INVESTIGATION INTO THE EFFECT OF METEOROLOGICAL PARAMETERS ON THE AIRBORNE DUST CONCENTRATION AT OVACIK OPEN PIT GOLD MINE

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INVESTIGATION INTO THE EFFECT OF METEOROLOGICAL PARAMETERS ON THE AIRBORNE DUST CONCENTRATION AT OVACIK OPEN PIT GOLD MINE

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Approval of the Graduate School of Natural and Applied Sciences

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ABSTRACT

INVESTIGATION INTO THE EFFECT OF METEOROLOGICAL PARAMETERS ON THE AIRBORNE DUST CONCENTRATION AT OVACIK OPEN PIT GOLD MINE

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In this thesis, it is aimed to investigate and analyze the effect of meteorological conditions on airborne dust measured at Ovacık Open Pit Gold Mine. Meteorological data must be sound and reliable which are used mainly to design an air model to predict the effect of industrial sites on air quality during production. Wind speed, wind direction, air temperature, air pressure, relative humidity, rainfall, evaporation and sunshine. are the parameters investigated in this study. In the thesis, the meteorological data observed are analyzed and discussed together with the airborne dust measured by MP101M Suspended Particulate Beta Gauge Monitor at Ovacık Gold Mine.

In this study, the most significant meteorological parameter affecting airborne dust concentration is determined as air temperature. In this study, it is also determined through airborne dust measurements that neither the short-term limit nor the long-term limit has been exceeded. Therefore, the airborne dust concentrations at Ovacık Gold Mine comply with the Turkish Air Quality Control Regulation.

Keywords: Airborne dust, meteorological parameter, Beta particulate gauge

ÖZ

OVACIK ALTIN MADENİ AÇIK OCAĞINDA METEOROLOJİK PARAMETRELERİN HAVADA ASILI KALAN TOZ KONSANTRASYONU ÜZERİNDEKİ ETKİSİNİN ARAŞTIRILMASI

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Nisan 2004, 191 sayfa

Bu çalışmada, meteorolojik koşulların Ovacık Altın Madeni açık ocağı çevresinde ölçülen havada asılı kalan toz parçacık miktarları üzerindeki etkisini araştırmak ve incelemek amaçlanmıştır. Esas olarak bir endüstriyel işletmenin üretimi süresince hava kalitesine yapacağı etkiyi belirlemek için oluşturulan hava modellemelerinde kullanılacak meteorolojik veriler doğru ve güvenilir olmalıdır. Bu çalışmada incelenen değişkenler; rüzgar hızı, rüzgar yönü, hava sıcaklığı, hava basıncı, bağıl nem, yağış miktarı, buharlaşma ve güneşlenme süresidir. Bu çalışmada, meteorolojik gözlem verileri, Ovacık Altın Madeni'nde

MP101M Beta asılı tanecik ölçer cihazıyla ölçülen toz miktarları ile birlikte incelenmiştir. Bu çalışmada, havada asılı kalan toz yoğunluğuna etki eden en önemli meteorolojik değişken olarak hava sıcaklığı saptanmıştır.

Bu çalışmada ayrıca, havada asılı kalan toz öçümleri yoluyla ne kısa vadeli sınır değerin, ne de uzun vadeli sınır değerin aşılmadığı saptanmıştır. Bu nedenle, Ovacık Altın Madeni'nde havada asılı toz yoğunlukları Türkiye Hava Kalitesi Korunması Yönetmeliği'ne uyugndur.

Anahtar Kelimeler: asılı tanecik toz, meteorolojik parametreler , Beta tanecik ölçer

To My Parents

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CHAPTER 1

INTRODUCTION

Environmental disturbance resulting from different mining activities is of considerable interest because of its detrimental effect on human health, ecology and ultimately the quality of life.

Mining is a struggle between human being and nature. It needs a great effort to excavate ore by either open pit or underground mining methods. Human being should carry on this struggle to support the development of his civilization without harming both nature and himself at no or minimum cost. During this struggle, some undesired byproducts occur such as dust, ground vibration, noise, tailings, etc., which are harmful for both nature and human being. Precautions must be taken against these to conserve the quality of life both during and after mining. Dust is one of the important harmful matters having effect on human health, nature, and machinery operating at mine site.

The amount and type of dust varies considerably and depends on many factors including source, climate, wind direction, and traffic. Therefore, it is important to determine how the dust is transported within the atmosphere and transferred from one medium to another.

To control harmful effects of mining operations, precautions must be taken. The maximum probable dust amount generating during operation must be calculated before operation starts so that the necessary precautions can be taken accordingly. Air quality models are used to obtain results. To obtain correct results, parameters used in the model must be chosen and measured carefully.

For modeling atmospheric dispersion, air models use several parameters such as topography, ground occupation factors, meteorological conditions, atmospheric turbulence, specific characteristics, and properties of dust, etc.

Meteorological conditions are the most important parameters to design an air model. It needs long term and reliable observations. There are many uncontrollable parameters in terms of meteorological conditions. Some of the meteorological parameters such as wind speed, wind direction, air temperature, atmospheric pressure, humidity, rainfall are used in these models. However, there are some discussions about which meteorological parameter should be used in models. Since it is consuming time and money and difficult to obtain all meteorological data, at every site, measurements should be done to obtain the most relevant parameter(s). In this thesis, the aim is to answer the following question in terms of meteorological conditions:

Which is/are the most important parameter(s) affecting suspended particulate dust amount?

