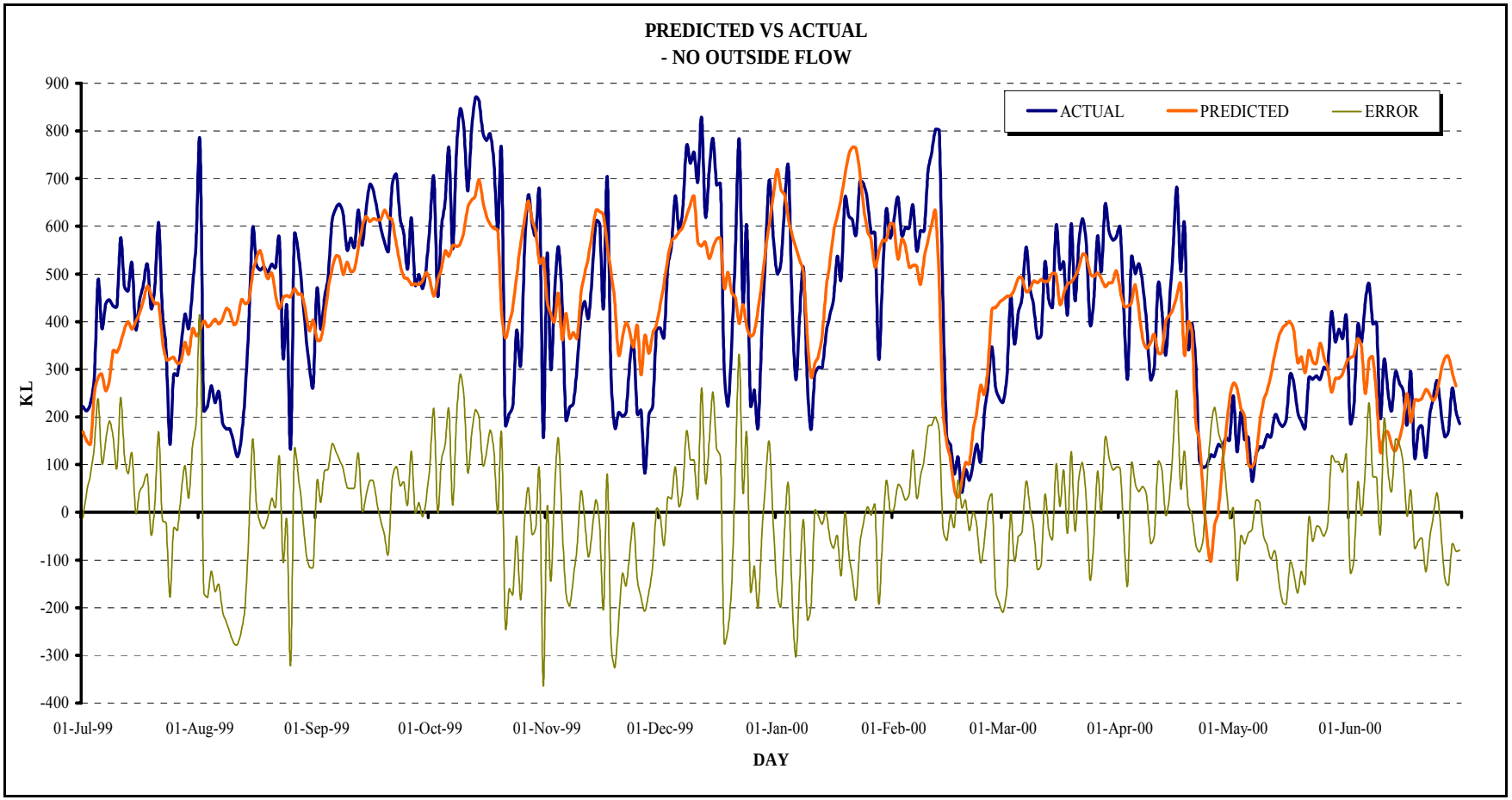

Figure 7-7: Graph - Actual Vs Predicted Results - No Outside Flow

This model lacks any consistency in estimation. It over- and under-estimates both peaks and troughs in the flow. This error is particularly noticeable following periods of rainfall. The data used for this analysis and the relevant errors have been tabulated in Appendix C.

7.3.2 With Outside Flow

Including the outside flow expanded variable; 3 day average; improved the model significantly. The results have been tabulated in Table 7-12: "Regression Results – Total Model 2".

Variable		Coefficient
Evaporation	**Average - 3 Days**	-21.8291
Relative Humidity	**Average - 5 Days**	-1.5270
Rainfall	**Average - 7 Days**	-0.81733
Temperature	**Maximum - Prev Day**	8.4531
Outside Flow	**Average - 3 Days**	0.9711
Intercept		-19.64573972
R^2		0.8436
$F_{calculated}$		1328.8900
F_{critic}		2.2181

Table 7-12: Regression Results - Total Model 2

The coefficient of correlation for this model, 0.8436, indicates that more than 84% of outside flow can be predicted. While the inclusion of the outside flow variable did reduce the $F_{calculated}$ value for the model the value is still significantly higher than the $F_{critical}$ value so the model is acceptable.

Figure 7-8: Graph – Actual Vs Predicted Results – With Outside Flow" shows the error resulting from this analysis.

This model is more consistent with prediction of peaks and troughs in flows however there appears to be a delay in these predictions. The data used for this analysis and the relevant errors have been tabulated in Appendix D.

7.3.3 Application of Restrictions

Water restrictions in Capella are based on reducing outside usage on a percentage basis. As the level of restriction increases the number of hours during which watering is permitted decreases. The model predicts full outside flow with normal Level 1 restrictions. By applying these restriction levels as a percentage of normal (Level 1) levels the outside flow can still be predicted.

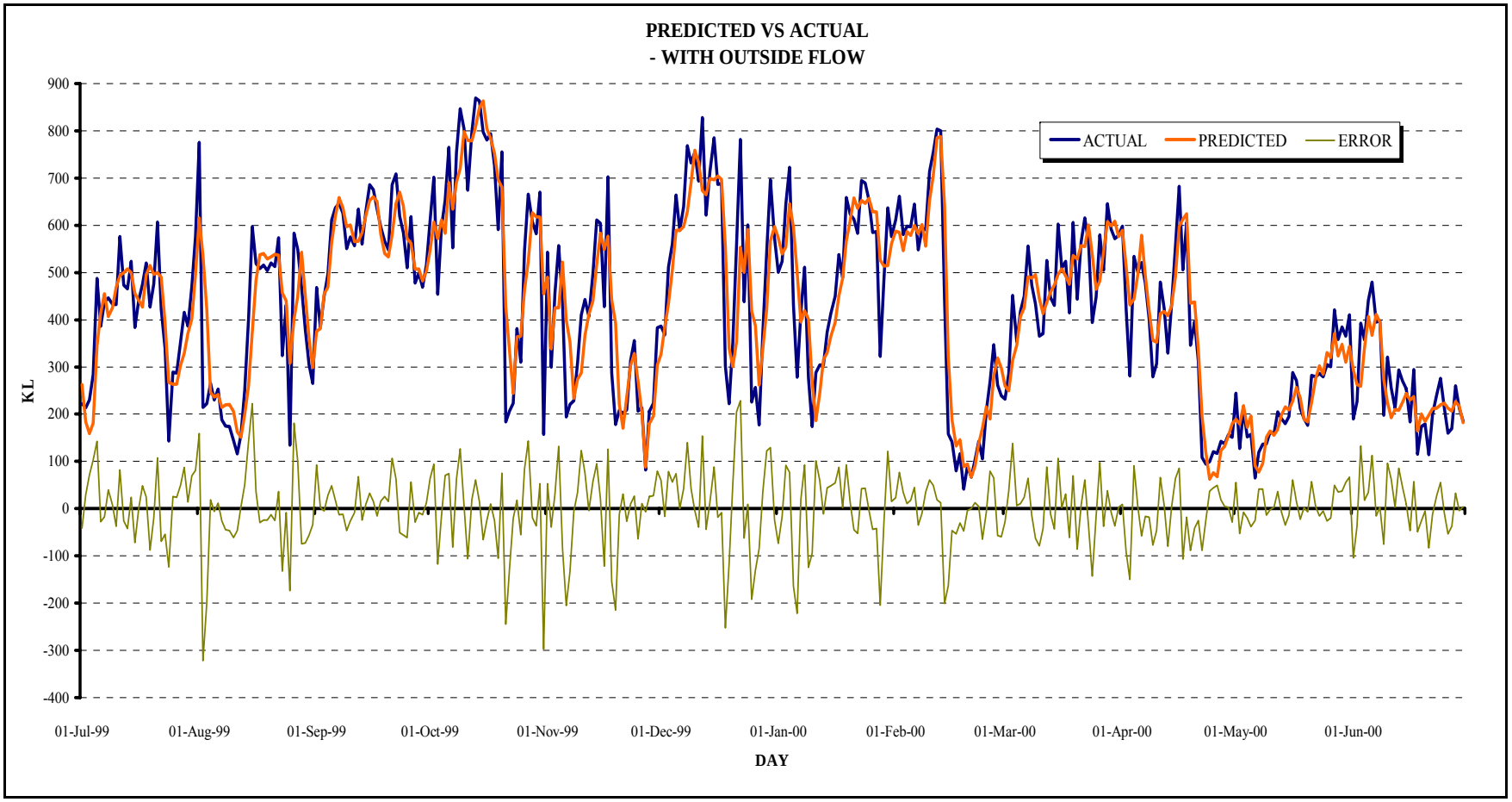

Figure 7-8: Graph - Actual Vs Predicted - Outside Flow

7.4 CONCLUSION

86% of the total outside flow for the town of Capella can be predicted on a daily basis by using the following equation:

Equation 7-3: Model - Total Outside Flow

Total Outside Flow =

- 21.8291 x Evaporatio n (3 Day Average)
- 1.5270 x Relative Humidity (5 DayAverage)
- 0.8173 x Rainfall (7 Day Average)
+ 8.4531 x Temperatur e (Max Previous Day)
+ 0.9711 x Outside Flow (3 Day Average)
- 19.6457

The error between predicted and actual values does not alter with the passing of seasons and annual climate cycles. By using variables based on average values of weather of previous days the model accounts for the short-term memory of these variables. This memory is particularly relevant to the inclusion of data of previous outside flows with the coefficient of correlation improving from 0.5978 to 0.8436 with this inclusion.

CHAPTER 8 WEATHER COMPARISONS

8.1 COMPARISON OF REGIONS

8.1.1 Rainfall

All three of the communities receive more rainfall in the summer months when compared to the colder months of the year although there is a wide range between the communities of monthly totals of rainfall received. Yeppoon's average monthly total rainfall received can be as much as twice that of Barcaldine. This difference is also reflected in the number of rain days experienced per month with Yeppoon experiencing an average of 10.8 days of rain in January and Barcaldine 7.3 days in the same month. Barcaldine and Capella appear to be more closely related although, on average, Capella receives more rain and experiences more rain days than Barcaldine. The average monthly rainfall and rain days of the three towns are shown in Figure 8-1: "Graph – Average Monthly Rainfall".

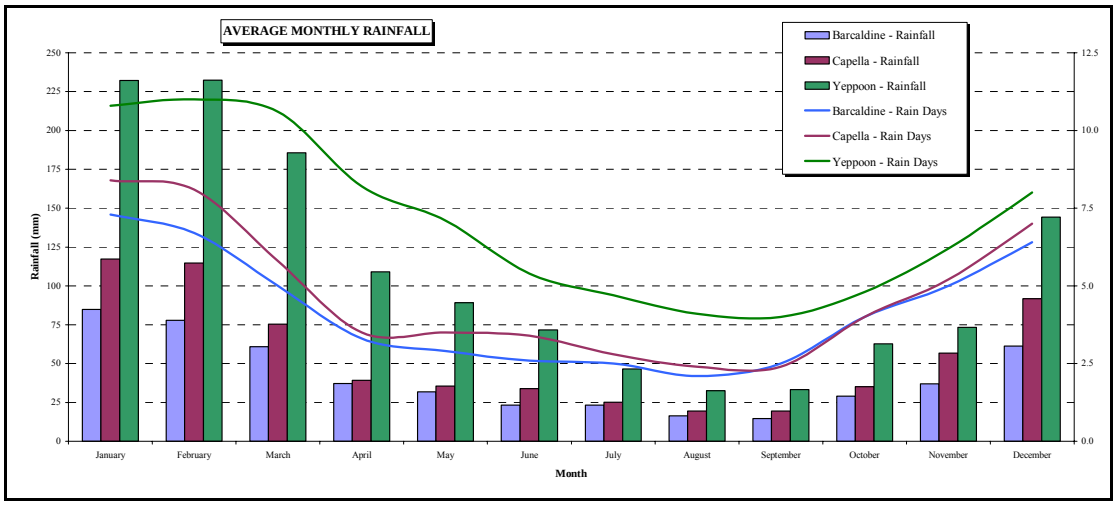

Figure 8-1: Graph – Average Monthly Rainfall

Analysis of the rainfall received data for the year 2005 showed that in that year Capella had a slightly higher mean rainfall than Yeppoon; 2.1350 compared with 2.0036. The mean daily rainfall for Barcaldine was 1.1683. Within the 334 available records Capella also had the

highest variance; 105.2544. The variance within the Barcaldine and Yeppoon data was 32.2237 and 52.7899 respectively.

Correlation analysis revealed that Capella and Yeppoon had the highest correlation; R equal to 0.4504; while Barcaldine and Yeppoon had the lowest; R equal to 0.1163. The correlation between Capella and Barcaldine was 0.1338. These results have been tabulated in Table 8-1: "Statistics – Average Monthly Rainfall".

	Capella	Barcaldine	Yeppoon
Mean	2.1350	1.1683	2.0036
Variance	105.2544	32.2237	52.7899

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.1338	0.4504
Barcaldine	0.1338	1	0.1163
Yeppoon	0.4504	0.1163	1

Table 8-1: Statistics – Average Monthly Rainfall

T-test analysis of the three combinations shows that in each case the $t_{calculated}$ statistic is less than the $t_{critical}$ value, therefore there is a high probability that the relationships between the data sets happened by chance.

	Capella	Barcaldine	Capella	Yeppoon	Barcaldine	Yeppoon
Observations	334		334		334	
df	519		600		629	
t Stat	1.506877915		0.191074149		-1.655719203	
P(T<=t) one-tail	0.066225179		0.424266069		0.049138735	
t Critical one-tail	1.647794878		1.647397192		1.647279747	
P(T<=t) two-tail	0.132450359		0.848532138		0.098277471	
t Critical two-tail	1.964545246		1.963925532		1.963742534	

Table 8-2: T-test Results – Rainfall

8.1.2 Temperature

8.1.2.1 Maximum Temperatures

The average maximum monthly temperatures of Capella and Barcaldine have a strong correlation; R equal to 0.8928, which is slightly higher than that of Capella and Yeppoon; R equal to 0.8380. The correlation between the maximum monthly temperatures of Barcaldine and Yeppoon is 0.8690. In the summer months the maximum monthly temperatures of Capella and Barcaldine are within the same range but are as much as 6 ^{0}C higher than those of Yeppoon.

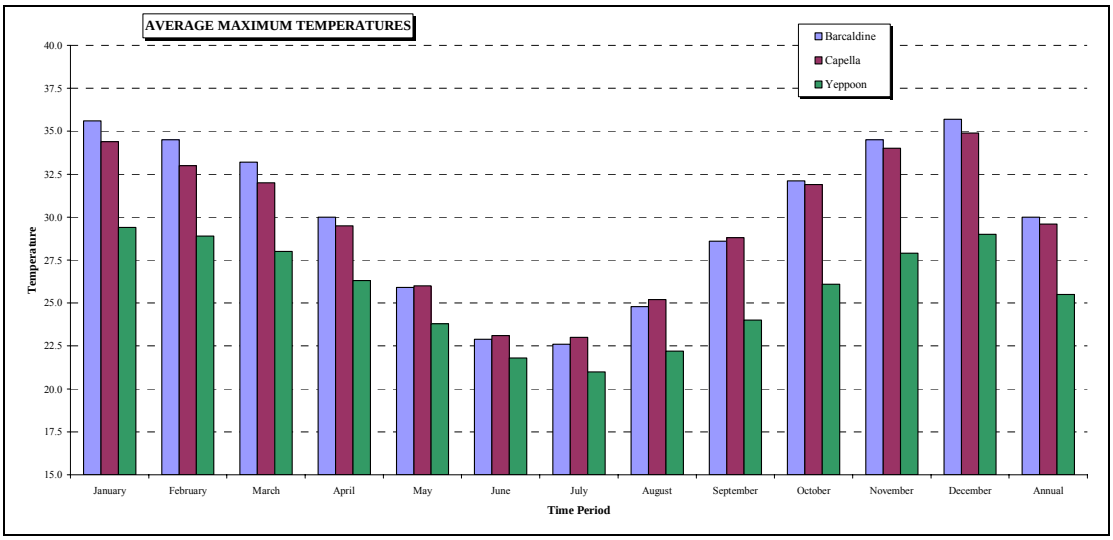

Figure 8-2: Graph – Average Monthly Maximum Temperatures

	Capella	Barcaldine	Yeppoon
Mean	30.8409	31.3291	26.2165
Variance	28.0209	38.3330	12.0822

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.8928	0.8380
Barcaldine	0.8928	1	0.8690
Yeppoon	0.8380	0.8690	1

Table 8-3: Statistics - Maximum Temperature

The $t_{statistic}$ and $t_{critical}$ analysis of the maximum temperatures of the towns shows that although the $t_{statistic}$ of the Capella / Yeppoon and Barcaldine / Yeppoon comparisons is higher than the $t_{critical}$ values that for the Capella / Barcaldine comparison is not. This means that the relationship between data from Capella / Yeppoon and Barcaldine / Yeppoon is significant but that the relationship between data from Capella / Barcaldine is not.

	Capella	Barcaldine	Capella	Yeppoon	Barcaldine	Yeppoon
Observations	357		357		357	
df	695		615		560	
t Stat	-1.132479407		13.79742734		13.60491608	
P(T<=t) one-tail	0.128911744		3.18356E-38		6.31416E-37	
t Critical one-tail	1.647049044		1.64733506		1.647579178	
P(T<=t) two-tail	0.257823489		6.36713E-38		1.26283E-36	
t Critical two-tail	1.963383135		1.963828719		1.964209111	

Table 8-4: T-test Results - Maximum Temperature

8.1.2.2 Minimum Temperature

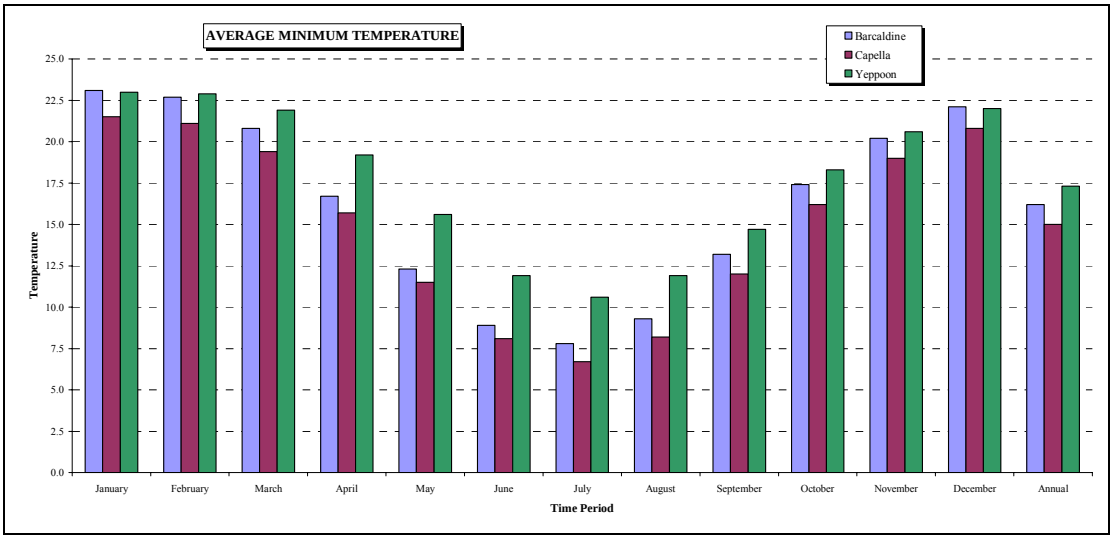

Figure 8-3: Graph - Average Monthly Minimum Temperatures

The differences in average minimum monthly temperatures recorded in the towns are not as marked as those in average maximum monthly temperatures however the monthly mean for

Capella is always less than that of Barcaldine and Yeppoon. This trend is reflected in the analysis of the minimum temperature data for 2005. In that year the correlation between data for Capella and Barcaldine is 0.9064 and between Capella and Yeppoon is 0.8961. Barcaldine and Yeppoon data has a slightly lower correlation of 0.8546.

	Capella	Barcaldine	Yeppoon
Mean	16.4529	18.2061	19.3108
Variance	31.9224	34.1220	22.4485

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.9064	0.8961
Barcaldine	0.9064	1	0.8546
Yeppoon	0.8961	0.8546	1

Table 8-5: Statistics - Average Monthly Minimum Temperature

In contrast to the t-test analysis of the maximum monthly temperatures the $t_{statistic}$ value is higher than the $t_{critical}$ value in all cases. The difference between the absolute values of the calculated $t_{statistic}$ and the $t_{critical}$ values is not large so it is concluded that for the year of 2005 any relationships between the data sets is not significant.

	Capella	Barcaldine	Capella	Yeppoon	Barcaldine	Yeppoon
Observations	342		342		342	
df	681		662		654	
t Stat	-3.989612168		-7.167636303		-2.716150423	
P(T<=t) one-tail	3.66768E-05		1.02169E-12		0.003389575	
t Critical one-tail	1.647094239		1.647158638		1.647186874	
P(T<=t) two-tail	7.33537E-05		2.04337E-12		0.00677915	
t Critical two-tail	1.96345355		1.963553885		1.963597879	

Table 8-6: T-test Results - Average Monthly Minimum Temperature

8.1.2.3 Average Temperatures

The mean average temperatures for each town in 2005 differ only by 2.00 ^{0}C with Barcaldine recording the highest with 24.87 ^{0}C and Yeppoon the lowest at 22.82 ^{0}C. This low range is reflected in correlation values of 0.936, 0.9248 and 0.9008 for Capella / Barcaldine, Capella / Yeppoon and Barcaldine / Yeppoon respectively.

	Capella	Barcaldine	Yeppoon
Mean	23.6963	24.8783	22.8229
Variance	25.6829	33.5792	14.9177

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.9360	0.9248
Barcaldine	0.9360	1	0.9008
Yeppoon	0.9248	0.9008	1

Table 8-7: Statistics - Average Monthly Average Temperature

	Capella	Barcaldine	Capella	Yeppoon	Barcaldine	Yeppoon
Observations	334		334		334	
df	654		622		580	
t Stat	-2.806179593		2.504938834		5.393990637	
P(T<=t) one-tail	0.002581221		0.006250935		5.02449E-08	
t Critical one-tail	1.647186874		1.647307092		1.647485042	
P(T<=t) two-tail	0.005162442		0.012501869		1.0049E-07	
t Critical two-tail	1.963597879		1.963785141		1.964062422	

Table 8-8: T-Test Results - Average Monthly Minimum Temperatures

The relationship between the average temperatures for Barcaldine and Yeppoon is slightly more significant than that between the other two combinations with a $s_{tatistics}$ of 5.3939. Between Capella / Barcaldine and Capella / Yeppoon the $s_{tatistics}$ are 2.806 and 2.5049. Any relationships between the data sets are not considered significant.

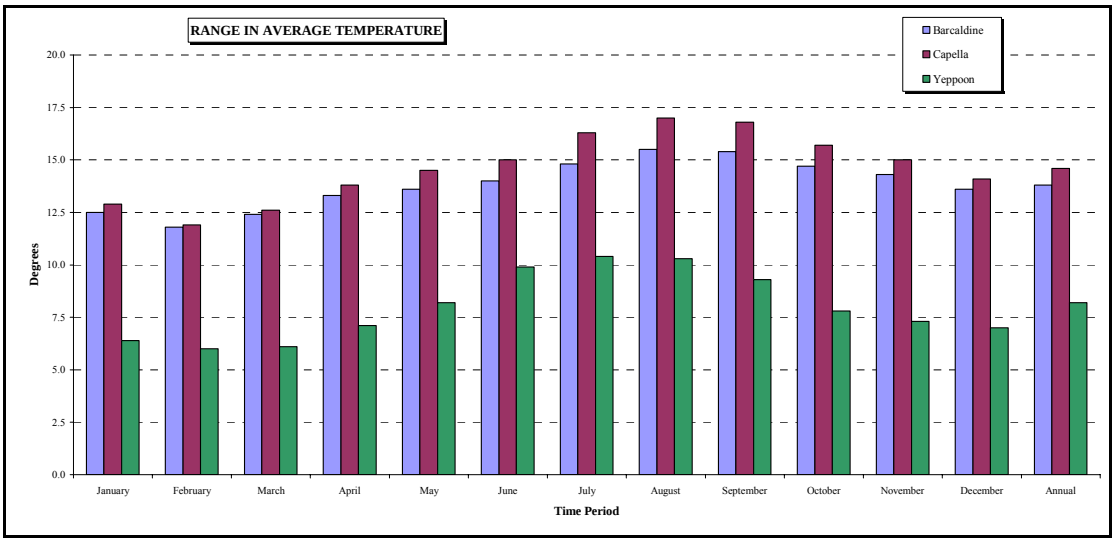

Figure 8-4: Graph - Range in Average Monthly Temperatures

8.1.3 Relative Humidity

On a long term basis Yeppoon experiences the highest average monthly relative humidity of all three communities. The relative humidity of Capella is consistently higher than the Barcaldine but is significantly less than that of Yeppoon.

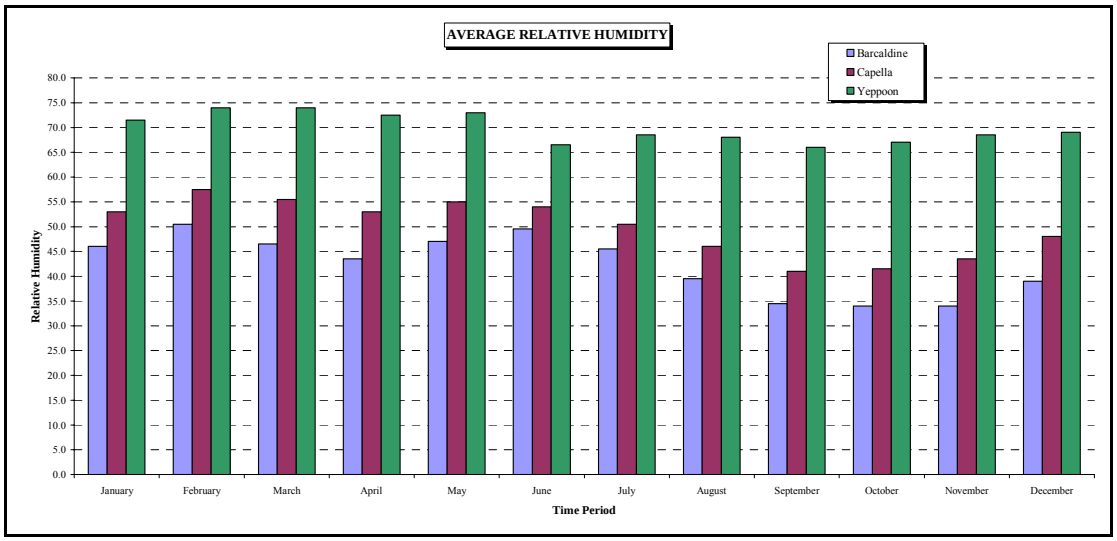

Figure 8-5: Graph - Average Monthly Relative Humidity

This large difference between Capella and Yeppoon is not reflected in the data for 2005. In that year Capella had a daily mean relative humidity of 61.1201 % while that of Yeppoon was

69.7478 % and Barcaldine 48.6015. Capella's data had the highest variance, 196.5709 and Yeppoon the lowest 158.2573. The correlation between the data sets is 0.5399 between Capella and Barcaldine, 0.4764 between Capella and Yeppoon and 0.3123 between Barcaldine and Yeppoon.

	Capella	Barcaldine	Yeppoon
Mean	61.1201	48.6015	69.7478
Variance	196.5709	190.3079	158.2573

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.5399	0.4764
Barcaldine	0.5399	1	0.3123
Yeppoon	0.4764	0.3123	1

Table 8-9: Statistics - Average Monthly Relative Humidity

	Capella	Barcaldine	Capella	Yeppoon	Barcaldine	Yeppoon
Observations	335		335		335	
df	668		660		662	
t Stat	11.64910823		-8.383086336		-20.73070932	
P(T<=t) one-tail	5.5606E-29		1.55635E-16		2.98786E-74	
t Critical one-tail	1.647137905		1.647165632		1.647158638	
P(T<=t) two-tail	1.11212E-28		3.11271E-16		5.97571E-74	
t Critical two-tail	1.963521583		1.963564784		1.963553885	

Table 8-10: T-test Results - Average Monthly Relative Humidity

The differences in the $t_{statistic}$ and $t_{critical}$ values for the three combinations of data are the most significant of all analysis carried out with the $t_{statistic}$ for the Barcaldine / Yeppoon data being equal to 20.7307, the highest achieved in this process.

8.1.4 Evaporation

Data is not available for evaporation experienced in Yeppoon. Comparison between data for Capella and Barcaldine, for 2005, shows that Barcaldine has a higher mean daily evaporation and there is a

higher degree of variance within the data. The correlation between the two sets of data is equal to 0.6854. The $t_{statistic}$ value, 8.9692, is higher than $t_{critical}$, 1.9636.

	Capella	Barcaldine	Yeppoon
Mean	6.5121	8.9565	NA
Variance	10.1596	15.0936	NA

CORRELATION	Capella	Barcaldine	Yeppoon
Capella	1	0.6854	NA
Barcaldine	0.6854	1	NA
Yeppoon	NA	NA	NA

Table 8-11: Statistics - Average Monthly Relative Humidity

	Capella	Barcaldine
Observations	340	
df	653	
t Stat	-8.969238574	
P(T<=t) one-tail	1.56389E-18	
t Critical one-tail	1.647190452	
P(T<=t) two-tail	3.12778E-18	
t Critical two-tail	1.963603454	

Table 8-12: T-test Results - Average Monthly Relative Humidity

8.2 CONCLUSION

While there is some evidence of strong correlation between data set combinations; R equal to 0.9360 for average temperature of Capella and Barcaldine for the 2005 year, the results of the t-test analysis carried out on all combinations of data sets fails to confirm that there is any relationships of any significance.

CHAPTER 9 MODELLING BARCALDINE

For completeness of this comparison an attempt was made to "fit" the available data from Barcaldine to the model produced for Capella.

Barcaldine's water is sourced from the Great Artesian Bore through two pumps. The residents of Barcaldine are not subject to any restrictions to water usage.

9.1 BARCALDINE DATA

For this comparison only data for the year 2005 will be used.

9.1.1 Service Provider Records

Recording of daily water flow for Barcaldine is irregular at best with many obvious gaps and discrepancies. For the year of 2005 this failure of most of the data has resulted in only 42 days of water consumption being suitable for use in a consumption model.

Total sewerage flows are recorded on a daily basis. As with Capella flows are based on total pump hours. Sewerage flow records are complete for 2005.

The number of connections to the water and sewerage networks in Barcaldine did not change in 2005.

9.1.2 Rainfall, Temperature & Relative Humidity Records

The Australian Bureau of Meteorology operates a weather station at Barcaldine. Records from this station include rainfall, temperatures, relative humidity and pressures. Temperature data is recorded as being more than 90% complete over more than 85 years. Rainfall has been recorded for more than 117 years and is 100% complete. Relative humidity has only been recorded for 51 years and is only 78 % complete. However all of these data sets are complete for the 2005 year.

9.1.3 Evaporation Records

Evaporation is not recorded at the Australian Bureau of Meteorology weather station at Barcaldine; however it is recorded at Longreach. Correlation analysis of these data sets determined that there was an average correlation of available data sets of 0.9231. For this reason the evaporation records for Longreach have been used in this model. A summary of this correlation comparison has been tabulated in Table 9-1 and a portion of the full data set has been included in Appendix E

Variable	Degree of Correlation
Global Solar Exposure at location – derived from satellite data (in mega-Joules per square meter)	0.9715
Precipitation in the 24 hours before 9am (local time) in mm	0.7226
Maximum temperature in 24 hours after 9am (local time) in Degrees C	0.9887
Minimum temperature in 24 hours before 9am (local time) in Degrees C	0.9758
Average daily temperature in Degrees C	0.9899
Dew point temperature observation at 06 hours Local Time in Degrees C	0.9035
Dew point temperature observation at 09 hours Local Time in Degrees C	0.8961
Dew point temperature observation at 15 hours Local Time in Degrees C	0.8679
Wet bulb temperature observation at 06 hours Local Time in Degrees C	0.9641
Wet bulb temperature observation at 09 hours Local Time in Degrees C	0.9716
Wet bulb temperature observation at 15 hours Local Time in Degrees C	0.9706
Relative humidity for observation at 06 hours Local Time in percentage %	0.8476
Relative humidity for observation at 09 hours Local Time in percentage %	0.8987
Relative humidity for observation at 15 hours Local Time in percentage %	0.8699
Vapour pressure at 06 hours Local Time in hPa	0.9119
Vapour pressure at 09 hours Local Time in hPa	0.9062
Vapour pressure at 15 hours Local Time in hPa	0.8835
Saturated vapour pressure at 06 hours in hPa	0.9695
Saturated vapour pressure at 09 hours in hPa	0.9834
Saturated vapour pressure at 15 hours in hPa	0.9693
Average Correlation	**0.9231**

Table 9-1: Correlation Results s- Barcaldine & Longreach

9.2 APPLICATION OF CAPELLA CONSUMPTION MODEL

Two processes were used to apply the Capella model to the consumption at Barcaldine. The first was a straight application of the equation resulting from modelling of Capella consumption. The second process involved the expansion of the Barcaldine data to determine values for the same variables used in the Capella consumption equation. These expanded Barcaldine variables were then subjected to linear regression analysis.

Due to the lack of, daily flow records inspection of the available data determined that only 17 records were available for use in these processes. While it is realised that results obtained from the use of this minimal data sample will not be any great significance the processes were carried out for completeness and to highlight the need for consistent record keeping.

9.2.1 Application of Capella Consumption Model

The coefficient, intercept and statistical details of the model produced to predict the total outside flow for the town of Capella have been reproduced in Table 9-2 below.

Variable		**Coefficient**
Evaporation	**Average - 3 Days**	-21.8291
Relative Humidity	**Average - 5 Days**	-1.5270
Rainfall	**Average - 7 Days**	-0.81733
Temperature	**Maximum - Prev Day**	8.4531
Outside Flow	**Average - 3 Days**	0.9711
Intercept		-19.64573972
R^2		0.8436
$F_{calculated}$		1328.8900
F_{critic}		2.2181

Table 9-2: Capella Consumption Model Details

The results of the application of this equation are tabulated in Table 9-3 below.

	Date	Actual Outside Flow	Predicted Outside Flow	Difference
1	13/01/2005	3,447.06	3,049.92	397.15
2	14/01/2005	3,914.15	3,463.27	450.88
3	3/02/2005	5,254.02	4,346.34	907.68
4	10/02/2005	2,823.91	4,471.82	-1,647.91
5	11/02/2005	1,472.69	3,076.07	-1,603.38
6	17/02/2005	4,024.75	4,678.01	-653.26
7	12/05/2005	1,238.29	2,590.67	-1,352.38
8	26/05/2005	2,838.35	2,961.50	-123.15
9	9/06/2005	3,062.31	2,882.55	179.75
10	1/09/2005	3,105.14	2,915.02	190.13
11	29/09/2005	5,050.88	4,061.08	989.80
12	30/09/2005	3,471.46	3,888.84	-417.38
13	7/10/2005	5,074.44	4,416.46	657.98
14	13/10/2005	4,466.16	5,982.06	-1,515.89
15	17/11/2005	4,056.18	4,374.98	-318.80
16	18/11/2005	4,438.06	4,200.37	237.70
17	24/11/2005	2,599.23	5,179.55	-2,580.33

Table 9-3: Results of Appliction of Capella Consumption Model to Barcaldine

This data has been plotted in Figure 9.1 following.

9.2.2 Linear Regression Analysis

The linear regression analysis of the available 17 records produced an R^2 value of 0.7891 – meaning that the variables used could predict 78.91% of the outside flow; this is only 5 % less than that for the Capella model. However the $F_{calcualted}$ value for this analysis is only 171.0594 whilst that for Capella was 1328.89. These results suggest that although the correlation coefficient is as high the actual relationship between the variables is much less significant.

Variable		Coefficient
Evaporation	**Average - 3 Days**	106.1696
Relative Humidity	**Average - 5 Days**	-26.5637
Rainfall	**Average - 7 Days**	-305.0818
Temperature	**Maximum - Prev Day**	69.1036
Outside Flow	**Average - 3 Days**	0.0602
Intercept		1,478.6006
R^2		0.7891
$F_{calculated}$		171.0594
F_{critic}		2.3092

Table 9-4: Results of LRA - Barcaldine

The results of the linear regression analysis can be seen in Table 9-4. These results have been plotted in Figure 9-1 which also allows comparison of these results with those obtained from the application of the Capella consumption equation.

	Date	Actual Outside Flow	Predicted Outside Flow	Difference
1	13/01/2005	3,447.06	3678.27	-231.21
2	14/01/2005	3,914.15	3900.69	13.46
3	3/02/2005	5,254.02	4841.84	412.18
4	10/02/2005	2,823.91	2122.50	701.41
5	11/02/2005	1,472.69	2044.44	-571.75
6	17/02/2005	4,024.75	4324.11	-299.36
7	12/05/2005	1,238.29	1482.45	-244.16
8	26/05/2005	2,838.35	3002.92	-164.58
9	9/06/2005	3,062.31	2491.96	570.35
10	1/09/2005	3,105.14	3056.95	48.19

	Date	Actual Outside Flow	Predicted Outside Flow	Difference
11	29/09/2005	5,050.88	4279.19	771.69
12	30/09/2005	3,471.46	4279.19	-807.73
13	7/10/2005	5,074.44	4018.77	1,055.66
14	13/10/2005	4,466.16	4758.03	-291.86
15	17/11/2005	4,056.18	4572.39	-516.21
16	18/11/2005	4,438.06	4320.49	117.58
17	24/11/2005	2,599.23	3162.89	-563.66

Table 9-5: Results of Linear Regression Analysis - Barcaldine

9.3 CONCLUSION

Due to the inadequacy of the available data it is not possible to draw any conclusion as to the existence of a significant relationship between the domestic water consumption of Capella and Barcaldine. Nor is it possible to conclude that there is a relationship between the expanded variables used in the models.

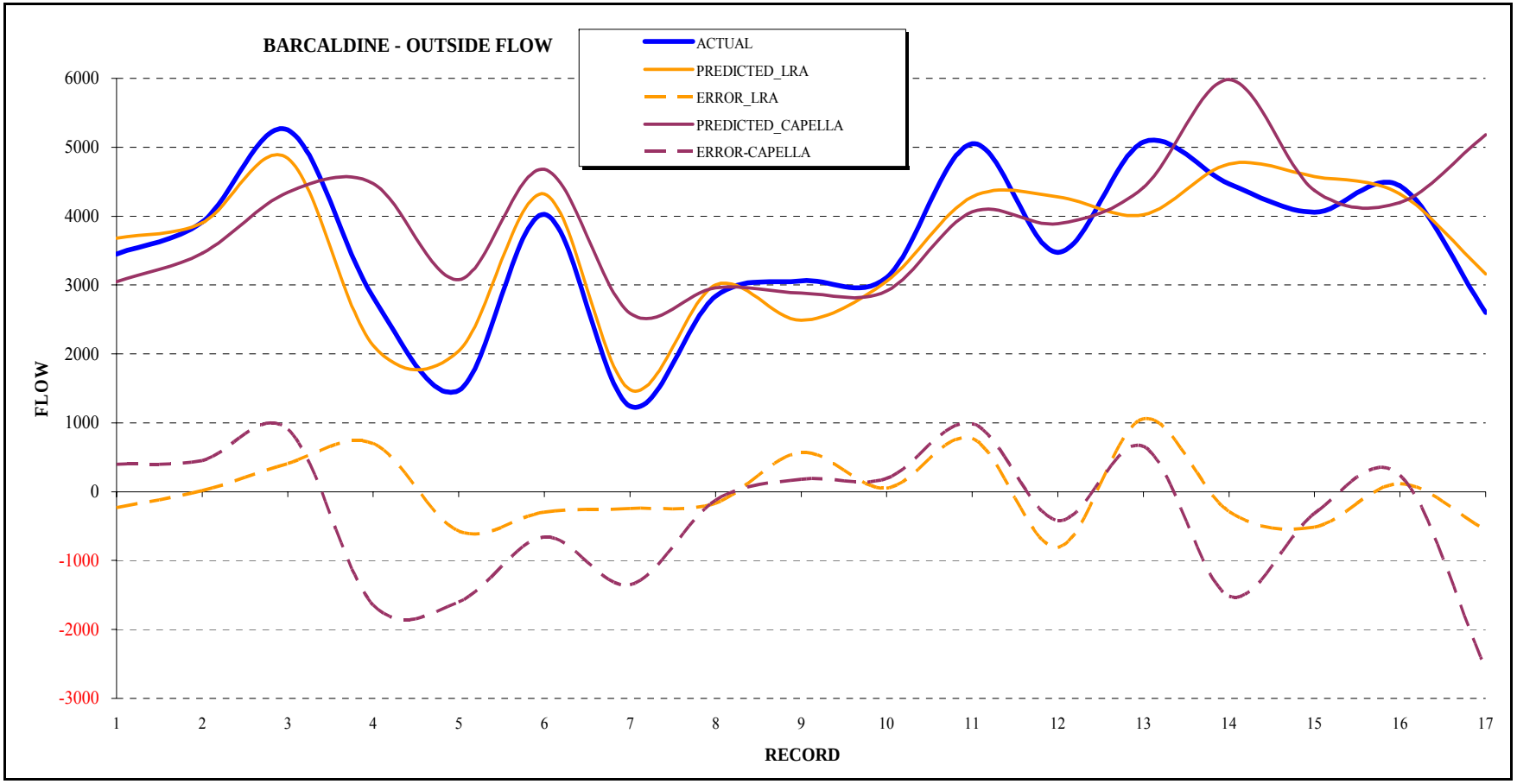

Figure 9-1: Graph - Results of Application of Models - Barcaldine

CHAPTER 10 CONCLUSIONS

10.1 MODELLING CAPELLA DOMESTIC WATER CONSUMPTION

The use of linear regression analysis produced an equation which may predict the total outside water flow for the town of Capella that had a correlation coefficient of 0.8436. It is considered that this prediction of 84.36 % of use is adequate for the purpose for which the model will be used.

The equation produced will be used by Peak Downs Shire Council as an aid in determining the volume of water required from both their facilities and those of SunWater Queensland. It will also be used to determine the proportion of supply required from each facility

10.2 COMPARISON OF LOCALITY WEATHER

The T-test analysis carried out on the weather data of the three towns which are the subject of this project; Capella, Barcaldine and Yeppoon; failed to produce a $T_{statistic}$ significantly larger than the appropriate $T_{critical}$. This failure has led to the conclusion that there is not a significant relationship between the variable compared for this project. However, this conclusion is qualified by the statement that only data from 2005 was analysed. Analysis of data from a longer timeframe may produce different results.

10.3 REGIONAL APPLICATION OF CONSUMPTION MODEL

As stated in Section 9.3 it has been concluded that a consumption model developed for one region may not be applicable to another region. Again this conclusion is qualified by the statement that only 17 records were analysed. Analysis of records from a longer timeframe may produce a different result.

10.4 INTEGRITY AND AVAILABILITY OF DATA

This project was hampered by the lack of suitable data, particularly that pertaining to daily water consumption. In order for an adequate aid for prediction of water consumption to be produced, service providers must ensure that complete, accurate records are kept. This is highlighted by the inability to compare consumption variables and models for the town of Yeppoon due to lack of data.

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APPENDIX A: PROJECT SPECIFICATION

University of Southern Queensland
FACULTY OF ENGINEERING AND SURVEYING

ENG4111 / 4112 Research Project

PROJECT SPECIFICATION

FOR: **Kym Therese DOWNEY**

TOPIC: Weather Induced changes on domestic water consumption

SUPERVISOR: Dr. V Aravinthan

ENROLMENT: ENG 4111 – S1, X, 2006 / ENG 4112 – S2, X, 2006

PROJECT AIM: This project aims to produce a model to aid in the prediction of domestic water consumption based on climatic factors such as rainfall, ambient temperature and percentage of daylight hours. This model will be for use within Queensland, Australia.