In this thesis, the meteorological data obtained from observations analyzed together with the airborne dust measured by MP101M Suspended Particulate Beta Gauge Monitor at Ovacık Open Pit Gold Mine. To reach this goal, one meteorological parameter is taken at a time, and a relation is sought between that meteorological parameter and the airborne dust amount measured at the three stations located around the Ovacık Open Pit Gold Mine on monthly basis. The results are analyzed statistically. Correlation coefficients for each parameter are tabulated and interpreted to obtain the best relationship between meteorological parameter and dust concentration.

In Chapter 2, relevant subjects and previous studies related with mine dust are given. Newmont Company and Ovacık Gold Mine are introduced, airborne dust monitor is described, and information about meteorological parameters are presented in Chapter 3. In Chapter 4, dust measuring procedure and stations are explained, meteorological data and dust data are analyzed and discussed separately, the relationships between dust and each meteorological parameter are analyzed statistically. Conclusions drawn from this study and some recommendations for further research are presented in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Dust Sources

Dust is formed by reducing materials to small size. Processes like crushing, grinding, blasting, and drilling produce dust particles of sizes varying from fine to coarse.

There is a certain level of dust in the air at all times. The amount and type of dust varies considerably and depends on many factors including source, climate, wind direction, and traffic. Therefore, it is important to determine how the dust is transported within the atmosphere and transferred from one medium to another. Dust is generated from many man made and natural sources and may be made up of soil, pollen, volcanic emissions, vehicle exhaust, smoke, or any other particles small enough to be suspended or carried by wind. The stronger the wind the larger the particles lifted and the more dust carried. Significant atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed fugitive because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations.

For the sources of fugitive dust, the dust-generation process is caused by two basic physical phenomena:

1. Pulverization and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.).

2. Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 19 kilometers per hour (km/hr) (12 miles per hour [mph]) (www.epa.gov , 2004).

If an operation itself creates dust; it is termed as primary, if operation disperses settled dust, it is termed as secondary source.

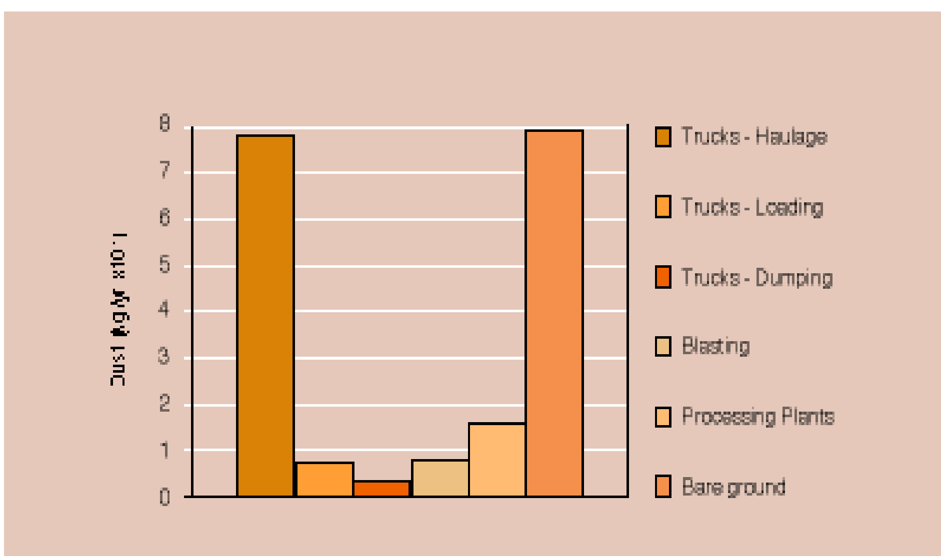


Figure 2.1 Dust emission rates from various locations and mining activities (Environment Australia, 1998)

Figure 2.1 shows major dust emission rates at an open pit mine.

Main dust sources in open pit mine are given below:

- Blasting, areas stripped for mining,
- Excavation, mining pits,
- Loading,
- Haulage, roads,
- Crushing,
- Dumping trucks, stockpiles,
- Tailings dams.

2.2 Movement of Dust Particles

Dust particles range in size from 0 to 400 microns. Particles grater than 10 microns are considered large and can be seen with the naked eye. Those particles from 1 to 10 microns and less than 1 micron are invisible to the naked eye and are considered fine and ultra-fine respectively (Cochrane, 1972).

Dust particles of different sizes behave differently, and are measured by the following size fractions: Deposited particulate refers to particles that settle out of the air, that are greater than about 10 to 20 microns. The primary effect is a nuisance one, in that particles may show up as a deposit on clean surfaces such as cars and window ledges.