PROGRAMME: Issue A, 27 March 2006

1. Research:
   - availability of climatic data – rainfall, temperature, percentage of daylight hours
   - availability of consumption data – meter readings, total pumped (daily, weekly, monthly, annually), losses, accuracy of readings
   - other factors affecting consumption – restrictions, breakages, variation to watering hours

2. Establish:
   - time parameters - 5 years (drought / rain)
   - locations – coastal / central (Peak Downs Shire Council) / western
3. Collect data and collate
   - check for gaps/inaccuracies etc (April / May)

4. Research existing models and accuracy / effectiveness of them

5. Develop new model (using data from Peak Downs Shire Council) to forecast consumption based on given variables

6. Test new model
   - predict usage and compare to actual

7. Apply model to data from other areas (coastal and western)
   - examine differences / relationships between variables of each region
   - investigate relationship between consumptions in different zones of Queensland
   - adapt central region model

If time permits:

8. Compare new model results with existing models

AGREED:

_____(Student) _____ / _____ / _____

_____(Supervisor) _____ / _____ / _____

APPENDIX B: WEATHER DATA – EMERALD & CLERMONT

Day Month Year	Precipitation in the 24 hours before 9am (local time) in mm				Evaporation in 24 hours before 9am (local time) in mm		
Station	**W Stn**	**Capella**	**Clermont**	**Emerald**	**W Stn**	**Clermont**	**Emerald**
Correlation Coefficient		**0.9911**	**0.2407**	**0.3039**		**0.8501**	
16/2/2003	0.40	0.00	0.20	0.00	8.86	8.60	
17/2/2003	0.00	0.00	0.00	0.00	10.67	9.00	
18/2/2003	0.00	0.00	0.00	0.00	7.61	7.40	
19/2/2003	0.00	0.00	0.00	0.00	10.07	8.40	
20/2/2003	0.00	0.00	0.00	0.00	10.40	7.80	
21/2/2003	0.00	0.00	0.00	0.00	9.88	7.50	
22/2/2003	0.00	0.00	0.00	0.00	10.03	7.40	
23/2/2003	0.00	0.00	0.00	0.00	9.08	6.80	
24/2/2003	0.20	0.00	0.70	2.00	7.20	6.20	
25/2/2003	34.80	27.00	6.10	5.00	3.25	2.90	
26/2/2003	3.00	2.60	31.60	7.00	2.96	2.40	
27/2/2003	1.20	2.50	8.10	2.00	4.22	4.30	
28/2/2003	0.40	0.20	22.40	0.80	7.04	4.00	
1/3/2003	0.00	0.00	0.80	0.00	6.32	3.90	
2/3/2003	0.00		7.10	0.00	5.05	3.00	
3/3/2003	4.00		6.30	0.00	6.25	3.20	
4/3/2003	0.20	2.40	0.00	0.00	12.88	7.60	
5/3/2003	0.00	0.00	0.00	0.00	9.60	6.40	
6/3/2003	0.00	0.00	0.00	0.00	8.78	6.40	
7/3/2003	0.00	0.00	0.00	0.00	9.11	6.60	
8/3/2003	0.00	0.00	0.00	0.00	8.73	6.40	
9/3/2003	0.00	0.00	0.00	0.00	9.94	6.70	
10/3/2003	0.00	0.00	0.00	0.00	9.29	6.60	
11/3/2003	0.00	0.00	0.00	0.00	8.59	8.00	
12/3/2003	0.00	0.00	0.00	0.00	7.50	4.40	
13/3/2003	0.00	0.00	0.00	0.00	4.73	3.50	
14/3/2003	0.00	0.00	0.00	0.20	5.61	4.30	
15/3/2003	0.00	0.00	0.00	0.00	5.27	2.80	
16/3/2003	0.00	0.00	0.00	0.00	8.03	6.20	
17/3/2003	0.00	0.00	0.00	0.00	7.95	6.60	
18/3/2003	0.00	0.00	0.00	0.00	8.63	5.80	
19/3/2003	0.00	0.00	0.00	0.00	9.85	6.30	
20/3/2003	0.00	0.00	0.00	0.00	8.44	7.20	
21/3/2003	0.00	0.00	0.00	0.00	8.30	5.60	
22/3/2003	0.00	0.00	0.00	0.00	8.80	6.80	
23/3/2003	0.00	0.00	0.70	0.00	8.80	6.50	
24/3/2003	0.00	1.60	6.80	8.00	6.68	6.40	
25/3/2003	0.00	0.00	0.00	0.00	6.42	4.70	
26/3/2003	1.20	0.00	0.00	3.00	6.92	5.90	
27/3/2003	0.00	0.00	0.00	0.00	7.67	6.70	
28/3/2003	0.00	0.00	0.00	0.00	8.59	5.80	
29/3/2003	0.00	0.00	0.00	0.00	8.60	6.10	
30/3/2003	0.00	0.00	0.00	0.00	6.15	5.10	
31/3/2003	0.00	0.00	0.00	0.00	6.46	5.20	
1/4/2003	0.00	0.00	0.00	0.00	6.89	6.00	
2/4/2003	0.00	0.00	0.00	0.00	8.94	6.60	
3/4/2003	0.00	0.00	0.00	0.00	7.49	6.00	
4/4/2003	8.60	6.80	5.80	8.00	6.65	5.50	
5/4/2003	0.00	0.00	0.20	9.00	6.38	5.30	
6/4/2003	0.00	0.00	0.00	0.00	5.64	5.20	

Day Month Year	Precipitation in the 24 hours before 9am (local time) in mm				Evaporation in 24 hours before 9am (local time) in mm		
Station	W Stn	Capella	Clermont	Emerald	W Stn	Clermont	Emerald
7/4/2003	0.00	0.00	0.00	0.00	8.77	6.70	
8/4/2003	0.00	0.00	0.00	0.00	8.65	6.10	
9/4/2003	0.00	0.00	0.00	0.00	8.13	5.30	
10/4/2003	0.00	0.00	0.00	0.00	7.67	5.60	
11/4/2003	0.00	0.00	0.00	0.00	7.21	5.40	
12/4/2003	0.00	0.00	0.50	0.00	8.83	5.80	
13/4/2003	0.00	0.00	0.00	0.00	8.78	6.50	
14/4/2003	0.00	0.00	0.00	0.00	7.17	5.60	
15/4/2003	0.00	0.00	0.20	0.00	7.79	6.40	
16/4/2003	3.40	2.80	0.00	6.00	4.82	4.20	
17/4/2003	0.00	0.00	0.00	0.00	8.05	7.70	
18/4/2003	0.00	0.00	0.00	0.00	8.37	6.40	
19/4/2003	0.00	0.00	0.00	0.00	8.25	5.80	
20/4/2003	0.00	0.00	0.00	0.00	8.42	6.20	
21/4/2003	0.00	0.00	0.00	0.00	8.58	6.20	
22/4/2003	0.00	0.00	0.00	0.00	8.36	4.90	
23/4/2003	0.20	0.00	0.00	0.00	8.59	6.10	
24/4/2003	0.00	0.00	0.00	0.00	8.64	6.20	
25/4/2003	0.00	0.00	0.00	0.00	8.63	6.60	
26/4/2003	0.00	0.00	0.00	0.00	9.02	6.10	
27/4/2003	0.00	0.00	0.00	0.00	7.44	4.20	
28/4/2003	0.00	0.00	0.00	0.00	6.05	3.80	
29/4/2003	0.00	0.00	0.00	0.00	5.50	4.70	
30/4/2003	0.00	0.00	0.00	0.00	6.09	5.20	
1/5/2003	0.00	0.00	0.00	0.00	6.62	4.80	
2/5/2003	1.20	0.00	0.00	0.00	6.90	4.80	
3/5/2003	3.00	3.40	2.10	23.00	5.03	3.30	
4/5/2003	0.00	0.00	0.00	0.00	5.44	3.80	
5/5/2003	0.00	0.00	0.00	0.00	8.14	5.70	
6/5/2003	0.00	0.00	0.00	0.00	8.94	6.10	
7/5/2003	0.00	0.00	0.00	0.00	9.24	6.00	
8/5/2003	0.00	0.00	0.00	0.00	7.57	5.60	
9/5/2003	0.00	0.00	0.00	0.00	7.78	4.40	
10/5/2003	0.00	0.00	0.00	0.00	5.79	3.30	
11/5/2003	0.00	0.00	0.00		6.45	4.00	
12/5/2003	0.00	0.00	0.00	0.00	5.50	4.00	
13/5/2003	0.00	0.00	0.00	0.00	3.46	1.80	
14/5/2003	0.20	0.00	0.00	0.20	4.53	2.90	
15/5/2003	0.00	0.00	0.00	0.00	3.75	2.10	
16/5/2003	3.80	3.60	6.20	1.00	2.56	1.00	
17/5/2003	0.40	0.00	0.00	0.00	4.76		
18/5/2003	0.00	0.00	0.00	0.00	5.45	6.60	
19/5/2003	0.00	0.00	0.00	0.00	6.24	4.00	
20/5/2003	0.00	0.00	0.00	0.00	7.63	5.50	
21/5/2003	1.00	0.00	0.00	0.00	8.44	4.60	
22/5/2003	0.00	0.00	0.00	0.00	8.77	7.50	
23/5/2003	0.00	0.00	0.00	0.00	6.02	4.00	
24/5/2003	0.00	0.00	0.00	0.00	5.57	3.80	
25/5/2003	0.00	0.00	0.00	0.00	5.76	3.60	

Day Month Year	Maximum temperature in 24 hours after 9am (local time) in Degrees C			Minimum temperature in 24 hours before 9am (local time) in Degrees C		
Station	**W Stn**	**Clermont**	**Emerald**	**W Stn**	**Clermont**	**Emerald**
Correlation Coefficient		**0.8360**	**0.7771**		**0.9693**	**0.9605**
16/2/2003	33.20	33.80	33.00	19.80	20.20	20.00
17/2/2003	32.20	35.50	33.00	20.40	21.60	21.00
18/2/2003	33.80	35.70	34.00	20.80	21.90	22.00
19/2/2003	34.60	36.60	35.00	22.90	22.90	23.00
20/2/2003	35.90	36.20	35.00	23.20	23.30	23.00
21/2/2003	35.10	35.50	34.00	22.20	22.60	23.00
22/2/2003	35.00	35.30	35.00	22.50	22.40	23.00
23/2/2003	35.30	36.10	31.00	23.50	24.10	24.00
24/2/2003	30.70	27.70	31.00	22.80	23.60	23.00
25/2/2003	29.60	30.20	31.00	23.00	23.10	23.00
26/2/2003	29.50	31.70	32.00	22.90	23.40	23.00
27/2/2003	31.20	30.70	33.00	24.00	23.40	23.00
28/2/2003	30.80	31.60	32.00	23.90	23.90	24.00
1/3/2003	32.20	33.50	33.00	24.70	24.10	25.00
2/3/2003	34.70	33.30	30.00	20.20	20.20	20.00
3/3/2003	29.80	31.80	32.00	18.20	19.80	17.00
4/3/2003	32.20	31.80	32.00	17.50	18.40	18.00
5/3/2003	31.10	33.10	34.00	19.80	19.60	20.00
6/3/2003	33.00	31.10	32.00	19.20	19.40	20.00
7/3/2003	30.80	31.60	33.00	20.00	19.50	20.00
8/3/2003	30.90	32.40	33.00	18.20	19.50	20.00
9/3/2003	32.60	33.30	34.00	17.80	18.90	20.00
10/3/2003	33.20	32.40	33.00	18.90	20.10	21.00
11/3/2003	32.10	29.20	31.00	21.70	21.80	23.00
12/3/2003	29.00	28.30	29.00	21.60	21.50	22.00
13/3/2003	28.10	26.80	30.00	20.90	21.00	22.00
14/3/2003	26.90	31.30	32.00	15.40	16.90	18.00
15/3/2003	31.60	33.30	34.00	16.70	17.90	19.00
16/3/2003	32.70	33.90	34.00	18.60	19.40	20.00
17/3/2003	32.90	33.10	33.00	19.90	20.10	21.00
18/3/2003	31.80	32.50	32.00	21.30	21.80	22.00
19/3/2003	30.90	32.10	32.00	16.30	17.60	18.00
20/3/2003	31.30	33.60	33.00	18.30	18.70	20.00
21/3/2003	34.40	34.60	34.00	19.60	19.90	22.00
22/3/2003	33.70	33.60	34.00	22.20	21.30	22.00
23/3/2003	33.10	33.70	32.00	17.70	18.80	18.00
24/3/2003	32.20	33.30	34.00	20.50	20.50	21.00
25/3/2003	32.20	33.70	33.00	21.10	21.10	22.00
26/3/2003	33.20	33.70	33.00	19.80	20.10	20.00
27/3/2003	32.90	33.30	32.00	19.30	19.90	20.00
28/3/2003	32.30	32.40	31.00	19.70	19.60	21.00
29/3/2003	31.60	33.10	33.00	22.30	21.90	23.00
30/3/2003	32.80	33.60	33.00	19.50	20.20	20.00
31/3/2003	33.90	35.90	35.00	19.10	20.10	20.00
1/4/2003	35.20	33.80	34.00	22.60	21.60	22.00
2/4/2003	32.30	33.20	33.00	21.40	20.60	23.00
3/4/2003	32.60	32.30	32.00	20.00	20.40	21.00
4/4/2003	31.80	33.20	30.00	21.80	21.00	21.00
5/4/2003	33.10	31.10	30.00	18.40	19.20	19.00
6/4/2003	29.90	29.50	28.00	9.70	12.50	14.00

Day Month Year	Maximum temperature in 24 hours after 9am (local time) in Degrees C			Minimum temperature in 24 hours before 9am (local time) in Degrees C		
Station	W Stn	Clermont	Emerald	W Stn	Clermont	Emerald
7/4/2003	28.30	30.50	29.00	12.10	12.50	15.00
8/4/2003	29.90	32.10	30.00	13.90	14.20	15.00
9/4/2003	32.00	33.70	32.00	15.40	15.00	17.00
10/4/2003	33.10	33.10	33.00	17.90	19.80	19.00
11/4/2003	32.60	34.30	34.00	20.50	19.50	22.00
12/4/2003	34.00	35.60	35.00	20.90	19.50	21.00
13/4/2003	35.70	35.60	34.00	22.20	22.60	23.00
14/4/2003	34.20	33.50	30.00	21.30	22.10	22.00
15/4/2003	32.60	34.60	33.00	19.80	20.90	21.00
16/4/2003	33.60	30.80	30.00	19.80	21.00	20.00
17/4/2003	30.50	31.40	30.00	14.20	16.90	16.00
18/4/2003	29.50	29.00	29.00	17.70	17.00	17.00
19/4/2003	28.20	29.10	28.00	13.10	15.50	15.00
20/4/2003	27.60	29.20	29.00	12.60	14.50	14.00
21/4/2003	28.20	29.60	30.00	13.80	14.80	16.00
22/4/2003	29.00	29.30	29.00	14.10	15.70	16.00
23/4/2003	28.80	29.30	29.00	14.90	15.70	16.00
24/4/2003	28.70	28.40	28.00	13.60	14.80	15.00
25/4/2003	28.40	28.40	28.00	13.30	13.50	15.00
26/4/2003	27.00	30.20	30.00	14.90	14.80	17.00
27/4/2003	29.90	30.70	31.00	19.30	17.90	20.00
28/4/2003	32.00	33.10	32.00	17.40	15.40	18.00
29/4/2003	31.90	33.70	32.00	17.20	17.40	19.00
30/4/2003	33.80	31.90	31.00	16.40	17.20	19.00
1/5/2003	31.70	29.20	30.00	16.70	16.80	19.00
2/5/2003	29.50	26.20	25.00	16.70	16.80	17.00
3/5/2003	25.60	27.10	27.00	10.60	10.60	13.00
4/5/2003	26.70	28.20	28.00	14.50	13.50	17.00
5/5/2003	27.80	25.90	25.00	12.60	13.40	14.00
6/5/2003	25.30	26.30	26.00	10.60	10.50	12.00
7/5/2003	25.90	27.20	26.00	11.90	12.90	13.00
8/5/2003	26.10	26.10	27.00	11.90	13.10	14.00
9/5/2003	26.30	28.20	27.00	12.90	14.40	14.00
10/5/2003	27.20	27.20	28.00	14.50	14.40	15.00
11/5/2003	27.50	23.20	24.00	15.60	14.30	15.00
12/5/2003	23.30	26.40	24.00	14.70	14.40	14.00
13/5/2003	24.50	26.10	26.00	14.70	15.10	16.00
14/5/2003	28.70	24.90	25.00	16.00	14.40	16.00
15/5/2003	24.70	27.80	27.70	15.90	18.00	18.00
16/5/2003	29.20	29.60	29.40	12.70		15.30
17/5/2003	29.80	30.20	30.00	14.20	12.80	15.10
18/5/2003	30.10	32.40	32.70	13.70	14.90	14.40
19/5/2003	32.90	33.40	34.20	18.40	15.70	15.60
20/5/2003	33.50	32.80	33.00	19.00	17.50	16.90
21/5/2003	32.70	28.20	27.00	7.30	9.50	11.30
22/5/2003	28.50	28.20	26.90	6.20	7.00	11.10
23/5/2003	29.30	28.80	27.30	6.80	8.00	12.20
24/5/2003	28.80	28.60	27.50	9.90	8.10	12.40
25/5/2003	29.10	28.20	26.40	10.40	11.00	11.60

Day Month Year	Average daily temperature - Records			Average daily temperature - Calculated		
Station	**W Stn**	**Clermont**	**Emerald**	**W Stn**	**Clermont**	**Emerald**
Correlation Coefficient		**0.9560**	**0.9408**		**0.9479**	**0.9358**
16/2/2003	26.80	22.73	26.86	26.50	27.00	26.50
17/2/2003	26.80	26.98	27.08	26.30	28.60	27.00
18/2/2003	27.50	27.05	28.01	27.30	28.80	28.00
19/2/2003	28.50	27.88	28.74	28.75	29.80	29.00
20/2/2003	29.10	27.98	28.95	29.55	29.80	29.00
21/2/2003	28.80	27.50	28.36	28.65	29.10	28.50
22/2/2003	28.40	27.93	27.96	28.75	28.90	29.00
23/2/2003	27.90	26.15	25.71	29.40	30.10	27.50
24/2/2003	25.10	25.20	25.65	26.75	25.70	27.00
25/2/2003	25.30	25.63	26.28	26.30	26.70	27.00
26/2/2003	25.30	26.05	25.85	26.20	27.60	27.50
27/2/2003	26.20	25.73	27.53	27.60	27.10	28.00
28/2/2003	27.00	26.20	27.73	27.35	27.80	28.00
1/3/2003	27.50	26.93	26.99	28.45	28.80	29.00
2/3/2003	26.30	26.03	24.78	27.45	26.80	25.00
3/3/2003	22.80	23.43	24.89	24.00	25.80	24.50
4/3/2003	24.80	23.53	25.48	24.85	25.10	25.00
5/3/2003	25.10	24.90	26.50	25.45	26.40	27.00
6/3/2003	25.90	23.98	26.11	26.10	25.30	26.00
7/3/2003	25.10	24.28	26.56	25.40	25.60	26.50
8/3/2003	25.00	24.18	26.55	24.55	26.00	26.50
9/3/2003	25.30	24.65	26.84	25.20	26.10	27.00
10/3/2003	25.90	25.03	27.08	26.05	26.30	27.00
11/3/2003	26.50	24.43	26.09	26.90	25.50	27.00
12/3/2003	24.80	24.03	25.19	25.30	24.90	25.50
13/3/2003	24.20	23.40	24.56	24.50	23.90	26.00
14/3/2003	22.10	22.65	24.49	21.15	24.10	25.00
15/3/2003	24.40	23.90	26.19	24.15	25.60	26.50
16/3/2003	26.20	24.88	27.00	25.65	26.70	27.00
17/3/2003	26.50	24.98	26.06	26.40	26.60	27.00
18/3/2003	26.60	25.70	26.40	26.55	27.20	27.00
19/3/2003	24.30	23.30	25.24	23.60	24.90	25.00
20/3/2003	25.40	24.28	26.75	24.80	26.20	26.50
21/3/2003	26.60	25.65	27.56	27.00	27.30	28.00
22/3/2003	27.50	25.53	24.79	27.95	27.50	28.00
23/3/2003	23.70	23.13	24.38	25.40	26.30	25.00
24/3/2003	26.10	26.43	26.39	26.35	26.90	27.50
25/3/2003	26.50	25.93	26.44	26.65	27.40	27.50
26/3/2003	26.20	25.05	26.50	26.50	26.90	26.50
27/3/2003	26.40	25.28	26.20	26.10	26.60	26.00
28/3/2003	26.00	24.40	25.75	26.00	26.00	26.00
29/3/2003	26.10	25.48	26.98	26.95	27.50	28.00
30/3/2003	26.30	25.13	26.61	26.15	26.90	26.50
31/3/2003	26.90	26.13	27.75	26.50	28.00	27.50
1/4/2003	28.60	26.43	27.73	28.90	27.70	28.00
2/4/2003	26.20	24.90	26.48	26.85	26.90	28.00
3/4/2003	25.50	24.13	25.75	26.30	26.40	26.50
4/4/2003	25.60	25.45	24.11	26.80	27.10	25.50
5/4/2003	24.00	23.30	23.70	25.75	25.20	24.50
6/4/2003	20.90	19.78	21.01	19.80	21.00	21.00

Day Month Year	Average daily temperature - Records			Average daily temperature - Calculated		
Station	W Stn	Clermont	Emerald	W Stn	Clermont	Emerald
7/4/2003	20.60	19.60	21.91	20.20	21.50	22.00
8/4/2003	22.20	21.08	22.75	21.90	23.20	22.50
9/4/2003	23.50	22.15	24.45	23.70	24.40	24.50
10/4/2003	25.60	24.90	26.09	25.50	26.50	26.00
11/4/2003	26.50	25.25	27.05	26.55	26.90	28.00
12/4/2003	27.30	26.08	27.66	27.45	27.60	28.00
13/4/2003	28.30	27.68	28.04	28.95	29.10	28.50
14/4/2003	27.50	25.73	25.44	27.75	27.80	26.00
15/4/2003	25.30	26.78	26.24	26.20	27.80	27.00
16/4/2003	26.50	24.58	25.03	26.70	25.90	25.00
17/4/2003	22.80	22.13	22.33	22.35	24.20	23.00
18/4/2003	22.70	21.40	22.30	23.60	23.00	23.00
19/4/2003	21.60	20.60	21.50	20.65	22.30	21.50
20/4/2003	20.50	19.50	21.75	20.10	21.90	21.50
21/4/2003	21.20	20.55	22.04	21.00	22.20	23.00
22/4/2003	22.10	20.98	22.39	21.55	22.50	22.50
23/4/2003	22.30	20.75	22.11	21.85	22.50	22.50
24/4/2003	21.40	20.40	21.68	21.15	21.60	21.50
25/4/2003	20.90	19.63	20.89	20.85	21.00	21.50
26/4/2003	20.90	20.28	22.76	20.95	22.50	23.50
27/4/2003	23.60	22.73	23.73	24.60	24.30	25.50
28/4/2003	23.30	22.03	24.33	24.70	24.30	25.00
29/4/2003	23.90	23.33	24.63	24.55	25.60	25.50
30/4/2003	24.60	23.08	24.86	25.10	24.60	25.00
1/5/2003	24.90	22.15	23.44	24.20	23.00	24.50
2/5/2003	21.80	19.83	20.19	23.10	21.50	21.00
3/5/2003	18.40	17.58	19.74	18.10	18.90	20.00
4/5/2003	20.50	19.63	21.45	20.60	20.90	22.50
5/5/2003	20.40	18.50	18.94	20.20	19.70	19.50
6/5/2003	17.90	16.63	18.74	17.95	18.40	19.00
7/5/2003	18.90	18.18	19.86	18.90	20.10	19.50
8/5/2003	19.30	18.00	19.55	19.00	19.60	20.50
9/5/2003	19.70	19.10	20.06	19.60	21.30	20.50
10/5/2003	20.80	16.37	21.00	20.85	20.80	21.50
11/5/2003	21.00	17.00	19.60	21.55	18.80	19.50
12/5/2003	19.10	18.90	19.91	19.00	20.40	19.00
13/5/2003	19.40	19.15	20.01	19.60	20.60	21.00
14/5/2003	20.70	19.30	21.23	22.35	19.70	20.50
15/5/2003	19.90	20.65	21.65	20.30	22.90	22.90
16/5/2003	20.40	20.23	21.48	20.95		22.40
17/5/2003	21.20	19.43	22.00	22.00	21.50	22.60
18/5/2003	21.70	21.48	23.16	21.90	23.70	23.60
19/5/2003	24.30	22.65	24.44	25.65	24.60	24.90
20/5/2003	25.00	23.78	24.28	26.25	25.20	25.00
21/5/2003	21.70	17.65	18.31	20.00	18.90	19.20
22/5/2003	16.90	15.38	18.53	17.35	17.60	19.00
23/5/2003	17.50	15.98	18.49	18.05	18.40	19.80
24/5/2003	18.10	15.58	18.70	19.35	18.40	20.00
25/5/2003	19.20	17.93	18.78	19.75	19.60	19.00

Day Month Year	Average Relative Humidity			Maximum Relative Humidity		
Station	**W Stn**	**Clermont**	**Emerald**	**W Stn**	**Clermont**	**Emerald**
Correlation Coefficient		**0.8406**	**0.8213**		**0.7576**	**0.7623**
16/2/2003	50.20	67.75	53.75	77.30	90.00	86.00
17/2/2003	50.60	67.50	53.13	77.70	84.00	84.00
18/2/2003	50.30	69.50	60.00	82.20	90.00	89.00
19/2/2003	51.80	69.25	57.75	81.90	89.00	87.00
20/2/2003	52.80	67.00	59.25	79.10	85.00	87.00
21/2/2003	53.00	68.25	61.38	81.40	86.00	87.00
22/2/2003	52.90	69.00	65.13	79.50	87.00	97.00
23/2/2003	65.50	83.75	87.13	89.60	93.00	99.00
24/2/2003	83.60	91.00	86.88	94.80	96.00	100.00
25/2/2003	83.20	87.50	82.25	92.50	95.00	99.00
26/2/2003	82.00	86.75	86.75	94.10	96.00	100.00
27/2/2003	76.90	83.75	74.25	90.80	91.00	99.00
28/2/2003	71.10	82.50	75.25	85.30	91.00	91.00
1/3/2003	75.90	86.25	86.00	92.70	96.00	99.00
2/3/2003	71.50	61.25	44.50	93.40	95.00	99.00
3/3/2003	35.60	51.50	43.13	49.70	55.00	53.00
4/3/2003	56.60	73.75	57.25	80.40	89.00	81.00
5/3/2003	62.30	73.75	59.25	84.30	95.00	90.00
6/3/2003	56.70	70.00	57.25	88.40	89.00	89.00
7/3/2003	57.50	70.00	55.50	82.00	89.00	85.00
8/3/2003	57.20	73.50	56.75	90.20	92.00	88.00
9/3/2003	53.30	70.75	52.13	81.30	89.00	83.00
10/3/2003	50.30	68.75	50.38	74.30	83.00	81.00
11/3/2003	49.70	75.75	57.25	74.40	83.00	78.00
12/3/2003	58.50	71.75	58.13	71.60	81.00	72.00
13/3/2003	59.10	70.25	59.75	75.50	80.00	78.00
14/3/2003	63.60	70.00	54.63	92.10	92.00	79.00
15/3/2003	51.50	68.50	49.50	75.90	88.00	72.00
16/3/2003	53.40	70.25	58.00	88.50	88.00	94.00
17/3/2003	52.60	68.50	60.25	82.00	83.00	82.00
18/3/2003	52.30	68.25	50.88	77.80	83.00	78.00
19/3/2003	54.10	71.25	52.63	90.70	92.00	80.00
20/3/2003	54.20	64.25	54.13	85.60	79.00	85.00
21/3/2003	48.90	64.00	54.75	72.20	79.00	79.00
22/3/2003	52.50	74.00	72.00	82.20	86.00	98.00
23/3/2003	71.50	82.50	73.50	97.50	98.00	99.00
24/3/2003	59.60	70.00	63.00	82.30	92.00	97.00
25/3/2003	55.70	72.25	69.38	86.70	90.00	99.00
26/3/2003	57.50	73.25	63.63	89.40	95.00	99.00
27/3/2003	55.20	68.25	61.50	90.50	87.00	96.00
28/3/2003	55.10	70.50	61.88	83.40	86.00	86.00
29/3/2003	53.20	66.50	56.25	72.50	75.00	76.00
30/3/2003	53.80	69.25	56.63	76.90	85.00	83.00
31/3/2003	50.20	68.25	48.38	79.70	97.00	79.00
1/4/2003	39.30	58.75	49.38	52.90	74.00	63.00
2/4/2003	54.30	71.75	57.88	82.30	87.00	80.00
3/4/2003	60.70	73.00	67.63	96.70	93.00	96.00
4/4/2003	62.90	72.00	76.00	81.10	83.00	100.00
5/4/2003	72.70	74.50	61.13	99.30	93.00	99.00
6/4/2003	45.90	49.50	41.38	84.50	72.00	57.00

Day Month Year	Average Relative Humidity			Maximum Relative Humidity		
Station	W Stn	Clermont	Emerald	W Stn	Clermont	Emerald
7/4/2003	41.40	60.50	49.38	76.70	77.00	71.00
8/4/2003	43.00	61.75	51.13	75.30	81.00	79.00
9/4/2003	44.10	62.50	48.63	80.50	78.00	76.00
10/4/2003	50.40	62.50	50.38	84.80	82.00	78.00
11/4/2003	45.70	60.00	51.75	75.30	76.00	72.00
12/4/2003	50.70	66.25	56.25	80.50	81.00	83.00
13/4/2003	53.60	65.00	58.50	81.50	78.00	82.00
14/4/2003	55.30	70.50	69.63	80.80	82.00	80.00
15/4/2003	66.40	63.50	67.75	92.50	83.00	96.00
16/4/2003	51.30	58.75	45.00	69.60	72.00	68.00
17/4/2003	44.00	49.50	56.88	73.80	59.00	74.00
18/4/2003	60.30	67.75	60.38	85.30	89.00	93.00
19/4/2003	46.90	52.50	43.13	70.30	65.00	65.00
20/4/2003	41.40	55.50	43.50	72.50	65.00	63.00
21/4/2003	48.00	62.50	49.13	79.70	84.00	64.00
22/4/2003	55.30	66.75	50.50	91.20	88.00	72.00
23/4/2003	50.10	65.75	51.63	85.00	85.00	77.00
24/4/2003	43.10	53.25	42.50	63.20	63.00	61.00
25/4/2003	40.80	55.50	47.63	65.00	67.00	60.00
26/4/2003	53.50	67.75	55.38	80.40	83.00	75.00
27/4/2003	57.00	70.25	61.75	82.10	85.00	80.00
28/4/2003	58.00	67.75	55.63	81.90	86.00	77.00
29/4/2003	51.80	63.00	56.00	81.10	76.00	82.00
30/4/2003	48.40	62.50	49.13	74.50	81.00	71.00
1/5/2003	45.00	58.75	55.13	72.40	73.00	93.00
2/5/2003	67.20	81.00	71.38	96.60	98.00	98.00
3/5/2003	61.40	64.50	56.88	86.60	89.00	74.00
4/5/2003	48.50	62.50	48.00	70.50	84.00	64.00
5/5/2003	46.20	57.00	47.63	77.70	74.00	73.00
6/5/2003	42.60	58.00	49.38	70.20	73.00	64.00
7/5/2003	48.20	62.25	52.13	73.10	79.00	71.00
8/5/2003	50.80	64.25	58.25	78.90	77.00	78.00
9/5/2003	56.10	66.25	58.00	83.70	80.00	81.00
10/5/2003	51.40	73.33	55.38	79.50	78.00	80.00
11/5/2003	44.60	66.67	52.00	67.90	70.00	64.00
12/5/2003	56.70	74.25	61.88	82.40	91.00	76.00
13/5/2003	68.60	77.00	70.75	92.80	87.00	90.00
14/5/2003	66.10	78.00	71.63	96.90	90.00	88.00
15/5/2003	82.90	79.50	72.25	101.90	94.00	97.00
16/5/2003	67.20	72.00	64.00	100.50	93.00	99.00
17/5/2003	54.00	66.75	51.00	75.50	88.00	68.00
18/5/2003	47.90	66.00	52.13	75.80	94.00	77.00
19/5/2003	46.50	63.00	44.00	77.30	93.00	74.00
20/5/2003	41.50	63.50	43.25	78.70	85.00	68.00
21/5/2003	41.20	49.75	35.71	80.30	78.00	46.00
22/5/2003	29.20	56.50	42.25	62.70	78.00	59.00
23/5/2003	37.00	52.75	45.00	66.90	79.00	61.00
24/5/2003	39.20	56.25	42.63	62.90	76.00	59.00
25/5/2003	38.10	50.00	39.13	64.00	69.00	56.00

Day Month Year	Minimum Relative Humidity		
Station	**W Stn**	**Clermont**	**Emerald**
Correlation Coefficient		**0.6574**	**0.7305**
16/2/2003	27.90	38.00	33.00
17/2/2003	25.50	38.00	31.00
18/2/2003	25.20	39.00	38.00
19/2/2003	25.00	32.00	36.00
20/2/2003	28.20	36.00	38.00
21/2/2003	29.20	44.00	42.00
22/2/2003	30.40	45.00	40.00
23/2/2003	32.70	66.00	60.00
24/2/2003	52.30	82.00	68.00
25/2/2003	65.00	70.00	62.00
26/2/2003	60.00	64.00	61.00
27/2/2003	55.50	68.00	52.00
28/2/2003	55.00	67.00	59.00
1/3/2003	51.80	61.00	69.00
2/3/2003	38.00	16.00	24.00
3/3/2003	19.20	49.00	34.00
4/3/2003	31.20	50.00	34.00
5/3/2003	37.90	39.00	30.00
6/3/2003	23.90	43.00	36.00
7/3/2003	35.80	41.00	32.00
8/3/2003	29.50	41.00	30.00
9/3/2003	22.30	36.00	27.00
10/3/2003	23.10	44.00	29.00
11/3/2003	24.30	60.00	43.00
12/3/2003	42.60	56.00	43.00
13/3/2003	39.10	52.00	42.00
14/3/2003	41.50	41.00	34.00
15/3/2003	29.60	39.00	27.00
16/3/2003	27.20	41.00	33.00
17/3/2003	30.50	46.00	36.00
18/3/2003	30.90	42.00	31.00
19/3/2003	29.10	35.00	33.00
20/3/2003	31.40	36.00	30.00
21/3/2003	24.60	38.00	34.00
22/3/2003	30.50	45.00	35.00
23/3/2003	31.10	50.00	45.00
24/3/2003	36.50	46.00	32.00
25/3/2003	34.00	47.00	39.00
26/3/2003	32.30	37.00	37.00
27/3/2003	29.30	36.00	37.00
28/3/2003	29.80	47.00	40.00
29/3/2003	34.80	47.00	38.00
30/3/2003	32.50	42.00	36.00
31/3/2003	27.60	35.00	24.00
1/4/2003	22.50	40.00	35.00
2/4/2003	31.00	43.00	39.00
3/4/2003	33.60	46.00	45.00
4/4/2003	37.10	47.00	48.00
5/4/2003	35.00	40.00	28.00
6/4/2003	25.40	28.00	26.00

Day Month Year	Minimum Relative Humidity		
Station	W Stn	Clermont	Emerald
7/4/2003	17.80	32.00	29.00
8/4/2003	20.80	31.00	27.00
9/4/2003	20.20	31.00	32.00
10/4/2003	22.30	37.00	30.00
11/4/2003	25.80	36.00	33.00
12/4/2003	29.50	41.00	36.00
13/4/2003	30.90	40.00	39.00
14/4/2003	34.50	47.00	50.00
15/4/2003	38.30	32.00	37.00
16/4/2003	31.00	34.00	30.00
17/4/2003	27.90	33.00	37.00
18/4/2003	29.90	38.00	30.00
19/4/2003	30.40	30.00	26.00
20/4/2003	22.00	36.00	28.00
21/4/2003	26.50	34.00	33.00
22/4/2003	27.00	34.00	28.00
23/4/2003	24.90	36.00	30.00
24/4/2003	28.30	30.00	27.00
25/4/2003	23.40	37.00	34.00
26/4/2003	33.60	43.00	39.00
27/4/2003	32.20	43.00	41.00
28/4/2003	31.10	34.00	32.00
29/4/2003	28.60	37.00	31.00
30/4/2003	23.90	32.00	32.00
1/5/2003	28.00	44.00	37.00
2/5/2003	33.70	52.00	44.00
3/5/2003	38.80	35.00	33.00
4/5/2003	31.00	30.00	29.00
5/5/2003	25.70	30.00	27.00
6/5/2003	20.10	37.00	33.00
7/5/2003	29.90	31.00	35.00
8/5/2003	29.80	41.00	37.00
9/5/2003	33.50	39.00	35.00
10/5/2003	29.40	68.00	32.00
11/5/2003	27.50	63.00	39.00
12/5/2003	35.50	54.00	50.00
13/5/2003	48.00	54.00	47.00
14/5/2003	32.00	55.00	52.00
15/5/2003	48.80	42.00	44.00
16/5/2003	33.30	36.00	33.00
17/5/2003	30.50	30.00	32.00
18/5/2003	26.30	26.00	27.00
19/5/2003	23.50	23.00	20.00
20/5/2003	18.00	29.00	25.00
21/5/2003	20.10	21.00	20.00
22/5/2003	11.00	21.00	26.00
23/5/2003	17.40	20.00	28.00
24/5/2003	19.40	26.00	29.00
25/5/2003	20.30	28.00	27.00

APPENDIX C: TOTAL MODEL 2 - DATA & RESULTS

Date	DATA					RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Predicted OUTSIDE	Residuals	Standard Residuals
1/07/1999	222.18	2.27	1.43	79.87	23.40	233.38	-11.2037	-0.0910
2/07/1999	213.18	2.27	1.43	79.60	18.60	168.84	44.3400	0.3602
3/07/1999	230.18	2.53	1.43	78.65	16.50	149.00	81.1831	0.6594
4/07/1999	284.18	2.53	1.43	80.55	17.10	143.72	140.4564	1.1409
5/07/1999	487.18	1.80	1.14	78.05	23.60	248.84	238.3367	1.9359
6/07/1999	386.18	1.60	1.14	75.60	24.90	282.52	103.6587	0.8420
7/07/1999	437.18	2.13	1.14	76.10	25.30	289.36	147.8170	1.2006
8/07/1999	446.18	2.47	0.00	77.55	22.20	255.03	191.1472	1.5526
9/07/1999	433.18	2.60	0.00	75.35	22.50	276.13	157.0511	1.2757
10/07/1999	432.18	2.13	0.00	73.45	26.40	339.43	92.7493	0.7534
11/07/1999	576.18	2.53	0.00	72.00	25.10	335.46	240.7244	1.9553
12/07/1999	473.18	3.00	0.00	69.65	25.00	355.14	118.0450	0.9588
13/07/1999	465.18	3.40	0.00	66.35	25.10	383.76	81.4168	0.6613
14/07/1999	523.18	3.33	0.00	65.60	25.90	399.59	123.5912	1.0039
15/07/1999	384.18	3.33	0.00	63.65	23.80	384.46	-0.2739	-0.0022
16/07/1999	442.18	3.73	0.00	61.35	23.50	400.40	41.7825	0.3394
17/07/1999	475.18	3.93	0.00	60.05	24.00	418.44	56.7402	0.4609
18/07/1999	520.18	3.60	0.00	60.10	26.00	442.72	77.4589	0.6292
19/07/1999	427.18	3.33	0.00	59.20	28.00	474.40	-47.2220	-0.3836
20/07/1999	476.18	3.33	0.00	56.90	25.40	454.85	21.3332	0.1733
21/07/1999	607.18	3.80	0.00	56.35	23.60	438.13	169.0528	1.3731
22/07/1999	421.18	3.87	0.00	54.45	22.50	437.09	-15.9084	-0.1292
23/07/1999	339.18	4.00	0.00	53.45	16.50	362.39	-23.2129	-0.1885
24/07/1999	143.18	3.07	1.40	57.85	17.80	320.93	-177.7489	-1.4438
25/07/1999	289.18	2.27	1.40	63.85	21.50	321.95	-32.7712	-0.2662
26/07/1999	287.18	1.93	1.40	65.65	22.90	325.42	-38.2389	-0.3106
27/07/1999	352.18	2.93	1.40	68.20	22.60	312.19	39.9935	0.3248
28/07/1999	415.18	3.80	1.40	70.10	23.40	317.61	97.5717	0.7925
29/07/1999	386.18	4.00	1.40	67.70	24.80	355.97	30.2083	0.2454
30/07/1999	470.18	3.67	1.40	66.60	22.70	331.71	138.4668	1.1247
31/07/1999	577.18	3.13	0.00	68.90	26.70	385.25	191.9310	1.5590
1/08/1999	775.27	3.07	0.00	69.15	25.80	370.39	404.8755	3.2886
2/08/1999	214.27	2.87	0.00	65.82	25.00	381.31	-167.0441	-1.3568
3/08/1999	222.27	3.33	0.00	65.97	26.20	401.12	-178.8525	-1.4527
4/08/1999	265.27	3.33	0.00	65.32	25.00	389.16	-123.8858	-1.0063
5/08/1999	230.27	3.80	0.00	63.05	24.00	395.78	-165.5103	-1.3444
6/08/1999	253.27	4.13	0.00	62.55	24.20	405.17	-151.9012	-1.2338
7/08/1999	188.27	4.33	0.00	65.73	25.00	395.32	-207.0536	-1.6818
8/08/1999	175.27	3.73	0.00	66.03	26.30	405.69	-230.4188	-1.8716
9/08/1999	174.27	3.27	0.00	66.03	28.20	427.72	-253.4537	-2.0587
10/08/1999	144.27	3.20	0.00	66.95	28.10	419.18	-274.9081	-2.2329
11/08/1999	116.27	3.67	0.00	68.45	26.70	393.34	-277.0743	-2.2505
12/08/1999	156.27	3.93	0.00	66.87	26.50	404.33	-248.0607	-2.0149
13/08/1999	250.27	4.13	0.00	64.77	28.30	446.09	-195.8175	-1.5905
14/08/1999	402.27	4.47	0.00	58.37	24.20	438.12	-35.8485	-0.2912
15/08/1999	597.27	5.13	0.00	53.52	21.70	444.27	152.9999	1.2427
16/08/1999	519.27	5.13	0.00	48.87	23.40	501.04	18.2316	0.1481
17/08/1999	508.27	4.87	0.00	47.10	24.80	530.61	-22.3372	-0.1814
18/08/1999	515.27	4.07	0.00	45.45	25.80	548.93	-33.6570	-0.2734
19/08/1999	504.27	4.13	0.00	51.10	26.30	516.08	-11.8073	-0.0959
20/08/1999	520.27	4.07	0.00	56.00	27.00	490.14	30.1327	0.2448
21/08/1999	513.27	4.33	0.00	58.20	28.80	501.77	11.4988	0.0934
22/08/1999	573.27	4.40	0.00	60.15	26.50	456.60	116.6664	0.9476

Date	DATA					RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Predicted OUTSIDE	Residuals	Standard Residuals
23/08/1999	324.27	4.67	0.00	63.25	25.80	427.20	-102.9258	-0.8360
24/08/1999	431.27	4.73	0.00	62.45	27.00	450.14	-18.8657	-0.1532
25/08/1999	134.27	4.60	0.00	63.60	28.00	454.54	-320.2707	-2.6014
26/08/1999	583.27	4.33	0.00	65.05	28.80	452.81	130.4565	1.0596
27/08/1999	549.27	4.40	0.00	65.55	30.20	469.23	80.0392	0.6501
28/08/1999	468.27	4.47	0.00	63.40	28.20	457.52	10.7506	0.0873
29/08/1999	378.27	5.13	0.00	61.10	26.50	456.52	-78.2508	-0.6356
30/08/1999	305.27	4.93	0.14	62.70	25.00	420.50	-115.2332	-0.9360
31/08/1999	265.27	4.33	0.14	66.75	24.60	380.53	-115.2625	-0.9362
1/09/1999	468.04	3.20	0.14	67.70	27.50	403.52	64.5174	0.5240
2/09/1999	384.04	3.27	0.14	69.95	25.70	363.13	20.9073	0.1698
3/09/1999	449.04	3.33	0.14	75.50	28.50	362.84	86.2018	0.7002
4/09/1999	497.04	3.73	0.14	71.85	29.50	406.43	90.6128	0.7360
5/09/1999	611.04	3.93	0.14	67.50	31.60	468.42	142.6220	1.1585
6/09/1999	637.04	4.80	0.00	65.90	33.00	509.15	127.8916	1.0388
7/09/1999	646.04	5.53	0.00	64.15	33.60	536.67	109.3710	0.8884
8/09/1999	625.04	6.00	0.00	59.80	30.90	534.65	90.3909	0.7342
9/09/1999	551.04	5.73	0.00	60.85	29.00	498.40	52.6373	0.4275
10/09/1999	575.04	5.33	0.00	60.70	31.10	524.89	50.1518	0.4074
11/09/1999	557.04	5.13	0.00	58.20	28.50	504.93	52.1068	0.4232
12/09/1999	634.04	6.13	0.00	57.58	27.90	510.18	123.8597	1.0061
13/09/1999	560.04	6.20	0.00	56.58	30.60	555.32	4.7250	0.0384
14/09/1999	629.04	6.27	0.00	52.83	31.60	596.57	32.4699	0.2637
15/09/1999	686.04	6.00	0.00	50.68	32.40	620.57	65.4676	0.5318
16/09/1999	675.04	7.00	0.00	52.08	31.70	610.02	65.0183	0.5281
17/09/1999	634.04	7.60	0.00	52.15	31.80	616.42	17.6229	0.1431
18/09/1999	596.04	8.33	0.00	45.72	27.80	613.73	-17.6892	-0.1437
19/09/1999	566.04	8.27	0.00	43.08	26.60	615.33	-49.2878	-0.4003
20/09/1999	548.04	7.67	0.00	40.48	27.00	633.96	-85.9202	-0.6979
21/09/1999	686.04	6.80	0.00	41.78	27.10	618.13	67.9131	0.5516
22/09/1999	709.04	6.13	0.00	43.13	27.90	613.46	95.5839	0.7764
23/09/1999	619.04	6.00	0.00	53.07	29.50	563.39	55.6482	0.4520
24/09/1999	584.04	5.60	0.00	59.40	30.00	521.39	62.6497	0.5089
25/09/1999	510.04	5.67	0.00	64.50	30.60	493.86	16.1841	0.1315
26/09/1999	618.04	5.93	0.00	64.60	30.20	490.04	127.9974	1.0397
27/09/1999	478.04	6.40	0.00	64.60	29.00	477.70	0.3417	0.0028
28/09/1999	499.04	6.20	0.00	63.80	28.80	478.82	20.2219	0.1643
29/09/1999	469.04	5.40	0.00	64.20	29.50	478.33	-9.2931	-0.0755
30/09/1999	516.04	5.20	0.00	63.85	30.00	485.93	30.1127	0.2446
1/10/1999	611.40	5.47	0.00	65.25	31.80	503.28	108.1219	0.8782
2/10/1999	701.40	5.87	0.00	67.77	31.50	484.80	216.6036	1.7594
3/10/1999	454.40	5.87	0.00	69.02	29.90	453.71	0.6873	0.0056
4/10/1999	595.40	4.87	0.20	67.52	32.40	487.12	108.2858	0.8796
5/10/1999	653.40	5.53	0.20	64.32	32.00	510.55	142.8553	1.1603
6/10/1999	764.40	5.80	0.20	61.12	32.90	548.32	216.0863	1.7552
7/10/1999	552.40	6.87	0.20	58.80	30.20	537.25	15.1512	0.1231
8/10/1999	753.40	6.33	0.20	57.65	31.60	559.97	193.4287	1.5711
9/10/1999	846.40	6.20	0.20	57.55	31.50	558.08	288.3178	2.3419
10/10/1999	804.40	6.60	0.20	59.15	32.40	562.77	241.6355	1.9627
11/10/1999	674.40	7.00	0.00	60.15	34.50	591.13	83.2701	0.6764
12/10/1999	798.40	7.20	0.00	56.85	36.10	638.70	159.7056	1.2972
13/10/1999	869.40	7.00	0.00	54.55	36.20	654.69	214.7120	1.7440
14/10/1999	863.40	7.67	0.00	51.80	35.00	663.83	199.5726	1.6210