The principal pollutant of interest is PM-10, particulate matter (PM) no greater than 10 micrometers in aerodynamic diameter (µmA). Because PM-10 is the size basis for the current primary USA National Ambient Air Quality Standards (NAAQS) for particulate matter, it represents the particle size range of the greatest regulatory interest. Because formal establishment of PM-10 as the primary standard basis occurred in 1987, many earlier emission tests have been referenced to other particle size ranges, such as: TSP Total Suspended Particulate, as measured by the standard high-volume ("hi-vol") air sampler, has a relatively coarse size range. TSP was the basis for the previous primary NAAQS for PM and is still the basis of the secondary standard. Wind tunnel studies show that the particle mass capture efficiency curve for the high-volume sampler is very broad, extending from 100 percent capture of particles smaller than 10 µm to a few percent capture of particles as large as 100 µm. In addition, the capture efficiency curve varies with wind speed and wind direction, relative to roof ridge orientation. Thus, high-volume samplers do not provide definitive particle size information for emission factors. However, an effective cut point of 30 µm aerodynamic diameter is frequently assigned to the standard high volume sampler. SP Suspended Particulate, which is often used as a surrogate for TSP, is defined as PM with an aerodynamic diameter no greater than 30 µm. SP may also be denoted as PM-30. IP Inhalable Particulate is defined as PM with an aerodynamic diameter no greater than 15 µm. IP also may be denoted as PM-15. FP Fine Particulate is defined as PM with an aerodynamic diameter no greater than 2.5 µm. FP may also be denoted as PM-2.5. The impact of a fugitive dust source on air pollution depends on the quantity and drift potential of the dust particles injected into the atmosphere. In addition to large dust particles that settle out near the source (often creating a local nuisance problem), considerable amounts of fine particles also are emitted and dispersed over much greater distances from the source. PM-10 represents a relatively fine particle size range and, as such, is not overly susceptible to gravitational settling.

The movement of dust particles in the air (suspension time) mainly depends on size, shape, and specific gravity of dust, temperature, humidity of air and airflow rate. Table 2.1 gives the relationship between diameter and settling time.

Table 2.1 The effect of diameter on settling velocity (Güyagüler, 2002)

Diameter(μ)	**Time passes for 1 m distance**
100.0	1.3 seconds
10.0	2.2 minutes
5.0	9.0 minutes
1.0	3.0 hours
0.5	

The movement of dust particles can be classified as follows:

- Newton's motion: Dust particle drop down under the influence of gravity.
- Stoke's motion: Dust particles settle down with constant velocity
- Brownian motion: Dust particles make zigzag motion, never settle down (Güyagüler, 2002)

The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. Theoretical drift distance, as a function of particle diameter and mean wind speed, has been computed for fugitive dust emissions. Results indicate that, for a typical mean wind speed of 16 km/hr (10 mph), particles larger than about 100 µm are likely to settle out within 6 to 9 meters (20 to 30 feet [ft]) from the edge of the road or other point of emission. Particles that are 30 to 100 µm in diameter are likely to undergo impeded settling. These particles, depending upon the extent of atmospheric turbulence, are likely to settle within a few hundred feet from the road. Smaller particles, particularly IP, 10 microns (PM-10), and FP, have much slower gravitational settling velocities and are much more likely to have their settling rate retarded by atmospheric turbulence (www.epa.gov, 2004).

Suspended particulate refers to particles that can remain suspended in the air for significant periods, ranging from several minutes for the larger particles to several days for very fine material. Elevated levels can affect visual quality and can have effects on human health, generally by irritating the eyes, mucous membranes, and skin.

2.3 Health Hazard

The method used for measuring suspended particulate picks up all particles up to about 100 microns in size. The size fraction less than 10 microns (PM10) is referred to as inhalable particulate. Because the particles are small enough to be inhaled, they can have an effect on human health. Figure 2.2 gives an idea about inhalable dust size with respect to human hair thickness.

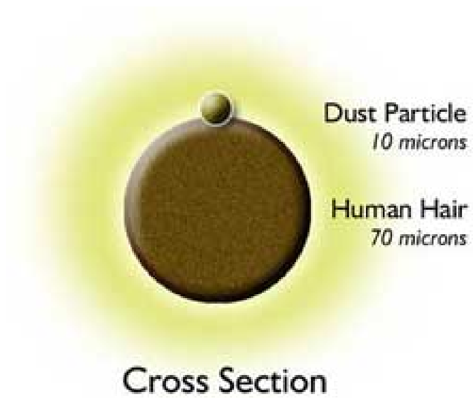


Figure 2.2 Dust figure comparing with human hair (www.newmont.com, 2004)

While levels are set for deposited particulate and total suspended particulate to protect against nuisance dust effects, PM10 levels are set to protect against health effects

Dust concentration is expressed in two ways:

- Gravimetric method, $\mu g/m^3$
- Counting method, number of particles /cm^3

There are some limits arranged for suspended particulate dust to protect human health and environment from harmful aspects in Turkish Air Quality Control Regulation (1986) such as

SPL: Short Period Limit (300$\mu g/m^3$)

LPL: Long Period Limit (150 $\mu g/m^3$).

For suspended particulate dust amount, short period is daily and long period is yearly (Air Quality Control Regulation, 1986).

Dust may cause to professional lung disease called pneumoconiosis if dust air inhaled long period. It can be defined as the acculamation of dust in the lungs and reaction of lung tissue to the presence of that dust.