Date	DATA					RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Predicted OUTSIDE	Residuals	Standard Residuals
15/10/1999	797.40	7.87	0.00	51.45	37.10	697.23	100.1702	0.8136
16/10/1999	780.40	8.07	0.00	52.25	34.30	654.58	125.8211	1.0220
17/10/1999	793.40	7.47	0.00	54.20	33.30	621.31	172.0891	1.3978
18/10/1999	727.40	7.60	0.00	56.25	33.00	603.73	123.6744	1.0045
19/10/1999	591.40	7.53	0.00	59.35	34.00	594.81	-3.4035	-0.0276
20/10/1999	755.40	7.53	0.00	58.95	33.50	590.74	164.6594	1.3375
21/10/1999	183.40	7.13	1.17	61.55	24.00	420.69	-237.2875	-1.9274
22/10/1999	206.40	5.33	1.17	66.85	24.00	366.35	-159.9453	-1.2992
23/10/1999	223.40	3.67	2.34	70.20	30.10	395.31	-171.9085	-1.3963
24/10/1999	381.40	2.47	3.43	67.32	33.10	431.37	-49.9672	-0.4059
25/10/1999	310.40	4.80	3.43	65.17	35.00	494.38	-183.9768	-1.4944
26/10/1999	546.40	6.33	3.43	62.22	37.60	565.48	-19.0779	-0.1550
27/10/1999	665.40	8.00	3.43	56.42	37.00	613.87	51.5319	0.4186
28/10/1999	607.40	7.80	2.34	51.82	36.50	653.10	-45.6986	-0.3712
29/10/1999	582.40	8.00	2.34	55.15	35.30	614.49	-32.0916	-0.2607
30/10/1999	670.40	7.53	1.17	58.68	34.30	587.43	82.9759	0.6740
31/10/1999	157.40	6.60	0.09	60.83	30.20	521.87	-364.4674	-2.9604
1/11/1999	542.55	5.47	0.09	64.23	33.50	532.89	9.6644	0.0785
2/11/1999	299.55	5.07	0.17	68.23	29.50	444.07	-144.5216	-1.1739
3/11/1999	456.55	5.00	0.20	69.98	28.50	416.72	39.8367	0.3236
4/11/1999	556.55	5.00	0.11	71.85	28.20	400.41	156.1386	1.2682
5/11/1999	436.55	4.20	0.11	70.05	32.00	458.57	-22.0155	-0.1788
6/11/1999	194.55	3.97	1.31	72.20	27.50	362.08	-167.5238	-1.3607
7/11/1999	220.55	3.67	3.83	72.80	34.50	416.97	-196.4179	-1.5954
8/11/1999	228.55	4.47	3.83	73.20	30.50	366.05	-137.5010	-1.1169
9/11/1999	308.55	4.43	3.74	71.75	30.50	377.30	-68.7520	-0.5584
10/11/1999	410.55	5.73	3.71	69.85	27.80	365.79	44.7593	0.3636
11/11/1999	442.55	6.47	3.71	61.15	29.40	456.83	-14.2774	-0.1160
12/11/1999	406.55	6.53	3.71	56.75	30.20	499.96	-93.4093	-0.7587
13/11/1999	498.55	6.80	2.51	54.95	30.50	536.11	-37.5609	-0.3051
14/11/1999	611.55	6.33	0.00	54.30	31.50	585.31	26.2382	0.2131
15/11/1999	604.55	7.20	0.00	53.30	33.90	633.61	-29.0601	-0.2360
16/11/1999	427.55	7.73	0.00	55.20	34.30	630.45	-202.8958	-1.6480
17/11/1999	702.55	7.73	0.00	56.30	34.30	622.59	79.9660	0.6495
18/11/1999	287.55	7.67	0.00	57.95	30.60	558.96	-271.4100	-2.2045
19/11/1999	178.55	6.33	2.57	60.95	31.70	504.78	-326.2276	-2.6498
20/11/1999	208.55	5.93	2.57	66.25	30.10	441.09	-232.5397	-1.8888
21/11/1999	201.55	5.13	3.46	71.90	26.50	331.23	-129.6823	-1.0533
22/11/1999	209.55	4.07	3.46	74.25	30.80	364.21	-154.6588	-1.2562
23/11/1999	313.55	3.60	3.46	74.15	33.50	398.04	-84.4834	-0.6862
24/11/1999	355.55	3.87	3.46	72.50	31.00	377.66	-22.1058	-0.1796
25/11/1999	206.55	5.20	3.46	71.75	27.50	346.76	-140.2077	-1.1388
26/11/1999	213.55	6.67	1.00	70.55	26.70	391.86	-178.3078	-1.4483
27/11/1999	81.55	5.60	1.29	72.45	21.20	288.41	-206.8576	-1.6802
28/11/1999	205.55	4.07	0.97	73.25	28.30	371.33	-165.7788	-1.3465
29/11/1999	223.55	2.93	0.97	74.75	27.10	333.63	-110.0804	-0.8941
30/11/1999	382.55	3.47	0.97	74.70	29.70	374.86	7.6909	0.0625
1/12/1999	386.63	5.00	0.97	72.80	29.10	394.16	-7.5259	-0.0611
2/12/1999	367.63	5.13	0.97	68.80	30.00	436.43	-68.7931	-0.5588
3/12/1999	511.63	5.53	0.86	66.35	31.50	479.95	31.6826	0.2573
4/12/1999	560.63	5.87	0.57	64.35	33.70	531.72	28.9087	0.2348
5/12/1999	663.63	6.60	0.00	61.22	33.70	568.78	94.8576	0.7705
6/12/1999	589.63	7.67	0.00	60.82	33.40	577.24	12.3963	0.1007

Date	DATA					RESULSTS		
	OUTSIDE	*Evap*	*Rainfall*	*Rel Humidity*	*Temp - Max*	*Predicted OUTSIDE*	*Residuals*	*Standard Residuals*
7/12/1999	639.63	8.47	0.00	59.97	33.20	587.86	51.7733	0.4205
8/12/1999	768.63	8.73	0.00	59.42	33.50	598.38	170.2504	1.3829
9/12/1999	732.63	8.67	0.00	58.97	35.00	621.75	110.8784	0.9006
10/12/1999	754.63	8.13	0.00	59.80	37.50	645.53	109.1029	0.8862
11/12/1999	693.63	8.33	0.00	57.75	37.50	662.01	31.6222	0.2569
12/12/1999	827.63	9.60	0.00	58.55	30.20	566.82	260.8140	2.1185
13/12/1999	621.63	8.53	0.00	62.20	32.20	558.66	62.9691	0.5115
14/12/1999	713.63	7.73	0.00	62.60	33.50	566.48	147.1479	1.1952
15/12/1999	784.63	6.67	0.00	63.50	32.20	532.30	252.3326	2.0496
16/12/1999	686.63	7.87	0.00	65.80	34.20	554.52	132.1086	1.0731
17/12/1999	688.63	8.07	0.00	64.03	34.50	573.13	115.4998	0.9382
18/12/1999	301.63	7.60	0.43	62.62	34.60	574.41	-272.7792	-2.2157
19/12/1999	222.63	8.27	1.43	66.27	29.50	469.91	-247.2743	-2.0085
20/12/1999	352.63	6.67	1.43	68.07	33.90	503.32	-150.6884	-1.2240
21/12/1999	557.63	6.87	1.43	68.67	31.00	460.72	96.9174	0.7872
22/12/1999	781.63	6.00	1.43	69.23	31.10	450.12	331.5095	2.6927
23/12/1999	438.63	7.73	1.43	69.05	26.00	396.68	41.9491	0.3407
24/12/1999	600.63	5.67	1.43	67.95	29.60	435.48	165.1514	1.3414
25/12/1999	225.63	4.33	1.00	68.55	27.00	388.97	-163.3347	-1.3267
26/12/1999	256.63	2.80	0.00	70.50	26.60	369.38	-112.7491	-0.9158
27/12/1999	177.63	3.13	0.00	76.10	29.90	378.09	-200.4580	-1.6282
28/12/1999	374.63	3.40	1.09	75.35	33.90	426.16	-51.5271	-0.4185
29/12/1999	544.63	4.53	1.09	71.05	34.90	481.10	63.5314	0.5160
30/12/1999	696.63	6.40	1.09	66.15	36.10	549.81	146.8259	1.1926
31/12/1999	572.83	8.20	1.09	59.60	35.50	604.78	-31.9443	-0.2595
1/01/2000	500.27	9.13	1.09	52.45	35.60	665.80	-165.5259	-1.3445
2/01/2000	523.27	9.07	1.09	47.95	37.20	719.50	-196.2281	-1.5939
3/01/2000	645.27	8.67	1.09	50.07	35.50	677.18	-31.9075	-0.2592
4/01/2000	722.27	7.73	0.00	53.57	35.90	664.27	58.0013	0.4711
5/01/2000	432.27	7.87	0.11	58.37	34.80	614.37	-182.0940	-1.4791
6/01/2000	278.27	6.73	0.46	61.47	35.10	581.23	-302.9558	-2.4608
7/01/2000	415.27	6.87	0.89	65.72	35.70	554.42	-139.1438	-1.1302
8/01/2000	511.27	6.40	0.89	66.05	34.30	528.39	-17.1122	-0.1390
9/01/2000	277.27	7.13	3.23	66.60	34.50	501.34	-224.0624	-1.8200
10/01/2000	174.27	7.60	6.83	70.25	30.20	369.90	-195.6313	-1.5890
11/01/2000	288.27	6.60	7.94	72.55	27.00	284.52	3.7550	0.0305
12/01/2000	304.27	5.40	7.83	72.60	29.70	312.15	-7.8805	-0.0640
13/01/2000	304.27	4.67	7.49	73.00	31.30	329.51	-25.2346	-0.2050
14/01/2000	374.27	5.87	7.06	71.45	32.50	374.14	0.1376	0.0011
15/01/2000	413.27	7.33	7.06	65.25	35.10	467.86	-54.5820	-0.4433
16/01/2000	449.27	8.27	4.71	62.35	34.70	524.18	-74.9019	-0.6084
17/01/2000	537.27	8.47	1.11	61.60	35.10	586.99	-49.7133	-0.4038
18/01/2000	489.27	8.33	0.00	60.05	35.80	622.04	-132.7647	-1.0784
19/01/2000	658.27	8.60	0.00	58.70	37.60	659.04	-0.7709	-0.0063
20/01/2000	623.27	8.87	0.00	57.10	39.90	704.76	-81.4856	-0.6619
21/01/2000	613.27	9.27	0.00	54.10	41.30	749.24	-135.9664	-1.1044
22/01/2000	583.27	9.27	0.00	51.20	41.00	765.81	-182.5399	-1.4827
23/01/2000	694.27	9.37	0.00	50.60	40.40	762.71	-68.4366	-0.5559
24/01/2000	689.27	9.50	0.00	52.60	37.50	709.49	-20.2151	-0.1642
25/01/2000	653.27	8.83	0.00	56.40	35.00	641.62	11.6503	0.0946
26/01/2000	585.27	7.73	0.00	59.15	33.50	591.14	-5.8692	-0.0477
27/01/2000	586.27	6.47	0.00	62.85	34.80	571.11	15.1631	0.1232
28/01/2000	322.27	5.67	1.03	66.45	34.10	514.06	-191.7902	-1.5578

Date	DATA					RESULSTS		
	OUTSIDE	*Evap*	*Rainfall*	*Rel Humidity*	*Temp - Max*	*Predicted OUTSIDE*	*Residuals*	*Standard Residuals*
29/01/2000	485.27	5.53	1.03	65.40	35.90	545.27	-59.9939	-0.4873
30/01/2000	636.27	6.53	1.03	64.43	36.50	569.63	66.6452	0.5413
31/01/2000	576.27	7.80	1.03	63.93	35.50	570.94	5.3306	0.0433
1/02/2000	610.87	8.87	1.03	61.88	36.20	605.04	5.8263	0.0473
2/02/2000	660.87	9.00	1.03	59.48	34.80	604.03	56.8349	0.4616
3/02/2000	580.87	8.93	1.03	60.38	30.10	531.92	48.9423	0.3975
4/02/2000	597.87	8.00	0.00	61.10	33.00	572.72	25.1441	0.2042
5/02/2000	596.87	7.33	0.00	62.25	33.00	558.41	38.4605	0.3124
6/02/2000	644.87	6.53	0.00	63.90	31.20	514.38	130.4885	1.0599
7/02/2000	547.87	6.73	0.00	64.80	31.80	518.08	29.7855	0.2419
8/02/2000	590.87	6.13	0.09	66.45	33.00	516.22	74.6458	0.6063
9/02/2000	590.87	6.47	0.09	67.95	30.80	478.09	112.7740	0.9160
10/02/2000	713.87	6.00	0.09	66.75	34.50	533.62	180.2439	1.4640
11/02/2000	753.87	6.73	0.09	65.55	36.10	571.06	182.8105	1.4849
12/02/2000	803.87	6.87	0.09	63.90	37.50	603.45	200.4172	1.6279
13/02/2000	799.87	8.07	0.09	60.70	37.00	630.37	169.4933	1.3767
14/02/2000	439.87	8.20	7.11	60.70	32.70	474.28	-34.4145	-0.2795
15/02/2000	157.87	8.00	9.74	68.10	20.70	216.87	-59.0030	-0.4793
16/02/2000	141.87	5.07	12.86	74.75	24.10	146.26	-4.3884	-0.0356
17/02/2000	79.87	2.67	12.91	80.70	26.20	110.06	-30.1898	-0.2452
18/02/2000	115.87	0.93	12.94	86.60	26.00	48.87	66.9972	0.5442
19/02/2000	41.87	1.87	12.94	90.60	26.20	31.59	10.2808	0.0835
20/02/2000	89.87	2.33	12.94	88.45	27.20	65.06	24.8028	0.2015
21/02/2000	66.87	2.73	9.83	88.35	26.60	104.46	-37.5911	-0.3053
22/02/2000	102.87	2.13	8.11	88.90	25.40	102.28	0.5900	0.0048
23/02/2000	142.87	1.67	5.14	88.25	27.40	171.68	-28.8144	-0.2340
24/02/2000	105.87	1.53	5.09	85.70	29.00	211.63	-105.7650	-0.8591
25/02/2000	206.87	2.13	5.06	83.60	31.40	265.75	-58.8837	-0.4783
26/02/2000	268.87	3.73	5.06	79.60	27.00	248.06	20.8067	0.1690
27/02/2000	346.87	4.20	5.06	75.65	29.10	309.63	37.2358	0.3024
28/02/2000	261.87	4.67	1.14	72.70	31.70	425.43	-163.5667	-1.3286
29/02/2000	238.87	4.87	0.14	72.60	30.80	429.43	-190.5636	-1.5479
1/03/2000	231.79	5.20	0.60	71.95	31.50	440.46	-208.6603	-1.6949
2/03/2000	286.79	5.93	0.60	71.00	31.00	447.03	-160.2352	-1.3015
3/03/2000	451.79	6.07	0.60	69.30	30.50	453.48	-1.6829	-0.0137
4/03/2000	352.79	6.47	0.60	70.60	31.00	454.77	-101.9718	-0.8283
5/03/2000	417.79	6.27	0.60	72.10	32.90	468.52	-50.7250	-0.4120
6/03/2000	449.79	6.00	0.60	71.55	34.40	490.78	-40.9825	-0.3329
7/03/2000	555.79	6.00	0.60	71.55	34.40	490.78	65.0175	0.5281
8/03/2000	473.79	6.13	0.00	73.05	32.50	463.32	10.4743	0.0851
9/03/2000	432.79	5.80	0.00	73.05	33.10	468.58	-35.7833	-0.2907
10/03/2000	365.79	5.60	0.14	70.80	33.40	485.00	-119.2008	-0.9682
11/03/2000	370.79	5.40	0.14	70.50	33.10	481.16	-110.3626	-0.8964
12/03/2000	524.79	5.80	0.14	70.58	33.40	488.37	36.4215	0.2958
13/03/2000	446.79	5.87	0.14	70.83	33.10	483.04	-36.2483	-0.2944
14/03/2000	430.79	6.07	0.14	70.43	33.00	486.35	-55.5520	-0.4512
15/03/2000	602.79	6.40	0.14	69.68	33.50	501.68	101.1172	0.8213
16/03/2000	509.79	6.67	0.14	69.83	33.10	497.51	12.2879	0.0998
17/03/2000	523.79	6.93	0.00	70.15	28.50	435.99	87.8057	0.7132
18/03/2000	414.79	5.80	0.00	69.78	30.70	458.70	-43.9057	-0.3566
19/03/2000	605.79	5.00	0.00	68.13	31.80	478.40	127.3902	1.0347
20/03/2000	443.79	4.40	0.00	68.08	32.50	482.97	-39.1703	-0.3182
21/03/2000	563.79	5.40	0.00	68.13	32.70	494.52	69.2725	0.5627

Date	DATA					RESULSTS		
	OUTSIDE	*Evap*	*Rainfall*	*Rel Humidity*	*Temp - Max*	*Predicted OUTSIDE*	*Residuals*	*Standard Residuals*
22/03/2000	615.79	5.93	0.00	67.48	33.30	512.35	103.4429	0.8402
23/03/2000	563.79	6.20	0.00	66.25	34.60	541.60	22.1925	0.1803
24/03/2000	394.79	6.33	0.14	65.60	33.90	535.79	-140.9946	-1.1452
25/03/2000	447.79	6.40	0.14	66.70	32.00	502.23	-54.4395	-0.4422
26/03/2000	579.79	5.93	0.14	68.20	32.50	494.17	85.6274	0.6955
27/03/2000	504.79	5.33	0.14	69.65	34.20	501.85	2.9440	0.0239
28/03/2000	645.79	5.13	0.14	70.60	34.00	490.46	155.3317	1.2617
29/03/2000	591.79	5.47	0.14	72.95	33.80	473.95	117.8475	0.9572
30/03/2000	571.79	5.93	0.14	71.30	33.20	481.70	90.0929	0.7318
31/03/2000	578.79	6.13	0.00	69.45	32.10	483.51	95.2821	0.7739
1/04/2000	598.22	6.13	0.00	68.55	33.30	506.56	91.6605	0.7445
2/04/2000	422.22	6.27	0.00	68.90	30.50	466.51	-44.2952	-0.3598
3/04/2000	281.22	5.33	0.51	70.40	30.00	433.18	-151.9616	-1.2343
4/04/2000	534.22	4.27	0.51	72.00	31.50	432.75	101.4638	0.8241
5/04/2000	500.22	3.53	0.51	72.95	33.00	440.02	60.1950	0.4889
6/04/2000	521.22	4.13	0.51	72.35	35.00	477.49	43.7319	0.3552
7/04/2000	478.22	5.27	0.51	71.55	30.00	424.35	53.8673	0.4375
8/04/2000	401.22	5.40	0.51	70.70	25.10	363.81	37.4068	0.3038
9/04/2000	279.22	4.60	0.51	72.40	25.10	344.34	-65.1264	-0.5290
10/04/2000	306.22	3.13	0.43	74.35	27.80	355.56	-49.3461	-0.4008
11/04/2000	479.22	2.33	0.43	75.00	30.00	374.06	105.1601	0.8542
12/04/2000	424.22	3.13	0.43	76.15	27.20	334.39	89.8249	0.7296
13/04/2000	329.22	3.80	0.63	76.30	27.10	335.25	-6.0334	-0.0490
14/04/2000	433.22	3.80	0.63	74.65	31.00	401.03	32.1836	0.2614
15/04/2000	556.22	3.33	0.63	74.70	32.20	413.02	143.1966	1.1631
16/04/2000	682.22	3.93	0.63	73.95	32.50	428.02	254.1956	2.0647
17/04/2000	506.22	4.67	0.20	73.60	33.40	455.65	50.5654	0.4107
18/04/2000	606.22	5.20	0.20	72.05	33.90	478.53	127.6878	1.0371
19/04/2000	346.22	4.93	0.37	72.55	23.80	330.31	15.9063	0.1292
20/04/2000	396.22	4.47	0.17	66.80	26.00	400.38	-4.1601	-0.0338
21/04/2000	312.22	4.13	0.17	66.70	24.60	378.66	-66.4450	-0.5397
22/04/2000	108.22	3.87	3.89	71.75	17.60	191.55	-83.3331	-0.6769
23/04/2000	94.22	2.93	4.43	77.25	18.50	148.61	-54.3947	-0.4418
24/04/2000	99.22	1.73	9.57	80.60	18.10	36.61	62.6097	0.5085
25/04/2000	120.22	0.80	11.60	88.55	18.50	-51.43	171.6501	1.3942
26/04/2000	117.22	0.87	11.86	94.00	17.80	-103.04	220.2602	1.7891
27/04/2000	142.22	1.07	12.77	92.10	23.00	-28.37	170.5843	1.3856
28/04/2000	137.22	1.27	12.77	89.15	23.40	0.08	137.1336	1.1139
29/04/2000	156.22	1.67	9.06	86.40	24.60	91.68	64.5339	0.5242
30/04/2000	151.22	1.93	8.51	83.10	27.40	164.02	-12.8051	-0.1040
1/05/2000	244.43	2.73	3.37	80.15	25.40	236.29	8.1393	0.0661
2/05/2000	127.43	2.93	1.60	79.45	25.60	270.53	-143.1063	-1.1624
3/05/2000	210.43	2.67	3.09	81.90	27.80	260.37	-49.9433	-0.4057
4/05/2000	152.43	2.33	2.17	84.45	25.40	218.59	-66.1646	-0.5374
5/05/2000	157.43	1.87	2.77	87.15	26.40	200.52	-43.0956	-0.3500
6/05/2000	65.43	2.00	2.77	89.20	20.20	101.26	-35.8326	-0.2911
7/05/2000	119.43	1.83	2.77	88.35	19.40	94.73	24.6916	0.2006
8/05/2000	136.43	1.90	4.91	87.25	22.40	114.92	21.5011	0.1746
9/05/2000	137.43	1.83	4.66	83.90	25.50	184.75	-47.3248	-0.3844
10/05/2000	162.43	2.07	2.74	80.95	25.30	231.83	-69.4063	-0.5638
11/05/2000	158.43	2.93	2.74	78.50	25.20	255.88	-97.4587	-0.7916
12/05/2000	204.43	3.73	2.14	77.90	26.00	286.91	-82.4860	-0.6700
13/05/2000	190.43	3.53	2.14	72.85	27.00	335.02	-144.5935	-1.1745

Date	DATA					RESULSTS		
	OUTSIDE	*Evap*	*Rainfall*	*Rel Humidity*	*Temp - Max*	*Predicted OUTSIDE*	*Residuals*	*Standard Residuals*
14/05/2000	180.43	3.53	2.14	69.37	27.60	368.22	-187.7954	-1.5254
15/05/2000	195.43	3.40	0.00	68.82	26.60	386.90	-191.4754	-1.5553
16/05/2000	288.43	3.80	0.00	66.32	25.60	394.58	-106.1578	-0.8623
17/05/2000	271.43	3.80	0.00	64.97	25.30	400.08	-128.6533	-1.0450
18/05/2000	211.43	4.27	0.00	64.02	23.10	380.68	-169.2551	-1.3748
19/05/2000	190.43	3.87	0.26	68.80	21.30	314.34	-123.9136	-1.0065
20/05/2000	176.43	3.33	0.26	70.20	23.20	325.76	-149.3329	-1.2130
21/05/2000	282.43	2.20	0.26	72.75	22.90	293.01	-10.5893	-0.0860
22/05/2000	279.43	2.33	0.26	71.80	25.70	339.79	-60.3608	-0.4903
23/05/2000	286.43	2.47	0.26	74.80	25.50	316.80	-30.3702	-0.2467
24/05/2000	279.43	3.00	0.26	74.80	24.90	313.37	-33.9418	-0.2757
25/05/2000	304.43	2.53	0.26	74.60	28.10	354.83	-50.4029	-0.4094
26/05/2000	300.43	2.40	0.00	75.20	26.10	325.21	-24.7853	-0.2013
27/05/2000	420.43	1.93	0.00	77.40	25.90	302.45	117.9751	0.9583
28/05/2000	358.43	2.87	0.00	74.15	20.00	252.54	105.8886	0.8601
29/05/2000	384.43	3.20	0.00	70.50	19.90	280.29	104.1374	0.8459
30/05/2000	365.43	3.60	0.00	67.20	18.00	281.23	84.1966	0.6839
31/05/2000	410.43	2.87	0.00	63.85	17.50	291.54	118.8825	0.9656
1/06/2000	189.67	2.67	0.00	61.50	18.10	314.82	-125.1457	-1.0165
2/06/2000	226.67	2.53	0.00	63.05	19.70	324.67	-97.9981	-0.7960
3/06/2000	392.67	2.60	0.00	63.35	20.20	330.06	62.6145	0.5086
4/06/2000	357.67	2.53	0.00	64.50	23.30	364.14	-6.4720	-0.0526
5/06/2000	440.67	2.53	0.00	67.25	23.50	347.26	93.4138	0.7588
6/06/2000	479.67	2.67	0.00	65.75	15.60	249.83	229.8387	1.8669
7/06/2000	395.67	2.67	0.00	61.75	18.60	319.95	75.7192	0.6150
8/06/2000	397.67	2.60	0.00	59.20	17.70	325.11	72.5631	0.5894
9/06/2000	197.67	2.10	0.00	61.45	13.20	242.16	-44.4864	-0.3613
10/06/2000	320.67	2.43	5.77	65.40	12.50	126.99	193.6807	1.5732
11/06/2000	255.67	3.50	6.49	70.60	17.90	164.40	91.2717	0.7414
12/06/2000	212.67	3.80	6.49	77.00	21.30	168.47	44.2010	0.3590
13/06/2000	293.67	3.27	6.49	80.35	21.40	141.03	152.6372	1.2398
14/06/2000	270.67	2.60	6.49	80.40	21.00	129.04	141.6293	1.1504
15/06/2000	253.67	2.60	6.49	76.75	21.00	155.13	98.5423	0.8004
16/06/2000	183.67	2.47	6.49	75.55	23.10	191.56	-7.8865	-0.0641
17/06/2000	294.67	2.20	0.71	76.15	21.90	248.51	46.1590	0.3749
18/06/2000	115.67	1.93	0.00	78.05	18.10	189.82	-74.1540	-0.6023
19/06/2000	173.67	1.80	0.49	79.60	22.70	234.45	-60.7800	-0.4937
20/06/2000	179.67	1.20	0.49	81.50	24.10	234.76	-55.0942	-0.4475
21/06/2000	114.67	1.07	0.49	83.75	25.70	239.61	-124.9436	-1.0149
22/06/2000	199.67	1.33	0.49	84.50	27.20	257.46	-57.7877	-0.4694
23/06/2000	240.67	1.60	0.49	82.70	25.40	247.84	-7.1727	-0.0583
24/06/2000	275.67	2.53	0.49	78.50	21.70	235.17	40.4949	0.3289
25/06/2000	214.67	2.67	0.49	75.50	21.30	252.30	-37.6285	-0.3056
26/06/2000	159.67	2.73	0.00	73.90	23.00	294.63	-134.9652	-1.0963
27/06/2000	169.67	2.20	0.00	72.85	24.80	322.18	-152.5105	-1.2388
28/06/2000	259.67	2.20	0.00	73.70	25.60	327.18	-67.5104	-0.5484
29/06/2000	212.67	2.33	0.00	72.75	22.60	293.66	-80.9886	-0.6578
30/06/2000	185.81	2.87	0.00	69.85	18.70	265.27	-79.4644	-0.6455

APPENDIX D: TOTAL MODEL 2 – DATA & RESULTS

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
1/07/1999	222.18	2.27	1.43	79.87	23.40	264.98	233.38	-11.2037	-0.0910
2/07/1999	213.18	2.27	1.43	79.60	18.60	225.08	168.84	44.3400	0.3602
3/07/1999	230.18	2.53	1.43	78.65	16.50	221.85	149.00	81.1831	0.6594
4/07/1999	284.18	2.53	1.43	80.55	17.10	242.51	143.72	140.4564	1.1409
5/07/1999	487.18	1.80	1.14	78.05	23.60	333.85	248.84	238.3367	1.9359
6/07/1999	386.18	1.60	1.14	75.60	24.90	385.85	282.52	103.6587	0.8420
7/07/1999	437.18	2.13	1.14	76.10	25.30	436.85	289.36	147.8170	1.2006
8/07/1999	446.18	2.47	0.00	77.55	22.20	423.18	255.03	191.1472	1.5526
9/07/1999	433.18	2.60	0.00	75.35	22.50	438.85	276.13	157.0511	1.2757
10/07/1999	432.18	2.13	0.00	73.45	26.40	437.18	339.43	92.7493	0.7534
11/07/1999	576.18	2.53	0.00	72.00	25.10	480.51	335.46	240.7244	1.9553
12/07/1999	473.18	3.00	0.00	69.65	25.00	493.85	355.14	118.0450	0.9588
13/07/1999	465.18	3.40	0.00	66.35	25.10	504.85	383.76	81.4168	0.6613
14/07/1999	523.18	3.33	0.00	65.60	25.90	487.18	399.59	123.5912	1.0039
15/07/1999	384.18	3.33	0.00	63.65	23.80	457.51	384.46	-0.2739	-0.0022
16/07/1999	442.18	3.73	0.00	61.35	23.50	449.85	400.40	41.7825	0.3394
17/07/1999	475.18	3.93	0.00	60.05	24.00	433.85	418.44	56.7402	0.4609
18/07/1999	520.18	3.60	0.00	60.10	26.00	479.18	442.72	77.4589	0.6292
19/07/1999	427.18	3.33	0.00	59.20	28.00	474.18	474.40	-47.2220	-0.3836
20/07/1999	476.18	3.33	0.00	56.90	25.40	474.51	454.85	21.3332	0.1733
21/07/1999	607.18	3.80	0.00	56.35	23.60	503.51	438.13	169.0528	1.3731
22/07/1999	421.18	3.87	0.00	54.45	22.50	501.51	437.09	-15.9084	-0.1292
23/07/1999	339.18	4.00	0.00	53.45	16.50	455.85	362.39	-23.2129	-0.1885
24/07/1999	143.18	3.07	1.40	57.85	17.80	301.18	320.93	-177.7489	-1.4438
25/07/1999	289.18	2.27	1.40	63.85	21.50	257.18	321.95	-32.7712	-0.2662
26/07/1999	287.18	1.93	1.40	65.65	22.90	239.85	325.42	-38.2389	-0.3106
27/07/1999	352.18	2.93	1.40	68.20	22.60	309.51	312.19	39.9935	0.3248
28/07/1999	415.18	3.80	1.40	70.10	23.40	351.51	317.61	97.5717	0.7925
29/07/1999	386.18	4.00	1.40	67.70	24.80	384.51	355.97	30.2083	0.2454
30/07/1999	470.18	3.67	1.40	66.60	22.70	423.85	331.71	138.4668	1.1247
31/07/1999	577.18	3.13	0.00	68.90	26.70	477.85	385.25	191.9310	1.5590
1/08/1999	775.27	3.07	0.00	69.15	25.80	607.54	370.39	404.8755	3.2886
2/08/1999	214.27	2.87	0.00	65.82	25.00	522.24	381.31	-167.0441	-1.3568
3/08/1999	222.27	3.33	0.00	65.97	26.20	403.94	401.12	-178.8525	-1.4527
4/08/1999	265.27	3.33	0.00	65.32	25.00	233.94	389.16	-123.8858	-1.0063
5/08/1999	230.27	3.80	0.00	63.05	24.00	239.27	395.78	-165.5103	-1.3444
6/08/1999	253.27	4.13	0.00	62.55	24.20	249.60	405.17	-151.9012	-1.2338
7/08/1999	188.27	4.33	0.00	65.73	25.00	223.94	395.32	-207.0536	-1.6818
8/08/1999	175.27	3.73	0.00	66.03	26.30	205.60	405.69	-230.4188	-1.8716
9/08/1999	174.27	3.27	0.00	66.03	28.20	179.27	427.72	-253.4537	-2.0587
10/08/1999	144.27	3.20	0.00	66.95	28.10	164.60	419.18	-274.9081	-2.2329
11/08/1999	116.27	3.67	0.00	68.45	26.70	144.94	393.34	-277.0743	-2.2505
12/08/1999	156.27	3.93	0.00	66.87	26.50	138.94	404.33	-248.0607	-2.0149
13/08/1999	250.27	4.13	0.00	64.77	28.30	174.27	446.09	-195.8175	-1.5905
14/08/1999	402.27	4.47	0.00	58.37	24.20	269.60	438.12	-35.8485	-0.2912
15/08/1999	597.27	5.13	0.00	53.52	21.70	416.60	444.27	152.9999	1.2427
16/08/1999	519.27	5.13	0.00	48.87	23.40	506.27	501.04	18.2316	0.1481
17/08/1999	508.27	4.87	0.00	47.10	24.80	541.60	530.61	-22.3372	-0.1814
18/08/1999	515.27	4.07	0.00	45.45	25.80	514.27	548.93	-33.6570	-0.2734
19/08/1999	504.27	4.13	0.00	51.10	26.30	509.27	516.08	-11.8073	-0.0959
20/08/1999	520.27	4.07	0.00	56.00	27.00	513.27	490.14	30.1327	0.2448
21/08/1999	513.27	4.33	0.00	58.20	28.80	512.60	501.77	11.4988	0.0934
22/08/1999	573.27	4.40	0.00	60.15	26.50	535.60	456.60	116.6664	0.9476

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
23/08/1999	324.27	4.67	0.00	63.25	25.80	470.27	427.20	-102.9258	-0.8360
24/08/1999	431.27	4.73	0.00	62.45	27.00	442.94	450.14	-18.8657	-0.1532
25/08/1999	134.27	4.60	0.00	63.60	28.00	296.60	454.54	-320.2707	-2.6014
26/08/1999	583.27	4.33	0.00	65.05	28.80	382.94	452.81	130.4565	1.0596
27/08/1999	549.27	4.40	0.00	65.55	30.20	422.27	469.23	80.0392	0.6501
28/08/1999	468.27	4.47	0.00	63.40	28.20	533.60	457.52	10.7506	0.0873
29/08/1999	378.27	5.13	0.00	61.10	26.50	465.27	456.52	-78.2508	-0.6356
30/08/1999	305.27	4.93	0.14	62.70	25.00	383.94	420.50	-115.2332	-0.9360
31/08/1999	265.27	4.33	0.14	66.75	24.60	316.27	380.53	-115.2625	-0.9362
1/09/1999	468.04	3.20	0.14	67.70	27.50	346.19	403.52	64.5174	0.5240
2/09/1999	384.04	3.27	0.14	69.95	25.70	372.45	363.13	20.9073	0.1698
3/09/1999	449.04	3.33	0.14	75.50	28.50	433.71	362.84	86.2018	0.7002
4/09/1999	497.04	3.73	0.14	71.85	29.50	443.37	406.43	90.6128	0.7360
5/09/1999	611.04	3.93	0.14	67.50	31.60	519.04	468.42	142.6220	1.1585
6/09/1999	637.04	4.80	0.00	65.90	33.00	581.71	509.15	127.8916	1.0388
7/09/1999	646.04	5.53	0.00	64.15	33.60	631.37	536.67	109.3710	0.8884
8/09/1999	625.04	6.00	0.00	59.80	30.90	636.04	534.65	90.3909	0.7342
9/09/1999	551.04	5.73	0.00	60.85	29.00	607.37	498.40	52.6373	0.4275
10/09/1999	575.04	5.33	0.00	60.70	31.10	583.71	524.89	50.1518	0.4074
11/09/1999	557.04	5.13	0.00	58.20	28.50	561.04	504.93	52.1068	0.4232
12/09/1999	634.04	6.13	0.00	57.58	27.90	588.71	510.18	123.8597	1.0061
13/09/1999	560.04	6.20	0.00	56.58	30.60	583.71	555.32	4.7250	0.0384
14/09/1999	629.04	6.27	0.00	52.83	31.60	607.71	596.57	32.4699	0.2637
15/09/1999	686.04	6.00	0.00	50.68	32.40	625.04	620.57	65.4676	0.5318
16/09/1999	675.04	7.00	0.00	52.08	31.70	663.37	610.02	65.0183	0.5281
17/09/1999	634.04	7.60	0.00	52.15	31.80	665.04	616.42	17.6229	0.1431
18/09/1999	596.04	8.33	0.00	45.72	27.80	635.04	613.73	-17.6892	-0.1437
19/09/1999	566.04	8.27	0.00	43.08	26.60	598.71	615.33	-49.2878	-0.4003
20/09/1999	548.04	7.67	0.00	40.48	27.00	570.04	633.96	-85.9202	-0.6979
21/09/1999	686.04	6.80	0.00	41.78	27.10	600.04	618.13	67.9131	0.5516
22/09/1999	709.04	6.13	0.00	43.13	27.90	647.71	613.46	95.5839	0.7764
23/09/1999	619.04	6.00	0.00	53.07	29.50	671.37	563.39	55.6482	0.4520
24/09/1999	584.04	5.60	0.00	59.40	30.00	637.37	521.39	62.6497	0.5089
25/09/1999	510.04	5.67	0.00	64.50	30.60	571.04	493.86	16.1841	0.1315
26/09/1999	618.04	5.93	0.00	64.60	30.20	570.71	490.04	127.9974	1.0397
27/09/1999	478.04	6.40	0.00	64.60	29.00	535.37	477.70	0.3417	0.0028
28/09/1999	499.04	6.20	0.00	63.80	28.80	531.71	478.82	20.2219	0.1643
29/09/1999	469.04	5.40	0.00	64.20	29.50	482.04	478.33	-9.2931	-0.0755
30/09/1999	516.04	5.20	0.00	63.85	30.00	494.71	485.93	30.1127	0.2446
1/10/1999	611.40	5.47	0.00	65.25	31.80	532.16	503.28	108.1219	0.8782
2/10/1999	701.40	5.87	0.00	67.77	31.50	609.62	484.80	216.6036	1.7594
3/10/1999	454.40	5.87	0.00	69.02	29.90	589.07	453.71	0.6873	0.0056
4/10/1999	595.40	4.87	0.20	67.52	32.40	583.74	487.12	108.2858	0.8796
5/10/1999	653.40	5.53	0.20	64.32	32.00	567.74	510.55	142.8553	1.1603
6/10/1999	764.40	5.80	0.20	61.12	32.90	671.07	548.32	216.0863	1.7552
7/10/1999	552.40	6.87	0.20	58.80	30.20	656.74	537.25	15.1512	0.1231
8/10/1999	753.40	6.33	0.20	57.65	31.60	690.07	559.97	193.4287	1.5711
9/10/1999	846.40	6.20	0.20	57.55	31.50	717.40	558.08	288.3178	2.3419
10/10/1999	804.40	6.60	0.20	59.15	32.40	801.40	562.77	241.6355	1.9627
11/10/1999	674.40	7.00	0.00	60.15	34.50	775.07	591.13	83.2701	0.6764
12/10/1999	798.40	7.20	0.00	56.85	36.10	759.07	638.70	159.7056	1.2972
13/10/1999	869.40	7.00	0.00	54.55	36.20	780.74	654.69	214.7120	1.7440
14/10/1999	863.40	7.67	0.00	51.80	35.00	843.74	663.83	199.5726	1.6210

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
15/10/1999	797.40	7.87	0.00	51.45	37.10	843.40	697.23	100.1702	0.8136
16/10/1999	780.40	8.07	0.00	52.25	34.30	813.74	654.58	125.8211	1.0220
17/10/1999	793.40	7.47	0.00	54.20	33.30	790.40	621.31	172.0891	1.3978
18/10/1999	727.40	7.60	0.00	56.25	33.00	767.07	603.73	123.6744	1.0045
19/10/1999	591.40	7.53	0.00	59.35	34.00	704.07	594.81	-3.4035	-0.0276
20/10/1999	755.40	7.53	0.00	58.95	33.50	691.40	590.74	164.6594	1.3375
21/10/1999	183.40	7.13	1.17	61.55	24.00	510.07	420.69	-237.2875	-1.9274
22/10/1999	206.40	5.33	1.17	66.85	24.00	381.74	366.35	-159.9453	-1.2992
23/10/1999	223.40	3.67	2.34	70.20	30.10	204.40	395.31	-171.9085	-1.3963
24/10/1999	381.40	2.47	3.43	67.32	33.10	270.40	431.37	-49.9672	-0.4059
25/10/1999	310.40	4.80	3.43	65.17	35.00	305.07	494.38	-183.9768	-1.4944
26/10/1999	546.40	6.33	3.43	62.22	37.60	412.74	565.48	-19.0779	-0.1550
27/10/1999	665.40	8.00	3.43	56.42	37.00	507.40	613.87	51.5319	0.4186
28/10/1999	607.40	7.80	2.34	51.82	36.50	606.40	653.10	-45.6986	-0.3712
29/10/1999	582.40	8.00	2.34	55.15	35.30	618.40	614.49	-32.0916	-0.2607
30/10/1999	670.40	7.53	1.17	58.68	34.30	620.07	587.43	82.9759	0.6740
31/10/1999	157.40	6.60	0.09	60.83	30.20	470.07	521.87	-364.4674	-2.9604
1/11/1999	542.55	5.47	0.09	64.23	33.50	456.79	532.89	9.6644	0.0785
2/11/1999	299.55	5.07	0.17	68.23	29.50	333.17	444.07	-144.5216	-1.1739
3/11/1999	456.55	5.00	0.20	69.98	28.50	432.89	416.72	39.8367	0.3236
4/11/1999	556.55	5.00	0.11	71.85	28.20	437.55	400.41	156.1386	1.2682
5/11/1999	436.55	4.20	0.11	70.05	32.00	483.22	458.57	-22.0155	-0.1788
6/11/1999	194.55	3.97	1.31	72.20	27.50	395.89	362.08	-167.5238	-1.3607
7/11/1999	220.55	3.67	3.83	72.80	34.50	283.89	416.97	-196.4179	-1.5954
8/11/1999	228.55	4.47	3.83	73.20	30.50	214.55	366.05	-137.5010	-1.1169
9/11/1999	308.55	4.43	3.74	71.75	30.50	252.55	377.30	-68.7520	-0.5584
10/11/1999	410.55	5.73	3.71	69.85	27.80	315.89	365.79	44.7593	0.3636
11/11/1999	442.55	6.47	3.71	61.15	29.40	387.22	456.83	-14.2774	-0.1160
12/11/1999	406.55	6.53	3.71	56.75	30.20	419.89	499.96	-93.4093	-0.7587
13/11/1999	498.55	6.80	2.51	54.95	30.50	449.22	536.11	-37.5609	-0.3051
14/11/1999	611.55	6.33	0.00	54.30	31.50	505.55	585.31	26.2382	0.2131
15/11/1999	604.55	7.20	0.00	53.30	33.90	571.55	633.61	-29.0601	-0.2360
16/11/1999	427.55	7.73	0.00	55.20	34.30	547.89	630.45	-202.8958	-1.6480
17/11/1999	702.55	7.73	0.00	56.30	34.30	578.22	622.59	79.9660	0.6495
18/11/1999	287.55	7.67	0.00	57.95	30.60	472.55	558.96	-271.4100	-2.2045
19/11/1999	178.55	6.33	2.57	60.95	31.70	389.55	504.78	-326.2276	-2.6498
20/11/1999	208.55	5.93	2.57	66.25	30.10	224.89	441.09	-232.5397	-1.8888
21/11/1999	201.55	5.13	3.46	71.90	26.50	196.22	331.23	-129.6823	-1.0533
22/11/1999	209.55	4.07	3.46	74.25	30.80	206.55	364.21	-154.6588	-1.2562
23/11/1999	313.55	3.60	3.46	74.15	33.50	241.55	398.04	-84.4834	-0.6862
24/11/1999	355.55	3.87	3.46	72.50	31.00	292.89	377.66	-22.1058	-0.1796
25/11/1999	206.55	5.20	3.46	71.75	27.50	291.89	346.76	-140.2077	-1.1388
26/11/1999	213.55	6.67	1.00	70.55	26.70	258.55	391.86	-178.3078	-1.4483
27/11/1999	81.55	5.60	1.29	72.45	21.20	167.22	288.41	-206.8576	-1.6802
28/11/1999	205.55	4.07	0.97	73.25	28.30	166.89	371.33	-165.7788	-1.3465
29/11/1999	223.55	2.93	0.97	74.75	27.10	170.22	333.63	-110.0804	-0.8941
30/11/1999	382.55	3.47	0.97	74.70	29.70	270.55	374.86	7.6909	0.0625
1/12/1999	386.63	5.00	0.97	72.80	29.10	330.91	394.16	-7.5259	-0.0611
2/12/1999	367.63	5.13	0.97	68.80	30.00	378.94	436.43	-68.7931	-0.5588
3/12/1999	511.63	5.53	0.86	66.35	31.50	421.97	479.95	31.6826	0.2573
4/12/1999	560.63	5.87	0.57	64.35	33.70	479.97	531.72	28.9087	0.2348
5/12/1999	663.63	6.60	0.00	61.22	33.70	578.63	568.78	94.8576	0.7705
6/12/1999	589.63	7.67	0.00	60.82	33.40	604.63	577.24	12.3963	0.1007

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
7/12/1999	639.63	8.47	0.00	59.97	33.20	630.97	587.86	51.7733	0.4205
8/12/1999	768.63	8.73	0.00	59.42	33.50	665.97	598.38	170.2504	1.3829
9/12/1999	732.63	8.67	0.00	58.97	35.00	713.63	621.75	110.8784	0.9006
10/12/1999	754.63	8.13	0.00	59.80	37.50	751.97	645.53	109.1029	0.8862
11/12/1999	693.63	8.33	0.00	57.75	37.50	726.97	662.01	31.6222	0.2569
12/12/1999	827.63	9.60	0.00	58.55	30.20	758.63	566.82	260.8140	2.1185
13/12/1999	621.63	8.53	0.00	62.20	32.20	714.30	558.66	62.9691	0.5115
14/12/1999	713.63	7.73	0.00	62.60	33.50	720.97	566.48	147.1479	1.1952
15/12/1999	784.63	6.67	0.00	63.50	32.20	706.63	532.30	252.3326	2.0496
16/12/1999	686.63	7.87	0.00	65.80	34.20	728.30	554.52	132.1086	1.0731
17/12/1999	688.63	8.07	0.00	64.03	34.50	719.97	573.13	115.4998	0.9382
18/12/1999	301.63	7.60	0.43	62.62	34.60	558.97	574.41	-272.7792	-2.2157
19/12/1999	222.63	8.27	1.43	66.27	29.50	404.30	469.91	-247.2743	-2.0085
20/12/1999	352.63	6.67	1.43	68.07	33.90	292.30	503.32	-150.6884	-1.2240
21/12/1999	557.63	6.87	1.43	68.67	31.00	377.63	460.72	96.9174	0.7872
22/12/1999	781.63	6.00	1.43	69.23	31.10	563.97	450.12	331.5095	2.6927
23/12/1999	438.63	7.73	1.43	69.05	26.00	592.63	396.68	41.9491	0.3407
24/12/1999	600.63	5.67	1.43	67.95	29.60	606.97	435.48	165.1514	1.3414
25/12/1999	225.63	4.33	1.00	68.55	27.00	421.63	388.97	-163.3347	-1.3267
26/12/1999	256.63	2.80	0.00	70.50	26.60	360.97	369.38	-112.7491	-0.9158
27/12/1999	177.63	3.13	0.00	76.10	29.90	219.97	378.09	-200.4580	-1.6282
28/12/1999	374.63	3.40	1.09	75.35	33.90	269.63	426.16	-51.5271	-0.4185
29/12/1999	544.63	4.53	1.09	71.05	34.90	365.63	481.10	63.5314	0.5160
30/12/1999	696.63	6.40	1.09	66.15	36.10	538.63	549.81	146.8259	1.1926
31/12/1999	572.83	8.20	1.09	59.60	35.50	604.70	604.78	-31.9443	-0.2595
1/01/2000	500.27	9.13	1.09	52.45	35.60	589.91	665.80	-165.5259	-1.3445
2/01/2000	523.27	9.07	1.09	47.95	37.20	532.13	719.50	-196.2281	-1.5939
3/01/2000	645.27	8.67	1.09	50.07	35.50	556.27	677.18	-31.9075	-0.2592
4/01/2000	722.27	7.73	0.00	53.57	35.90	630.27	664.27	58.0013	0.4711
5/01/2000	432.27	7.87	0.11	58.37	34.80	599.94	614.37	-182.0940	-1.4791
6/01/2000	278.27	6.73	0.46	61.47	35.10	477.61	581.23	-302.9558	-2.4608
7/01/2000	415.27	6.87	0.89	65.72	35.70	375.27	554.42	-139.1438	-1.1302
8/01/2000	511.27	6.40	0.89	66.05	34.30	401.61	528.39	-17.1122	-0.1390
9/01/2000	277.27	7.13	3.23	66.60	34.50	401.27	501.34	-224.0624	-1.8200
10/01/2000	174.27	7.60	6.83	70.25	30.20	320.94	369.90	-195.6313	-1.5890
11/01/2000	288.27	6.60	7.94	72.55	27.00	246.61	284.52	3.7550	0.0305
12/01/2000	304.27	5.40	7.83	72.60	29.70	255.61	312.15	-7.8805	-0.0640
13/01/2000	304.27	4.67	7.49	73.00	31.30	298.94	329.51	-25.2346	-0.2050
14/01/2000	374.27	5.87	7.06	71.45	32.50	327.61	374.14	0.1376	0.0011
15/01/2000	413.27	7.33	7.06	65.25	35.10	363.94	467.86	-54.5820	-0.4433
16/01/2000	449.27	8.27	4.71	62.35	34.70	412.27	524.18	-74.9019	-0.6084
17/01/2000	537.27	8.47	1.11	61.60	35.10	466.61	586.99	-49.7133	-0.4038
18/01/2000	489.27	8.33	0.00	60.05	35.80	491.94	622.04	-132.7647	-1.0784
19/01/2000	658.27	8.60	0.00	58.70	37.60	561.61	659.04	-0.7709	-0.0063
20/01/2000	623.27	8.87	0.00	57.10	39.90	590.27	704.76	-81.4856	-0.6619
21/01/2000	613.27	9.27	0.00	54.10	41.30	631.61	749.24	-135.9664	-1.1044
22/01/2000	583.27	9.27	0.00	51.20	41.00	606.61	765.81	-182.5399	-1.4827
23/01/2000	694.27	9.37	0.00	50.60	40.40	630.27	762.71	-68.4366	-0.5559
24/01/2000	689.27	9.50	0.00	52.60	37.50	655.61	709.49	-20.2151	-0.1642
25/01/2000	653.27	8.83	0.00	56.40	35.00	678.94	641.62	11.6503	0.0946
26/01/2000	585.27	7.73	0.00	59.15	33.50	642.61	591.14	-5.8692	-0.0477
27/01/2000	586.27	6.47	0.00	62.85	34.80	608.27	571.11	15.1631	0.1232
28/01/2000	322.27	5.67	1.03	66.45	34.10	497.94	514.06	-191.7902	-1.5578