Various kinds of pneumoconiosis are caused by different kinds of dust and some are more severe than others are. Classification of pneumoconiosis is given below:

A. Proliferative (fibrotic) pneumoconiosis

1. Silicosis (rounded opasities) – major
2. Mixed dust pneumoconiosis (rounded opasites) – major
3. Asbestosis (linear opasities)- major
4. Talcosis (linear opasities) – major

B. Benign pneumoconiosis
1. Siderosis (Fe oxide)
2. Stannosis (tin)
3. Barytosis (Ba dust)

Centuries before the Christian era, Hippocrates wrote of a lung disease common to those who mined in hard rock. He was obviously discussing silicosis. Other ancient writings indicate the Egyptians were aware of this malady. Silicosis among hard rocks miners was certainly described by Agricola in his ‘De Re Metallica’ published in 1556 (Karakaş, 2002).

The medical community in Europe and the U.S: recognized the silica health hazard in the early 1900s. They were concerned about the health hazard of sandblasting in polishing shops, the efficiency exhaust systems, and the necessity to protect the sandblasters against dust hazard. Sandblasting, hard rock mining and drilling are equally hazardous occupations .

Winslow, a professor of public health at Yale School of Medicine, recommended in 1919 a dust level below 21 mg/ m^3 of air and the use of a positive pressure helmet and respirator. The U.S. Department of Labor described the need for personnel respiratory protection in 1939 as: ‘Prevention of silicosis consists of preventing silica dust from getting into the air that workers breathe.’

In 1966, the American Conference of Government Industrial Hygienists (ACGIH) made a recommendation on allowable silica levels in the workplace atmosphere. In 1972, Cralley reported, 'Silicosis remains a serious occupational disease throughout the world.' (Karakaş, 2002).

In 1974, the medical community began to recognize silicosis as a progressive disease. A definite, but limited, progression of the lesion (silicotic nodule) in the host takes place, following the host's removal from additional exposure to quartz. The fibrosis may proceed even when further exposure to silica ceases. In a proportion of cases, the disease progresses remorselessly to severe respiratory disability and death, often many years after the responsible industry has been left .

One reason that silicosis is such a potentially dangerous disease is that it has a tendency to progress. Silica particles smaller than 10 microns are respirable; they can enter the respiratory tract and descend through the bronchial tree into the terminal branches known as alveolar sacs. Particles larger than 10 microns are caught in the ciliary escalator and brought back up through the bronchial tree to the throat and are either swelled or expectorated. The smaller particles, however, remain in the alveolar sacs where they are attacked by macrophages. These scavenger cells might well be called the garbage collectors of the respiratory system, since they ingest all foreign particulate matter. If the particle is a common house dust, the ingestion takes place and the particle is walled off and rendered harmless by the macrophage. However, if the macrophage ingests a silica particle, an entirely different set of events takes place. The macrophage attempts to ingest and wall off the silica particle, but for reasons that are not known, the macrophage literally explodes. The lung is then left with a destroyed macrophage and a free silica particle. This particle is then ingested by another macrophage, which, in turn, is destroyed by explosion. Therefore, the process goes on (Karakaş, 2002).

Everyone has billions of macrophages. However, when an individual inhales a sufficient number of less than 10-microns size particles, the macrophage system is eventually overwhelmed. When enough macrophages have been destroyed, the residual biological materials begin to form scar tissue. At first, these scars are small, but then they grow and adjacent scars begin to coalesce. When a cross section of scar tissue is explained under a microscope, its concentric rings have the appearance of an onion. The chest X-ray appearance of the silicotic individual is very distinctive. At first, there may be fine mottling of the entire lung field. There may also be distinctive eggshell-like lymph nodes that are calcifying in the regions of the lungs (Karakaş, 2002).

As the scar tissue continues to proliferate, more lung tissues are rendered as useless. The individual then begins to develop shortness of breath and his capacity to perform useful understanding, the silicotic individual becomes susceptible to infection by the tubercle bacillus, with the result pulmonary tuberculosis, which is a common complication of silicosis (Karakaş, 2002).

The factors that determine harmfulness of dust are:

- Composition: Mineralogical composition is more important than chemical composition. Free silica is more damaging then combined silica. Asbestos is cancerogenic. The surface energy of the particles is determining factor. Solubility is an important variable in toxic dusts.
- Concentration: Concentration can be expressed as ppcc, mppcc, or mg/m^3. High concentration increases harmful effects of dust.
- Particle sizes: Dangerous dust size range, called respirable range, is between 0.2 to 5 microns. Figure 2.3 shows the relationship between particle diameter and percent penetration or deposition.
- Exposure time: The average time for the development of pneumoconiosis has been found to be 20 to 30 years. In some cases, silicosis has been diagnosed in less than 1 year of exposure
- Individual Susceptibility: Susceptibility to pulmonary disorder is a function of age and may differ depending on individual.

In the study conducted by Pittsburgh Research Laboratory National Institute for Occupational Safety and Health, the control technology to reduce worker exposure to silica and other harmful contaminants in metal/nonmetal mining operations is described (www.epa.gov, 2004).