Date	DATA						RESULSTS		
	OUTSIDE	*Evap*	*Rainfall*	*Rel Humidity*	*Temp - Max*	*Outside Flow*	*Predicted OUTSIDE*	*Residuals*	*Standard Residuals*
29/01/2000	485.27	5.53	1.03	65.40	35.90	464.61	545.27	-59.9939	-0.4873
30/01/2000	636.27	6.53	1.03	64.43	36.50	481.27	569.63	66.6452	0.5413
31/01/2000	576.27	7.80	1.03	63.93	35.50	565.94	570.94	5.3306	0.0433
1/02/2000	610.87	8.87	1.03	61.88	36.20	607.80	605.04	5.8263	0.0473
2/02/2000	660.87	9.00	1.03	59.48	34.80	616.00	604.03	56.8349	0.4616
3/02/2000	580.87	8.93	1.03	60.38	30.10	617.53	531.92	48.9423	0.3975
4/02/2000	597.87	8.00	0.00	61.10	33.00	613.20	572.72	25.1441	0.2042
5/02/2000	596.87	7.33	0.00	62.25	33.00	591.87	558.41	38.4605	0.3124
6/02/2000	644.87	6.53	0.00	63.90	31.20	613.20	514.38	130.4885	1.0599
7/02/2000	547.87	6.73	0.00	64.80	31.80	596.53	518.08	29.7855	0.2419
8/02/2000	590.87	6.13	0.09	66.45	33.00	594.53	516.22	74.6458	0.6063
9/02/2000	590.87	6.47	0.09	67.95	30.80	576.53	478.09	112.7740	0.9160
10/02/2000	713.87	6.00	0.09	66.75	34.50	631.87	533.62	180.2439	1.4640
11/02/2000	753.87	6.73	0.09	65.55	36.10	686.20	571.06	182.8105	1.4849
12/02/2000	803.87	6.87	0.09	63.90	37.50	757.20	603.45	200.4172	1.6279
13/02/2000	799.87	8.07	0.09	60.70	37.00	785.87	630.37	169.4933	1.3767
14/02/2000	439.87	8.20	7.11	60.70	32.70	681.20	474.28	-34.4145	-0.2795
15/02/2000	157.87	8.00	9.74	68.10	20.70	465.87	216.87	-59.0030	-0.4793
16/02/2000	141.87	5.07	12.86	74.75	24.10	246.53	146.26	-4.3884	-0.0356
17/02/2000	79.87	2.67	12.91	80.70	26.20	126.53	110.06	-30.1898	-0.2452
18/02/2000	115.87	0.93	12.94	86.60	26.00	112.53	48.87	66.9972	0.5442
19/02/2000	41.87	1.87	12.94	90.60	26.20	79.20	31.59	10.2808	0.0835
20/02/2000	89.87	2.33	12.94	88.45	27.20	82.53	65.06	24.8028	0.2015
21/02/2000	66.87	2.73	9.83	88.35	26.60	66.20	104.46	-37.5911	-0.3053
22/02/2000	102.87	2.13	8.11	88.90	25.40	86.53	102.28	0.5900	0.0048
23/02/2000	142.87	1.67	5.14	88.25	27.40	104.20	171.68	-28.8144	-0.2340
24/02/2000	105.87	1.53	5.09	85.70	29.00	117.20	211.63	-105.7650	-0.8591
25/02/2000	206.87	2.13	5.06	83.60	31.40	151.87	265.75	-58.8837	-0.4783
26/02/2000	268.87	3.73	5.06	79.60	27.00	193.87	248.06	20.8067	0.1690
27/02/2000	346.87	4.20	5.06	75.65	29.10	274.20	309.63	37.2358	0.3024
28/02/2000	261.87	4.67	1.14	72.70	31.70	292.53	425.43	-163.5667	-1.3286
29/02/2000	238.87	4.87	0.14	72.60	30.80	282.53	429.43	-190.5636	-1.5479
1/03/2000	231.79	5.20	0.60	71.95	31.50	244.18	440.46	-208.6603	-1.6949
2/03/2000	286.79	5.93	0.60	71.00	31.00	252.49	447.03	-160.2352	-1.3015
3/03/2000	451.79	6.07	0.60	69.30	30.50	323.46	453.48	-1.6829	-0.0137
4/03/2000	352.79	6.47	0.60	70.60	31.00	363.79	454.77	-101.9718	-0.8283
5/03/2000	417.79	6.27	0.60	72.10	32.90	407.46	468.52	-50.7250	-0.4120
6/03/2000	449.79	6.00	0.60	71.55	34.40	406.79	490.78	-40.9825	-0.3329
7/03/2000	555.79	6.00	0.60	71.55	34.40	474.46	490.78	65.0175	0.5281
8/03/2000	473.79	6.13	0.00	73.05	32.50	493.13	463.32	10.4743	0.0851
9/03/2000	432.79	5.80	0.00	73.05	33.10	487.46	468.58	-35.7833	-0.2907
10/03/2000	365.79	5.60	0.14	70.80	33.40	424.13	485.00	-119.2008	-0.9682
11/03/2000	370.79	5.40	0.14	70.50	33.10	389.79	481.16	-110.3626	-0.8964
12/03/2000	524.79	5.80	0.14	70.58	33.40	420.46	488.37	36.4215	0.2958
13/03/2000	446.79	5.87	0.14	70.83	33.10	447.46	483.04	-36.2483	-0.2944
14/03/2000	430.79	6.07	0.14	70.43	33.00	467.46	486.35	-55.5520	-0.4512
15/03/2000	602.79	6.40	0.14	69.68	33.50	493.46	501.68	101.1172	0.8213
16/03/2000	509.79	6.67	0.14	69.83	33.10	514.46	497.51	12.2879	0.0998
17/03/2000	523.79	6.93	0.00	70.15	28.50	545.46	435.99	87.8057	0.7132
18/03/2000	414.79	5.80	0.00	69.78	30.70	482.79	458.70	-43.9057	-0.3566
19/03/2000	605.79	5.00	0.00	68.13	31.80	514.79	478.40	127.3902	1.0347
20/03/2000	443.79	4.40	0.00	68.08	32.50	488.13	482.97	-39.1703	-0.3182
21/03/2000	563.79	5.40	0.00	68.13	32.70	537.79	494.52	69.2725	0.5627

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
22/03/2000	615.79	5.93	0.00	67.48	33.30	541.13	512.35	103.4429	0.8402
23/03/2000	563.79	6.20	0.00	66.25	34.60	581.13	541.60	22.1925	0.1803
24/03/2000	394.79	6.33	0.14	65.60	33.90	524.79	535.79	-140.9946	-1.1452
25/03/2000	447.79	6.40	0.14	66.70	32.00	468.79	502.23	-54.4395	-0.4422
26/03/2000	579.79	5.93	0.14	68.20	32.50	474.13	494.17	85.6274	0.6955
27/03/2000	504.79	5.33	0.14	69.65	34.20	510.79	501.85	2.9440	0.0239
28/03/2000	645.79	5.13	0.14	70.60	34.00	576.79	490.46	155.3317	1.2617
29/03/2000	591.79	5.47	0.14	72.95	33.80	580.79	473.95	117.8475	0.9572
30/03/2000	571.79	5.93	0.14	71.30	33.20	603.13	481.70	90.0929	0.7318
31/03/2000	578.79	6.13	0.00	69.45	32.10	580.79	483.51	95.2821	0.7739
1/04/2000	598.22	6.13	0.00	68.55	33.30	582.94	506.56	91.6605	0.7445
2/04/2000	422.22	6.27	0.00	68.90	30.50	533.08	466.51	-44.2952	-0.3598
3/04/2000	281.22	5.33	0.51	70.40	30.00	433.88	433.18	-151.9616	-1.2343
4/04/2000	534.22	4.27	0.51	72.00	31.50	412.55	432.75	101.4638	0.8241
5/04/2000	500.22	3.53	0.51	72.95	33.00	438.55	440.02	60.1950	0.4889
6/04/2000	521.22	4.13	0.51	72.35	35.00	518.55	477.49	43.7319	0.3552
7/04/2000	478.22	5.27	0.51	71.55	30.00	499.88	424.35	53.8673	0.4375
8/04/2000	401.22	5.40	0.51	70.70	25.10	466.88	363.81	37.4068	0.3038
9/04/2000	279.22	4.60	0.51	72.40	25.10	386.22	344.34	-65.1264	-0.5290
10/04/2000	306.22	3.13	0.43	74.35	27.80	328.88	355.56	-49.3461	-0.4008
11/04/2000	479.22	2.33	0.43	75.00	30.00	354.88	374.06	105.1601	0.8542
12/04/2000	424.22	3.13	0.43	76.15	27.20	403.22	334.39	89.8249	0.7296
13/04/2000	329.22	3.80	0.63	76.30	27.10	410.88	335.25	-6.0334	-0.0490
14/04/2000	433.22	3.80	0.63	74.65	31.00	395.55	401.03	32.1836	0.2614
15/04/2000	556.22	3.33	0.63	74.70	32.20	439.55	413.02	143.1966	1.1631
16/04/2000	682.22	3.93	0.63	73.95	32.50	557.22	428.02	254.1956	2.0647
17/04/2000	506.22	4.67	0.20	73.60	33.40	581.55	455.65	50.5654	0.4107
18/04/2000	606.22	5.20	0.20	72.05	33.90	598.22	478.53	127.6878	1.0371
19/04/2000	346.22	4.93	0.37	72.55	23.80	486.22	330.31	15.9063	0.1292
20/04/2000	396.22	4.47	0.17	66.80	26.00	449.55	400.38	-4.1601	-0.0338
21/04/2000	312.22	4.13	0.17	66.70	24.60	351.55	378.66	-66.4450	-0.5397
22/04/2000	108.22	3.87	3.89	71.75	17.60	272.22	191.55	-83.3331	-0.6769
23/04/2000	94.22	2.93	4.43	77.25	18.50	171.55	148.61	-54.3947	-0.4418
24/04/2000	99.22	1.73	9.57	80.60	18.10	100.55	36.61	62.6097	0.5085
25/04/2000	120.22	0.80	11.60	88.55	18.50	104.55	-51.43	171.6501	1.3942
26/04/2000	117.22	0.87	11.86	94.00	17.80	112.22	-103.04	220.2602	1.7891
27/04/2000	142.22	1.07	12.77	92.10	23.00	126.55	-28.37	170.5843	1.3856
28/04/2000	137.22	1.27	12.77	89.15	23.40	132.22	0.08	137.1336	1.1139
29/04/2000	156.22	1.67	9.06	86.40	24.60	145.22	91.68	64.5339	0.5242
30/04/2000	151.22	1.93	8.51	83.10	27.40	148.22	164.02	-12.8051	-0.1040
1/05/2000	244.43	2.73	3.37	80.15	25.40	183.95	236.29	8.1393	0.0661
2/05/2000	127.43	2.93	1.60	79.45	25.60	174.36	270.53	-143.1063	-1.1624
3/05/2000	210.43	2.67	3.09	81.90	27.80	194.09	260.37	-49.9433	-0.4057
4/05/2000	152.43	2.33	2.17	84.45	25.40	163.43	218.59	-66.1646	-0.5374
5/05/2000	157.43	1.87	2.77	87.15	26.40	173.43	200.52	-43.0956	-0.3500
6/05/2000	65.43	2.00	2.77	89.20	20.20	125.09	101.26	-35.8326	-0.2911
7/05/2000	119.43	1.83	2.77	88.35	19.40	114.09	94.73	24.6916	0.2006
8/05/2000	136.43	1.90	4.91	87.25	22.40	107.09	114.92	21.5011	0.1746
9/05/2000	137.43	1.83	4.66	83.90	25.50	131.09	184.75	-47.3248	-0.3844
10/05/2000	162.43	2.07	2.74	80.95	25.30	145.43	231.83	-69.4063	-0.5638
11/05/2000	158.43	2.93	2.74	78.50	25.20	152.76	255.88	-97.4587	-0.7916
12/05/2000	204.43	3.73	2.14	77.90	26.00	175.09	286.91	-82.4860	-0.6700
13/05/2000	190.43	3.53	2.14	72.85	27.00	184.43	335.02	-144.5935	-1.1745

Date	DATA						RESULSTS		
	OUTSIDE	Evap	Rainfall	Rel Humidity	Temp - Max	Outside Flow	Predicted OUTSIDE	Residuals	Standard Residuals
14/05/2000	180.43	3.53	2.14	69.37	27.60	191.76	368.22	-187.7954	-1.5254
15/05/2000	195.43	3.40	0.00	68.82	26.60	188.76	386.90	-191.4754	-1.5553
16/05/2000	288.43	3.80	0.00	66.32	25.60	221.43	394.58	-106.1578	-0.8623
17/05/2000	271.43	3.80	0.00	64.97	25.30	251.76	400.08	-128.6533	-1.0450
18/05/2000	211.43	4.27	0.00	64.02	23.10	257.09	380.68	-169.2551	-1.3748
19/05/2000	190.43	3.87	0.26	68.80	21.30	224.43	314.34	-123.9136	-1.0065
20/05/2000	176.43	3.33	0.26	70.20	23.20	192.76	325.76	-149.3329	-1.2130
21/05/2000	282.43	2.20	0.26	72.75	22.90	216.43	293.01	-10.5893	-0.0860
22/05/2000	279.43	2.33	0.26	71.80	25.70	246.09	339.79	-60.3608	-0.4903
23/05/2000	286.43	2.47	0.26	74.80	25.50	282.76	316.80	-30.3702	-0.2467
24/05/2000	279.43	3.00	0.26	74.80	24.90	281.76	313.37	-33.9418	-0.2757
25/05/2000	304.43	2.53	0.26	74.60	28.10	290.09	354.83	-50.4029	-0.4094
26/05/2000	300.43	2.40	0.00	75.20	26.10	294.76	325.21	-24.7853	-0.2013
27/05/2000	420.43	1.93	0.00	77.40	25.90	341.76	302.45	117.9751	0.9583
28/05/2000	358.43	2.87	0.00	74.15	20.00	359.76	252.54	105.8886	0.8601
29/05/2000	384.43	3.20	0.00	70.50	19.90	387.76	280.29	104.1374	0.8459
30/05/2000	365.43	3.60	0.00	67.20	18.00	369.43	281.23	84.1966	0.6839
31/05/2000	410.43	2.87	0.00	63.85	17.50	386.76	291.54	118.8825	0.9656
1/06/2000	189.67	2.67	0.00	61.50	18.10	321.84	314.82	-125.1457	-1.0165
2/06/2000	226.67	2.53	0.00	63.05	19.70	275.59	324.67	-97.9981	-0.7960
3/06/2000	392.67	2.60	0.00	63.35	20.20	269.67	330.06	62.6145	0.5086
4/06/2000	357.67	2.53	0.00	64.50	23.30	325.67	364.14	-6.4720	-0.0526
5/06/2000	440.67	2.53	0.00	67.25	23.50	397.00	347.26	93.4138	0.7588
6/06/2000	479.67	2.67	0.00	65.75	15.60	426.00	249.83	229.8387	1.8669
7/06/2000	395.67	2.67	0.00	61.75	18.60	438.67	319.95	75.7192	0.6150
8/06/2000	397.67	2.60	0.00	59.20	17.70	424.34	325.11	72.5631	0.5894
9/06/2000	197.67	2.10	0.00	61.45	13.20	330.34	242.16	-44.4864	-0.3613
10/06/2000	320.67	2.43	5.77	65.40	12.50	305.34	126.99	193.6807	1.5732
11/06/2000	255.67	3.50	6.49	70.60	17.90	258.00	164.40	91.2717	0.7414
12/06/2000	212.67	3.80	6.49	77.00	21.30	263.00	168.47	44.2010	0.3590
13/06/2000	293.67	3.27	6.49	80.35	21.40	254.00	141.03	152.6372	1.2398
14/06/2000	270.67	2.60	6.49	80.40	21.00	259.00	129.04	141.6293	1.1504
15/06/2000	253.67	2.60	6.49	76.75	21.00	272.67	155.13	98.5423	0.8004
16/06/2000	183.67	2.47	6.49	75.55	23.10	236.00	191.56	-7.8865	-0.0641
17/06/2000	294.67	2.20	0.71	76.15	21.90	244.00	248.51	46.1590	0.3749
18/06/2000	115.67	1.93	0.00	78.05	18.10	198.00	189.82	-74.1540	-0.6023
19/06/2000	173.67	1.80	0.49	79.60	22.70	194.67	234.45	-60.7800	-0.4937
20/06/2000	179.67	1.20	0.49	81.50	24.10	156.34	234.76	-55.0942	-0.4475
21/06/2000	114.67	1.07	0.49	83.75	25.70	156.00	239.61	-124.9436	-1.0149
22/06/2000	199.67	1.33	0.49	84.50	27.20	164.67	257.46	-57.7877	-0.4694
23/06/2000	240.67	1.60	0.49	82.70	25.40	185.00	247.84	-7.1727	-0.0583
24/06/2000	275.67	2.53	0.49	78.50	21.70	238.67	235.17	40.4949	0.3289
25/06/2000	214.67	2.67	0.49	75.50	21.30	243.67	252.30	-37.6285	-0.3056
26/06/2000	159.67	2.73	0.00	73.90	23.00	216.67	294.63	-134.9652	-1.0963
27/06/2000	169.67	2.20	0.00	72.85	24.80	181.34	322.18	-152.5105	-1.2388
28/06/2000	259.67	2.20	0.00	73.70	25.60	196.34	327.18	-67.5104	-0.5484
29/06/2000	212.67	2.33	0.00	72.75	22.60	214.00	293.66	-80.9886	-0.6578
30/06/2000	185.81	2.87	0.00	69.85	18.70	219.38	265.27	-79.4644	-0.6455

APPENDIX E: WEATHER DATA – BARCALDINE & LONGREACH

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
	Longreach	Barcaldine	Longreach	Barcaldine	Longreach	Barcaldine	Longreach	Barcaldine
		0.9715		0.7226		0.9887		0.9758
25/12/2004	10.92	11.84	18.2	1.6	28.5	30.8	22.3	24
26/12/2004	24.66	21.75	2.8	22.6	31.8	30.2	21.9	21.5
27/12/2004	31.69	32.2	0	1	35.5	33.4	21.5	21.2
28/12/2004	32.44	32.99	0	0	36.7	35.2	23.6	23.1
29/12/2004	32.75	32.57	0	0	34.3	32.7	18.9	17.6
30/12/2004	33.1	32.88	0	0	37.2	34.2	19.9	19.4
31/12/2004	33.28	32.77	0	0	36.8	34.2	24.2	22.7
1/1/2005	33.19	32.71	0	0	37.6	34.3	23.1	23.1
2/1/2005	27.01	29.77	0	0	37.7	35.7	24.4	22.9
3/1/2005	32.6	32.99	0	0	40.1	37.9	22.7	24.4
4/1/2005	20.55	19.61	0	0	37.5	36.1	26.9	25.7
5/1/2005	23.92	24.25	12	19.6	32.5	33.7	24.3	23.2
6/1/2005	17.3	19.31	34.2	21	25.6	28.2	19.2	21.2
7/1/2005	15.21	15.93	9.6	2.4	29.1	29.3	20.6	22.3
8/1/2005	33.1	32.97	0.2	0	35.9	34.2	21.2	22.9
9/1/2005	33.03	32.72	0	0	36.4	34.4	20	22.2
10/1/2005	32.8	32.76	0	0	35.1	33.2	22.2	22.9
11/1/2005	32.95	32.78	0	0	34.7	32.9	20.6	22
12/1/2005	33.01	33.03	0	0	35.1	33.5	19	19.3
13/1/2005			0	0	36.9	34.6	19	19.8
14/1/2005			0	0	36.1	34	18.9	19.8
15/1/2005	32.76	31.7	0	0	37.8	36.8	22.4	23.6
16/1/2005	32.86	32.5	0	0	39.7	38.7	23.8	25
17/1/2005	32.72	32.83	0	0	39.4	38.8	26.1	25.4
18/1/2005	31.57	29.64	0	0	40.2	39.2	23	23.8
19/1/2005	32.99	32.2	0	2.4	38	36.2	24.1	23.6
20/1/2005	31.45	30.22	0	0	38.3	36.4	25.1	24.4
21/1/2005	32.84	31.9	0	0	41.2	38.8	24.8	25
22/1/2005	32.74	32.69	8.6	0	39	37.5	23.4	24.8
23/1/2005	22.37	20.43	0	0	35.6	32.5	25.2	26.1
24/1/2005	28.39	25.7	0	0	37.2	33.7	23.5	23.7
25/1/2005	26.12	22.1	0	0	34.5	31.1	20.8	22.5
26/1/2005	22.5	19.96	0	0	31.8	30.3	21.2	21.8
27/1/2005	31.32	31.85	0	0.4	36.6	34.6	21.7	20.4
28/1/2005	32.54	30.57	0	0	39.1	38.3	21.9	21.6
29/1/2005	31.53	30.02	0	0	43.1	41.3	23	24.2
30/1/2005	30.64	29.78	0	0	44.2	41.7	26.2	25.9
31/1/2005	31.27	26.59	0	0	44.2	42	28	26.9
1/2/2005	31.7	30.91	0	4.2	42.4	40.1	27.1	24.5
2/2/2005	30.63	30.14	0	0	36.8	39	28.7	27.1
3/2/2005	32.03	31.58	0	0	31.9	31.6	16.1	19.2
4/2/2005	32.25	31.68	0	0	33.2	33.4	14.5	17.2
5/2/2005	31.83	31.61	0	0	38.2	37.3	16.8	15.2
6/2/2005	31.97	31.66	0	0	41	40.2	17.7	18.6
7/2/2005	31.73	30.02	0	0	40.7	39.9	22.7	23.2
8/2/2005	22.86	25.42	0	0	39.5	40.1	27.9	25.8
9/2/2005	21.48	22.76	29.4	18.2	31.4	31.9	22.2	22
10/2/2005	31.96	31.19	8.8	20	34.5	34	22	21.2
11/2/2005	31.95	31.47	0	0	35.3	34.4	19.3	19.1
12/2/2005	31.71	31.25	0	0	38.1	36.9	19.4	19.2
13/2/2005	31.45	30.46	0	0	39.6	37.5	22.3	22.8
14/2/2005	31.64	31.27	0	0	39.6	35.2	25.9	25
15/2/2005	31.57	30.88	0	0	37.2	34.8	22.2	22.8
16/2/2005			0	0	37.7	36.5	22.6	23.7
17/2/2005	29.37	29.74	0	0	39.9	38.2	22	23.1
18/2/2005	29.07	30.09	0	0	38.6	36.3	24.2	25
19/2/2005	31.3	30.73	0	0	39.1	37.5	25.1	25.2
20/2/2005	30.58	29.95	0	0	39.9	38.2	26.5	26
21/2/2005	31.17	30.98	0.2	15	39.8	37.2	23.6	22.8
22/2/2005	29.49	30.36	0.2	0	40.5	37.5	26.2	26.3
23/2/2005	28.67	21.24	0	0	40.2	36.3	25.1	25.6
24/2/2005	30.13	29.13	1.6	0	39.4	37.2	21.8	24.2
25/2/2005			1	0	39.7	37	23.7	25
26/2/2005			0	0	39.8	37.4	24.1	25.1