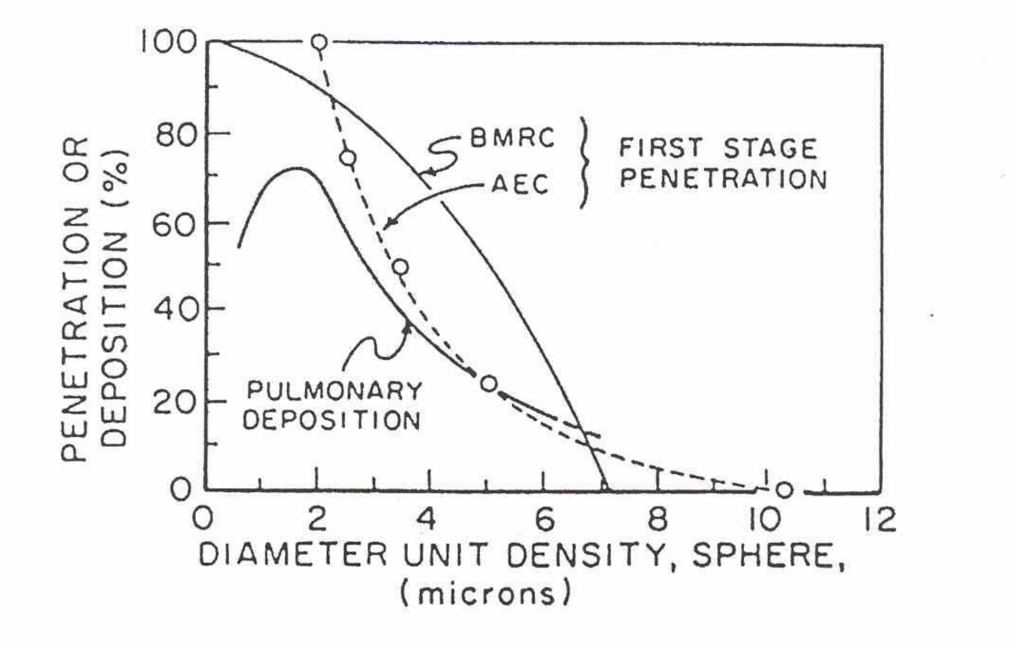


Figure 2.3 Pulmonary deposition and first stage penetration (Güyagüler, 2002)

Although all types of respirable dust can harm a worker's lungs, overexposure to respirable silica is extremely hazardous. Chronic overexposure to respirable crystalline silica (particle diameter < 10 microns) leads to progressive lung deterioration known as silicosis. In addition, the International Agency for Research on Cancer has stated that silica dust is carcinogenic (lungs). Records of the Mine Safety and Health Administration (MSHA) show that there is a significant percentage of both underground and surface metal/nonmetal miners overexposed to silica each year. The following occupations have the highest exposures: truck drivers, crusher operators, front-end loader operators, rotary drill operators, bag operators, bag stackers, laborers, maintenance, cleanup, and utility workers.

An extensive effort is ongoing to lower equipment operators' dust exposure by improving filtration efficiency and pressurization in enclosed cabs in all types of mining equipment. This research is being done jointly by the Pittsburgh Research Laboratory and the Engineering and Physical Hazards Branch (Cincinnati) in cooperation with MSHA, a number of mining companies, and several dust filtration and pressurization manufacturers. Evaluations are being done at several different surface mining operations on rotary drilling machines. An enclosed cab study is also being evaluated on a haul truck at an underground limestone mine.

2.4 Dust Control

In dust control, the most preferable and most economical case is to prevent the occurrence of airborne dust. Dust is managed by many methods. A summary of dust control measures includes:

- sprinkler systems,
- dust collectors and filters on drill rigs and crushers,
- water sprays where required,
- keeping stockpiles low,
- wheel washing,
- watering haul roads, applying water to roads, pits and stockpiles; (Figure 2.4),
- minimizing the disturbed area by only opening up areas immediately before mining,

- progressive rehabilitation, maximizing the rehabilitation area to reduce the area disturbed,
- forward stripping topsoil at predetermined times to avoid summer stripping, and sowing the area with appropriate cover crop to stabilize it, which will then be mined through,
- aerial seeding of open areas inaccessible to machinery to establish some form of cover on the area,
- vegetation cover on long-term stockpiles, sowing topsoil stockpiles with an appropriate cover crop,
- using chemical dust suppressants on roads and other open areas,
- erecting shade-cloth fencing for containment of mineral stockpiles which are too large for chemical crusting sprays (Environment Australia, 1998).

Figure 2.4 Watering roads

2.5 Air Models, Parameters and Uncertainties

Amongst the many environmental impacts that minerals extraction can have air pollution is one. This can be in many forms, such as dust from exposed workings and haulage operations, to gaseous and particulate emissions from minerals processing. In order to alleviate the environmental impacts of air pollution it is important to understand and quantify the process of dispersion of such air pollutants in the atmosphere. This is achieved through air pollution modeling (Johnston and Durucan, 1998).

The purpose of a dispersion model is to provide a means of calculating ambient ground-level concentrations of an emitted substance given information about the emissions and the nature of the atmosphere. The amount released can be determined from knowledge of the industrial process or actual measurements. However, predictive compliance with an ambient air quality guideline is determined by the concentration of the substance at ground level. Air quality guidelines refer to concentration in the ambient air, not in the emission source. In order to assess whether an emission meets the ambient air guideline it is necessary to determine the ground-level concentrations that may arise at various distances from the source. This is the function of a dispersion model.

A dispersion model is a set of mathematical relationships or physical models, based on scientific principles that relate emission rates of an air contaminant to the resulting ambient concentrations. It is a series of equations describing the relationships between the concentration of a substance in the atmosphere arising at a chosen location, the release rate, and factors affecting the dispersion and dilution in the atmosphere. The model requires information on the emission characteristics and the local meteorology. Modeling can also be used to predict future scenarios, short-term episodes, and long-term trends. Model predictions are useful in a wide variety of air quality decisions, including determining appropriateness of facility location, monitoring-network design, and stack design. Models also provide information on the areas most influenced by emissions from a source, the contribution of weather to observed trends, and the air quality expected under various scenarios. Dispersion modeling requires knowledge of emission rates and the local meteorology and topography (Idriss, 2003).

In order to model atmospheric dispersion, air models use a deterministic 3D resolution of the Fluid Dynamics Eulerian equations. In this regard, all the phenomena and parameters that could influence the transport diffusion of pollutants in the air are taken into account:

- 3D topography, however complex.
- Ground occupation factors (urban areas, forests, fields, water bodies…).
- Meteorological conditions (fixed or variable).
- Atmospheric turbulence.
- Pollutants specific characteristics and properties (NOx, SO_2, CO, C_6H_6, dust, COV, Hg, …).

While designing an air model, the choice of the parameters and the basis for the model, which is generally Gaussian plume equation, are very important. However, there are some missing aspects in this model. For example, while the maximum wind speed is taken as the major parameter, the number of wind blows are not considered. Nevertheless, the wind directions and the number of winds blow, which determines the dominant wind directions, has more important effect than the wind speed only. On the other hand, Industrial Source Complex (ISC) Dispersion Model developed by US Environmental Development Agency (EPA) takes the wind directions into account. Measurement of wind direction is done 16 directions in Turkey, but in USA, it is done in 32 directions. Therefore, using ISC model developed by EPA in Turkey can result in erroneous results. Air models must be designed according to the local measurable meteorological parameters (Değerli, 2001).

The basic concept of the Industrial Source Complex-Short Term (ISCST) computer model is developed by the United States Environmental Protection Agency (USEPA) and frequently used for the air quality determinations (Hamzaoğlu et al., 1998).

The basic concept of the ISCST model is similar to that of the steady state, straight-line Gaussian plume equation. The model combines various dispersion model algorithms for pollutant sources such as stack and fugitive emissions. The four input sets used by the model are:

- Meteorological data
- Source data
- Receptor data
- Control data

Meteorological data set consists of hourly wind speed and direction, ambient air temperature, Pasquill stability class, mixing height wind profile exponent and potential vertical temperature gradient (optional) values (Hamzaoğlu et al., 1998).

Source data are from deposition and concentration values for each source and receptor combinations. They can be evaluated using more than 150 combinations for more than 200 pollution sources. The model is capable of dealing with multiple sources, which are categorized as point, volume and area source type (Hamzaoğlu et al., 1998).

Air pollutants are primarily sourced within the atmospheric boundary layer. This boundary layer is lowest layer of the atmosphere and the Earth's surface. Consequently, the dispersal, of air pollutants is a combination of transport (advection) by the wind and dispersion by turbulence. Although this is a very efficient method of dispersal, the numerical modeling of turbulence presents considerable problems (Johnston and Durucan, 1998).

The atmospheric dispersion of heavy particles is different to that of passive gaseous pollutants, because the effect of gravitational forces imposes a downward settling velocity on the particle. In order to predict the motion of such a particle it is necessary to have knowledge of the particle trajectory that is both the function of downward settling velocity and the local turbulence intensity of the fluid. It is non-linear coupling between the turbulence and the settling motion that makes predictions of particle trajectories difficult (Calviac and Vesovic, 1998).

First, the particle, due to its inertia, takes a finite amount of time to respond to the changes in the fluid velocity caused by turbulent fluctuations. This delay, measured by the response time of the particle, causes the particle velocity correlation functions to lag and in general to be numerically different from the fluid velocity correlation function. Secondly, as the particle settles and drifts downwards, under the influence of gravity, it moves from one turbulent eddy to another. This effect, known as 'crossing-trajectory effect', makes it necessary to introduce more than one fluid timescale in order to properly account for the particle interaction with fluid eddies (Calviac and Vesovic, 1998).

In particular, the deposition of particles will be investigated as a function of downwind and crosswind distance for given atmospheric conditions, average wind speed and particle size. Ultimately, it is expected that the proposed model will form the basis for a realistic model of particle dispersion and deposition in the mining environment where the only input parameter is the average wind profile, which can be obtained from meteorological data or models (Calviac and Vesovic, 1998).