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
27/2/2005			0	0	39.3	37.1	23.8	24.5
28/2/2005			0	0	39.2	36.2	24.3	24.5
1/3/2005	29.81	29.03	0	0	38.2	35.7	24	23.9
2/3/2005	29.81	28.81	0	0	38.3	35.7	23.2	24
3/3/2005			0	0	38	34.9	23.8	23.2
4/3/2005	29.48	28.5	0	0	37.7	35.1	21.9	22.7
5/3/2005	29.85	29.11	0	0	39.2	37.6	20.8	20.7
6/3/2005			0	0	40	37.7	24.3	23.4
7/3/2005	29.04	25.64	0	0.2	38.7	36.6	23.9	22.6
8/3/2005	29.52	25.97	0	0	38.4	36	24.4	23
9/3/2005	29.27	28.33	0	0.8	37.1	35.9	24.9	23.4
10/3/2005	27.19	26.96	0	0	37	35.2	24.8	24.1
11/3/2005	28.93	25.45	0	0	37.3	34.4	22.6	24.1
12/3/2005	29.08	28.12	0	0	36.5	34.5	22.8	22.7
13/3/2005	28.5	28.11	0	0	36.2	35.5	20.6	22.2
14/3/2005	28.43	26.93	0	0	35.9	34.1	22.5	22.9
15/3/2005	26.61	26.01	0	0	36.6	34.8	20.8	21.6
16/3/2005			0	0	37.4	36.1	21.8	23.9
17/3/2005	15.6	16.72	0	0	35.2	33.3	24.5	26.7
18/3/2005	28.23	26.51	0	8.6	36.1	33.1	21.1	20.1
19/3/2005	26.41	26.68	0	0	37.8	35.4	21.6	21.7
20/3/2005	27.51	26.44	0.2	0	39	36.7	21.8	22.3
21/3/2005	26.55	26.29	0	0	39.3	37.8	25.1	24.1
22/3/2005	27.02	26.42	0	0	37.3	35.8	19.7	20
23/3/2005	27.27	26.44	0	0	35.5	34	16.9	18.3
24/3/2005	23.97	25.67	0	0	34.4	34.2	17.9	17.8
25/3/2005			0	0	35.1	33.7	14.8	16.8
26/3/2005	27.07	26.4	0	0	34.8	35.7	17.5	17.5
27/3/2005	26.87	26.5	0	0	37.5	35.4	17.4	17.7
28/3/2005	26.19	25.06	0	0	37.2	35.6	19.6	22.8
29/3/2005	26.65	25.43	0	0	38.4	36.8	21.6	20.6
30/3/2005	25.61	24.84	0	0	35.8	34.2	24.2	23.2
31/3/2005	25.94	25.13	0	0	35.4	33.1	24	23.2
1/4/2005	26.31	25.69	0	0	34.3	31.6	22.4	20.4
2/4/2005	26.13	25.41	0	0	33.4	31.5	21.2	19.2
3/4/2005	25.93	25.26	0	0	33.2	31.3	20.1	19.7
4/4/2005	25.86	25.18	0	0	35.6	34.5	15.6	16.8
5/4/2005	25.77	25.07	0	0	34.3	31.9	19.8	20.6
6/4/2005	25.49	24.81	0	0	34.2	32.7	19.1	20.2
7/4/2005			0	0	35.8	33.7	21.1	21.4
8/4/2005			0	0	36.5	34.3	23	23.1
9/4/2005			0	0	34.7	31.4	24.5	22.6
10/4/2005			0	0	34.8	33	21.7	21.8
11/4/2005			0	0	35	33.1	22.1	22.4
12/4/2005			0	0	33.4	32	21.3	20
13/4/2005			0	0	32.9	31	19.1	19.2
14/4/2005			0	0	33.1	31	18	19.3
15/4/2005			0	0	33.5	31.7	16	19.2
16/4/2005			0	0	34.2	32.6	17	18.2
17/4/2005			0	0	34.4	32.6	16.6	19
18/4/2005			0	0	35.4	33.8	17.7	18.1
19/4/2005			0	0	36.4	34.6	17.8	18.4
20/4/2005			0	0	35.9	34	17.3	19.4
21/4/2005			0	0	34.1	32.1	19.8	20.5
22/4/2005			0	0	32.8	30.5	17.8	19.6
23/4/2005			0	0	32.2	29.8	18.4	18.9
24/4/2005			0	0	32.3	30.1	16.3	18.1
25/4/2005			0	0	32.3	29.9	15.8	14.9
26/4/2005			0	0	31.8	30	14.8	15.7
27/4/2005			0	0	31.9	29.6	15.4	16.1
28/4/2005			0	0	31.7	30	15.7	16.2
29/4/2005			0	0	31.7	30.4	17.8	17.5
30/4/2005			0	0	33	31.5	16.6	16.9
1/5/2005			0	0	33.2		16.6	15.4
2/5/2005			0	0	30.4	29.5	15.8	
3/5/2005			0	0	30.8	28.9	14	14.6
4/5/2005			0	0	29.6	28.2	14.2	13.9

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
5/5/2005			0	0	31.2	29.1	11.2	14.3
6/5/2005			0	0	30.9	28.7	14.2	14.9
7/5/2005			0	0	30.4	28.5	14.7	16.3
8/5/2005			0	0	30.8	28.3	15.4	17.4
9/5/2005			0	0	30.8	29.5	15	18.2
10/5/2005			0	0	29.1	26.8	20	20
11/5/2005			48.4	16.6	25.7	25.2	18.2	17.5
12/5/2005			0	2.6	21.9	20.8	15.2	14.7
13/5/2005			0	1.4	25.1	23.4	11.7	12.9
14/5/2005			0	0	25.7	24.5	10.1	11.6
15/5/2005			0	0	27	25.7	11	11
16/5/2005			0	0	27.5	26.4	10.9	11
17/5/2005			0	0	24.7	23.5	11.8	12.9
18/5/2005			0	0	24.8	23.3	8.9	8.4
19/5/2005			0	0	24.8	24	10.2	8.6
20/5/2005			0	0	24.9	23.7	10	9.9
21/5/2005			0	0	24.9	23.8	8.3	8.5
22/5/2005			0	0	26.5	25.5	8	7.2
23/5/2005			0	0	27.9	26.8	9.8	10.6
24/5/2005			0	0	27.4	27	10.8	10.6
25/5/2005			0	0	28	26.7	10.9	8.1
26/5/2005			0	0	27.4	26.5	13.2	13.2
27/5/2005			0	0	25.7	25.7	8.2	9.8
28/5/2005			0	0	24.7	24.8	7	9.4
29/5/2005			0	0	23.6	23.2	8.6	9
30/5/2005			0	0	25.1	24.6	9.1	7.7
31/5/2005			0	0	26	25.1	10.1	10.6
1/6/2005			0	0	26.5	25.9	11.1	11.4
2/6/2005			0	0	27.7	26.1	8.1	9.8
3/6/2005			0	0	26.9	25.7	12.7	11.6
4/6/2005			0	0	27.7	26.8	10.6	12.7
5/6/2005			0	0	27.3	27.1	15.1	16.2
6/6/2005			0	1.4	28.6	27.8	16.6	14.6
7/6/2005			0	0	27.7	26	14.7	13.1
8/6/2005			0	0	28	27	13.6	12.6
9/6/2005			0	0	27.5	26.9	12.2	13.1
10/6/2005			0	0	28.5	27.1	15.9	14
11/6/2005			0	0	30.2	28.9	16.4	16.3
12/6/2005			0	0	28.7	28.2	16.3	15.5
13/6/2005			1.4	3.2	31.1	29	15.6	18.1
14/6/2005			0.2	0	25	28.3	15.9	15.8
15/6/2005			9.8	5	15	14.8	14.6	13.9
16/6/2005			2.8	9	19.3	19.2	7.2	8.4
17/6/2005			0	0	20.8	20.9	8.5	8.4
18/6/2005			0	0	20.7	21.7	11.4	12.1
19/6/2005			7	5.4	18.4	19	14.5	14.7
20/6/2005			51	56	15.7	15.5	15.4	
21/6/2005	10.12	10.89	24.4	33.2	17.6	16.7	12	12.5
22/6/2005	16.44	16.02	0.2	0	18.2	17.6	8.8	9.6
23/6/2005	16.31	16.19	0	0	17.5	17	5.6	7.2
24/6/2005	16.36	16.11	0	0	18.7	19	4.8	5.5
25/6/2005	16.23	16	0	0	20.7	20.4	6.1	6.2
26/6/2005	16.27	16.01	0	0	22.6	22.2	6.7	8.2
27/6/2005	14.04	13.76	0	1	22.5	21.8	11	11.6
28/6/2005	13.53	13.47	0.4	5	20.4	20.7	9.4	11.9
29/6/2005	16.22	16.02	0	0	20.2	20.9	6.3	9.5
30/6/2005	16.19	15.98	0	0	21.1	22.1	5.6	6.7
1/7/2005	16.1	15.8	0	0	23	23.2	5.4	6.8
2/7/2005	16.05	15.63	0	0	22.9	21.8	8.2	9.8
3/7/2005	14.53	12.65	0	0	20.9	20.3	7.6	10
4/7/2005	16.15	15.83	0	0	23.9	22.4	6.1	5.8
5/7/2005	15.76	15.22	0	0	26.4	25	12.2	10.2
6/7/2005	16.14	15.74	0	0	26.5	25.2	14.5	13.6
7/7/2005	16.04	15.82	0	0	26.4	24.5	13.9	13
8/7/2005	16.09	15.29	0	0	26.7	26	11.6	14.2
9/7/2005	13.49	12.55	0	0	20.3	19.5	13.7	15.2
10/7/2005	16.06	15.77	0	0	18.1	17	5.6	7.2

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
11/7/2005	15.73	15.28	0	0	19.9	19.8	3.8	5
12/7/2005	16.06	14.85	0	0	23.5	22	4.9	6.9
13/7/2005	16.18	15.96	0	0	24.9	25.3	10.5	14.4
14/7/2005	14.86	14.36	0	0	28.8	27.6	9.1	9.7
15/7/2005	15.93	15.63	0	0	21.6	21.1	9.8	8.9
16/7/2005	16.31	15.86	0	0	20.7	21.2	4.1	4.8
17/7/2005	16.35	15.92	0	0	21.5	21.1	5.8	6.8
18/7/2005	16.31	15.97	0	0	22.7	21	6	7.8
19/7/2005			0	0	23.6	23.2	7.3	7.9
20/7/2005	7.88	7.92	13.4	0.2	17.9	18.9	13.6	13.9
21/7/2005	16.52	16.05	2.4	0	23.3	23	8.9	10.2
22/7/2005	16.51	16.13	0	0	24.2	23.4	12	11.9
23/7/2005	16.6	16.17	0	0	24.2	24	9.1	9.9
24/7/2005	16.14	16.29	0	0	25.2	24.6	9.4	11
25/7/2005	15.43	14.46	0	0	25.2	24.4	15.8	15.9
26/7/2005	15.63	15.45	0	0	24.5	24.5	8.4	7.9
27/7/2005	15.05	15.05	0	0	24.9	24.8	8.6	7.1
28/7/2005	15.25	15.07	0	0	26.1	25.3	7	9.6
29/7/2005	15.37	15.12	0	0	26	25.8	7.1	9.6
30/7/2005	15.33	14.96	0	0	26.1	26	10.4	12.2
31/7/2005	13.5	12.55	0	0	26.4	25.5	15.1	14.2
1/8/2005	1.64	2.14	1.8	1.4	18.2	20.7	15.3	17.3
2/8/2005	8.86	9.88	4.6	0	24.1	23.8	15.3	15.5
3/8/2005	11.02	12.12	0.8	0	25.7	25.3	15.5	16.2
4/8/2005	10.41	5.98	4.4	0	23	20.7	17.1	18.1
5/8/2005	15.8	15.87	1.6	4.6	20	19.6	10.9	11.9
6/8/2005	15.84	15.83	0	0	19.9	19.7	4.8	6
7/8/2005	13.07	12.67	0	0	22.8	22.2	6.1	8.2
8/8/2005	13.6	12.57	0	0	23.9	22.6	10.2	9.8
9/8/2005	15.92	15.96	0	0	24.2	23.9	7.9	8.8
10/8/2005	16.1	14.91	0	0	25	25.6	6.7	9.5
11/8/2005	10.01	10.08	0	0	22.9	24.3	7.7	9.6
12/8/2005	15.47	15.48	0	0	20.4	20.1	10	13
13/8/2005	16.35	16.37	0	0	18.6	18.2	3.7	4.3
14/8/2005	16.29	16.55	0	0	23.3	23	2.7	3.6
15/8/2005	16.46	16.49	0	0	25.8	25.8	5.3	10
16/8/2005	16.62	15.95	0	0	26.8	26.8	8.9	11.9
17/8/2005	16.59	16.47	0	0	26.2	25.5	10.3	13.9
18/8/2005	16.88	16.9	0	0	26	24.9	11.8	12.1
19/8/2005	16.75	16.87	0	0	26.5	25.4	9.4	12.2
20/8/2005	17.12	17.06	0	0	24.6	26.1	11	11.4
21/8/2005	17.2	17.28	0	0	25	25.3	6.5	10.7
22/8/2005	17.09	17.08	0	0	25.6	25	8.5	10
23/8/2005	17.53	17.66	0	0	25.2	24.9	7.5	9.6
24/8/2005	17.57	17.61	0	0	25.7	24.8	8.3	9.3
25/8/2005	17.69	17.64	0	0	26.6	25.1	7.2	10.4
26/8/2005	17.78	17.82	0	0	26.7	25.4	8.9	10.4
27/8/2005	17.57	17.66	0	0	26.5	25.4	9.7	10.4
28/8/2005	15.98	14.25	0	0	26.1	24.4	11	11.9
29/8/2005	17.88	17.69	0	0	26.8	26.5	10.3	12.3
30/8/2005	18.18	18.09	0	0	28.2	27.2	14.5	14
31/8/2005	18.59	18.47	0	0	30.4	29.5	11.6	15.4
1/9/2005	18.71	18.59	0	0	31.6	30.9	14.2	16.1
2/9/2005	18.74	18.65	0	0	31.9	31.1	15.2	15.6
3/9/2005	18.55	18.67	0	0	30.8	30.1	12.7	15.7
4/9/2005	18.71	18.67	0	0	33.5	31.9	14.9	14.8
5/9/2005	19.17	19.17	0	0	29.3	29.8	15	17.1
6/9/2005	18.95	19.04	0	0	28.9	28.3	10.7	13.2
7/9/2005	19.17	18.29	0	0	31.9	30	11.7	15.6
8/9/2005	19.09	18.13	0	0	32.4	30.2	17.5	18.8
9/9/2005	17.81	18.22	0	0	30.8	29.3	17.7	17.3
10/9/2005	5.46	13.49	0	0	28.9	29.5	18	17.9
11/9/2005	18.41	16.54	29.6	20.2	23.7	24.1	14.8	17.1
12/9/2005	20.14	20.19	0	0	23.7	23.5	5.9	8.4
13/9/2005	20.24	20.08	0	0	27.2	27.1	7.1	9.1
14/9/2005	20.67	20.49	0	0	29.5	29.2	11.9	13.3
15/9/2005	20.31	19.98	0	0	31.6	30.4	9.8	11.2

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
16/9/2005	12.33	6.78	0	0	29.9	28.9	17.7	18.5
17/9/2005	20.69	20.56	0	0	23.9	23.1	4.8	9
18/9/2005	21.05	20.91	0	0	28.5	28.1	7.7	8.8
19/9/2005	21.37	21.06	0	0	30.8	30.6	10	10.1
20/9/2005	18.06	18.4	0	0	31.8	30.3	13.3	14.1
21/9/2005	21	20.54	0	0	33.2	32.3	12.3	13.7
22/9/2005	21.59	21.39	0	0	33.4	31.4	16.5	18.3
23/9/2005			0	0	32.5	31	14.9	17.2
24/9/2005			0	0	33.5	32	14.8	17.8
25/9/2005			0	0	33.8	32.4	15.4	17.2
26/9/2005			0	0	34	32.3	17.6	18.2
27/9/2005	22.3	21.9	0	0	34.9	33.7	15.6	18.6
28/9/2005	21.93	21.64	0	0	38.5	36.2	15.7	18.8
29/9/2005	22.26	22.3	0	0	37.6	36.1	20.3	20.1
30/9/2005	18.47	19.54	0	0	38.1	37.6	18.5	21
1/10/2005	20.26	17.93	0.8	0	38.7	36.9	25.4	25.4
2/10/2005	19.11	21.62	0	0	39.9	38	21.5	23.5
3/10/2005	13.26	13.65	0	0	39.1	37.8	21.9	23.2
4/10/2005	20.77	16.47	0.2	4.4	34.7	30.8	18.9	19
5/10/2005	23.75	23.79	0.8	0	37.4	35.5	18.9	19.8
6/10/2005	23.71	23.58	0	0	37.1	35.9	18	19
7/10/2005	23.43	23.6	0	0	38.6	36.9	16.9	18.2
8/10/2005	17.67	17.15	0	0	34	34.2	21.2	23.2
9/10/2005	23.72	23.66	0	0	31	30.4	14.1	16
10/10/2005	24.28	24.23	0	0	33.4	33.1	9.8	11.6
11/10/2005	20.96	21.54	0	0	35.7	35.4	13.1	13.8
12/10/2005	21.52	22.27	0	0	38.9	37.7	20.2	20.9
13/10/2005	11.1	14.92	0	0	37.6	35.2	21	24.2
14/10/2005	10.12	5.03	3.2	0	26.8	27.2	17.5	18.6
15/10/2005	9.8	6.53	13	62.8	27.1	24.9	18.5	16.7
16/10/2005	24.65	24.35	4.6	1.8	34.4	32.8	18.6	18.7
17/10/2005	24.97	24.17	0	0	33.5	31.9	15.9	18.4
18/10/2005	15.83	17.37	0	0	33.1	32.3	19.9	19.7
19/10/2005	12.26	13.81	0	1.2	35.4	33.7	23	21.8
20/10/2005	20.31	22.04	1	0	35.1	34.2	17.6	21.4
21/10/2005	26	24.91	3	1.4	34.6	33	17.8	19.2
22/10/2005	26.24	25.92	0	0	34.9	33.6	15.7	16.4
23/10/2005	26.23	25.88	0	0	37.5	36.2	12.9	14.2
24/10/2005	25.52	24.73	0	0	38.1	36.1	19.9	20.1
25/10/2005	26.68	26.38	0	0	36.4	34.6	16.4	20.6
26/10/2005	24.49	23.14	0	0	41.7	37.9	15	18.4
27/10/2005	24.68	21.08	0	0	39.7	38	24	23.9
28/10/2005	27.72	27.03	1.2	2.6	39.3	36.1	19.4	21.5
29/10/2005	27.05	26.86	0	0	39.3	36.1	24	23.8
30/10/2005	27.06	26.44	0	0	37.4	34.5	25.2	23
31/10/2005			0	0	37.8	35.5	23.3	23.1
1/11/2005	27.27	26.53	0	0	38.8	36.2	24.6	23.9
2/11/2005	27.14	27.04	0	0	37.6	34.8	24.8	24
3/11/2005	22.44	23.66	0	0	36.8	34	24.4	22.7
4/11/2005	27.47	26.94	0	0	36.3	33.7	23.7	22.7
5/11/2005	27.61	27.22	0	0	37.6	35	23	23.2
6/11/2005	27.83	27.5	0	0	39.2	37.7	24.7	24.5
7/11/2005	12.16	19.33	0	0	35	35.2	27.1	25.7
8/11/2005	27.66	27.47	0	0	40.6	38.8	23.5	25.6
9/11/2005	28.2	28.09	0	0	42.2	40	26.9	26
10/11/2005	11.28	18.34	0	0	33.1	35.7	27	26.7
11/11/2005	29.13	28.44	0	0	37.1	36.2	18.3	21.2
12/11/2005	28.65	27.4	0	0	37	36	18.4	19.2
13/11/2005	28.95	28.33	0	0	38.5	37.7	18	17.3
14/11/2005	28.37	27.53	0	0	39.5	37.2	21.6	23.2
15/11/2005	28.79	26.15	0	1.2	38.6	37.7	23.8	25
16/11/2005	28.45	28.75	0	0.8	38.8	37	24.7	23.7
17/11/2005	28.03	26.42	0	0	37.4	35.4	23.1	21.6
18/11/2005	28.47	26.12	0	0	39.1	36.9	20.8	22.7
19/11/2005	27.29	25.78	0	2.6	41.6	38.9	24.9	23.7
20/11/2005	18.74	21.75	0	0.4	37.8	35.2	25	21.7
21/11/2005	25.64	25.48	0	0	38.9	37.2	24.2	21.7

Day Month Year	Global Solar Exposure at location - derived from satellite data (in mega-Joules per square meter)		Precipitation in the 24 hours before 9am (local time) in mm		Maximum temperature in 24 hours after 9am (local time) in Degrees C		Minimum temperature in 24 hours before 9am (local time) in Degrees C	
22/11/2005	19.52	25.41	0	2.8	36	34.6	22.9	21.8
23/11/2005	21.58	20.01	6.4	5	33.2	31.6	21.4	22
24/11/2005	20.74	20.1	0	0	35.2	33.5	20.4	22.5
25/11/2005	29.28	29.29	0	6.4	38.5	35	19.2	19
26/11/2005	28.33	28.96	0	0	42.2	38.9	20.1	23.2
27/11/2005	30.27	29.77	0.8	0	38.3	36.9	26.4	26.1
28/11/2005	30.6	30.08	0	0	34.6	33	17.8	18.9
29/11/2005	30.15	30.04	0	0	36	35.2	12.8	16.1
30/11/2005	29.65	28.89	0	0	40.1	38.5	13.8	16.2
1/12/2005	22.07	20.84	0	0	42.1	37.8	24.5	24.9
2/12/2005	24.69	18.14	2.2	7.8	37.3	32.5	22.3	21.6
3/12/2005	31.19	30.93	0	7	36	34.2	18.7	20.4
4/12/2005	31.12	30.7	0	0	39.9	37.8	14	15
5/12/2005	26.83	27.46	0	0	43	40.6	18.6	19.4
6/12/2005	26.99	27.67	0	0	44.6	41.5	27.3	27.2
7/12/2005	20.75	24.61	0	0	40.3	38.6	28.7	27.7
8/12/2005	25.99	25.64	0	0	40.7	38.2	25.9	27.5
9/12/2005	31.46	30.96	3	1.2	42.5	40.2	22.6	23.4
10/12/2005	31.1	30.69	0	0	42.5	39.5	25	23.8
11/12/2005	31.25	30.43	0	0	41.7	39.6	22.9	23.5
12/12/2005	30.24	30.21	0	0	42.7	41.1	22.3	24
13/12/2005	16.76	21.33	0	0	40.9	41.6	26.9	26.7
14/12/2005	25.85	23.09	0.4	0	39.7	38.6	25.3	26.2
15/12/2005	29.65	26.17	0	0	43.9	42.5	25.6	25.8
16/12/2005	22.88	23.05	0	0	39.6	39.5	28.9	25.7
17/12/2005	30.66	29.05	0	0	39.7	38.6	26.8	26.2
18/12/2005	31.72	31.17	0	0	37.6	35.5	18.7	22.8
19/12/2005	31.65	31.3	0	0	38.8	37.4	19.6	19.7
20/12/2005	31.96	31.48	0	0	40.5	38.5	19.5	21.7
21/12/2005	31.41	31.07	0	0	40.9	38.7	23.2	23
22/12/2005	31.77	30.04	0	0	41.3	39.5	25.2	25.2
23/12/2005	31.27	30.16	0	0	41	39.8	23	25.5
24/12/2005	30.84	29.33	0	0	42.6	41.1	25.3	27.7
25/12/2005	30.63	29.98	0	0	42.9	42.1	27.9	26.8
26/12/2005	26.03	21.71	0	1.8	40.9	38	27.8	26.5
27/12/2005	32.13	30.59	0	0	42.3	41.2	28.5	27
28/12/2005	30.35	29.71	0	0	41.7	39.5	28	27
29/12/2005	28.67	28.46	0	0	41.5	40.3	27.4	27.4
30/12/2005	25.63	21.89	0	0	41.2	38.6	25.5	25.8
31/12/2005	32.05	30.4	0	0	41	38.5	28	27.1