Gaussian plume models based on the Pasquill-Gifford (PG) dispersion scheme for estimating the dispersion are commonly used at present for modeling air pollution. They have the considerable advantage of simplicity for modeling what is an inherently complex phenomenon, the turbulent dispersion of air pollutants. The Gaussian plume model takes advantage of the fact that steady state conditions can be assumed to exist in the boundary layer over an averaging period of approximately one hour. The model then describes dispersion for each averaging period using the advection transport of a pollutant in the mean wind direction together with a statistical description of the dispersion due to turbulence in the crosswind and vertical directions. These concentration distributions are assumed Gaussian or normal distributions. The Pasquill-Gifford is a simple empirical scheme that models these concentration distributions based on a classification of atmospheric stability: a measure of the enhancement or suppression of turbulence and hence dispersion, in the atmosphere. PG based Gaussian plume models also have the further advantage that they only require a minimum set of easily measurable meteorological observations. All these factors have lead to the widespread use of PG based Gaussian plume models today, which is perhaps typified by the US Environmental Protection Agency's ISC model (Johnston and Durucan, 1998).

The fact that most models then in use and still currently, perform quite poorly in predicting air quality. Shortcomings behind the PG method of Gaussian plume modeling include (Johnston and Durucan, 1998):

- The assumption that concentration distributions are Gaussian. It is now understood that in the convective boundary layer the vertical distribution quickly becomes non-Gaussian for both elevated releases and ground- level releases. The distribution in the convective boundary layer is of particular importance as these are often the conditions under which maximum ground level concentrations occur

- The application of PG dispersion coefficients to conditions differing to that from which were developed. They were originally based on short-term averaging periods for non-buoyant plumes released from ground level sources, and for distances of up to 800 m from the source. The use of PG dispersion coefficients also introduces a stratification of atmospheric conditions, when there is actually a continuum of motion within the atmosphere. This is considered a source of potential error.
- The application of the Pasquill-Turner method of classifying stability based on surface observations ignores the variation of the turbulent properties of the boundary layer with height and has a strong bias towards neutral stability when convective conditions actually exist
- No account is made for differences in plume behavior and dispersion characteristics depending on the release height. Releases from low-level sources behave very differently to those from high-level sources due to the differing conditions within the vertical structure of the boundary layer.
- If an air pollutant is released with either convective or momentum buoyancy the release height used in the model needs to be adjusted accordingly. Most PG Gaussian plume models assume that if calculated effective height of plume due to buoyancy exceeds the height of the mixed layer it becomes trapped in the upper stable atmosphere and has no impact on ground level concentrations. This ‘all or none ‘approach ignores the potential for the partial penetration of the plume through the top of the boundary layer. This is dependant on the

plume's residual buoyancy on reaching the elevated inversion, the strength of the inversion, ultimately the structure of the boundary layer and its effect on plume rise

The models have often been found wanting in the accuracy of their predictions. The correlation between observed and predicted concentrations paired in time and space is not achievable due to the inherent uncertainty of atmospheric dispersion. Part of the problem has been related to the tendency to make air pollution models resemble the US EPA's guideline models, such as ISC2 to enable models to be approved of regulatory applications. The aim, rather, should be to make models fundamentally better at predicting concentration levels. However, due to stochastic nature of atmospheric dispersion, a limit to the predictive accuracy of models has been suggested as ± 20 % assuming all input and modeling errors are eliminated (Hanna 1993).

The direct use of turbulence measurements as for time been considered a more appropriate method of estimating the dispersion coeffients. Indeed, the use of dispersion coefficients based on a stability classification was only provided as an alternative in the absence of turbulence data in Pasquill's original paper. However, accurate and representative turbulence measurements are rarely avaible in practice. This has lead to the development of various empirical schemes of which the PG method has come to predominate. Yet despite being based on the limited knowledge of the boundary layer and dispersion at the time, it continues to be popular. This is undoubtedly due to its use of surface observations of readily available meteorological parameters overcoming the need for direct turbulence measurements (Johnston and Durucan, 1998).

Recent advances in the physical understanding of the boundary layer now make it possible to use simple meteorological measurements to provide a more realistic description of boundary layer turbulence and therefore improve the modeling of atmospheric dispersion. The basic approach involves the use of scaling and dimensional analysis to determine characteristic length, velocity and temperature scales from which estimates of the dispersion parameters can be made (Johnston and Durucan, 1998).

There are some important points that need to be considered whilst conducting an air pollution modeling and monitoring campaign. The first and foremost amongst these is the very nature of a process governed by turbulence. Because of its essentially random nature, turbulence introduces a relatively high degree of inherent uncertainty. The concentration predicted by a model is an ensemble average defined by the meteorological parameters input to the model. It is an ensemble average because is repeatable with the same conditions in time and space. In the atmosphere, the meteorological conditions that define an observed concentration do not repeat with sufficient frequency. As a result, the observed concentration is normally a time-average drawn from that ensemble (Johnston and Durucan, 1998).

Following on from this, the total uncertainty in an air pollution model is made up of three different elements such as; uncertainty due to errors in the model physics, uncertainty due to errors in the data, and inherent uncertainty.

Data errors are introduced into a model through the measurement of model parameters such as source emission rates, meteorological conditions and observed concentrations. These errors combined are often a major component of the total model uncertainty (Johnston and Durucan, 1998).

For example, a primary source of data error is in the measurement of wind direction. In one field experiment, it was reported that there was a standard deviation of the error in wind direction measurements of 20º. Such errors in the wind direction result in very poor correlations between observed and predicted concentrations paired in time and space, the pattern of predicted concentrations may be the same but shifted in space (Johnston and Durucan, 1998).

Another typical source of error is monitoring gauges. Theoretically the flux into the dust gauge should be a function of air concentration, wind speed, wind direction relative to each aperture and aperture size. However, studies have shown that the directional dust gauge has a variable collection efficiency that in some cases can be as low as 20% (Johnston and Durucan, 1998).

The sitting of monitoring stations can also play a role in the accuracy of measurements. They should be clear of major obstructions and at representative locations. For example, if there is a strong prevailing wind direction, then some monitoring gauges should be placed downwind of the release site (Johnston and Durucan, 1998).

Unusual site and meteorological conditions may greatly affect concentration predictions. Limited number of data sets that are often used in validation studies may not reflect all the conditions in which a model may later be applied (Johnston and Durucan, 1998).

Most Gaussian plume models were developed for application in flat or gently rolling terrain. The results obtained for complex terrain should be treated with considerable caution (Johnston and Durucan, 1998).

2.6 The Relationships Between Dust Particulates And Meteorological Parameters

The actual analysis of dust particulate as a function of one or more meteorological parameters can be carried out on quite different levels; yearly, and monthly. The analysis of dust particulate and climate data can be utilized to illustrate certain functional and other statistical relationships. The correlation and regression analysis techniques are useful in investigating these relationships. The relationship between meteorological parameters and pollutant concentrations has been well studied in different parts of the world for different time periods. A lot of research has been devoted to the study of the local climatic conditions in relation to the air quality. Dickson (1961), for example, studied the relationship between precipitation and particulate matter in Nashville, whereas Sham (1979), used a linear correlation to model respirable dust particulate and average wind speed at Kuala Lumpur and Petaling Jaya, his study yielded r- value of -0.2358 (Yassen, 2000).

A linear correlation between dust particulates and rainfall yields reasonable negative relationship, the r-values ranged from - 0.050 to - 0.687. A correlation between dust concentrations and rainfall amount shows poor to moderate results. The resulting t-value was low (ranged between -0.481 and -1.016) and not statistically significant at 0.05 level. The negative relation might be dust particulate reduced through washout process. Sham (1979) pointed out that a poor relation between dust and precipitation amount may probably be due to the generally more stable atmospheric condition and hence less pollution dispersion when rain occurs. Kerker and Hampel (1974) stated that washout may be significant factor in cleansing the atmosphere of 0.1 mm aerosol. The lighter rainfall is much more efficient in cleansing the atmosphere of 0.1 mm aerosol because of the greater collection efficiency of the smaller raindrops. Precipitation is important through the absorption processes within the cloud, known as rainout, and that termed washout, which is a scavenging of air pollutants by falling raindrops (Yassen, 2000).

Relative humidity also correlates negatively with dust particulate. The correlation coefficients between mean dust particulates and relative humidity ranged from 0.013 to -0.712. No significant relationship was found between dust and relative humidity, although there appears to be a tendency towards an inverse relationship between the two variables. The relative humidity in the study area more than 70% on the average.

Therefore, the higher the relative humidity, the greater the rate of settling of the dust from the atmosphere (Yassen, 2000).

A linear correlation between dust particulates and temperature yields a moderate positive relationship, r-value ranged from 0.02 to 0.612. The resulting t-value is not statistically significant at the 0.05 level. It is nevertheless interesting to note that the r-value is slightly better than that between TSP and temperature. Sham (1979), stated that the influence of weather factors upon respirable dust particulates in Kuala Lumpur-Petaling Jaya area is largely inconclusive (Yassen, 2000).

A linear correlation between dust particulate and wind speed also yields a poor relationship. The correlation coefficient however is low, r-value ranged between 0.063 and -0.510 and statistically is not significant at 0.05 level. Dust particulate comes more from the lower level of domestic sources. The effects of wind speed operate to be far more effectively on high level emissions than on lower emissions. Chow and Lim (1984) stated that winds below an altitude of 1 km over the Klang Valley, especially the urban centers, are generally light and variable. Hence, with regard to the horizontal transport pollutants it is suspected that the dispersion of pollutants by wind in the Klang Valley region is relatively limited. Sham (1979) found a poor relationship between respirable dust particulate and wind speed, the correlation coefficient in the order of -0.1273 in Kuala Lumpur-Petaling Jaya (Yassen, 2000).

The results of the above mentioned studies show that most meteorological parameters correlate negatively with dust particulates, thereby indicate that lower concentrations of dust particulates are associated with higher meteorological parameters. Yassen (2000) concludes that the relationships are reasonable good as is evidenced by even moderate correlation coefficients.

2.7 Scope of the Thesis

The main objectives of this study can be summarized as:

- To determine the tendencies, if any, by analyzing the graphs drawn between the airborne dust concentration and the meteorological parameters,

- To investigate which meteorological parameter(s) have an inverse or direct influence on the airborne dust concentration,

- To determine which meteorological parameter(s) correlate the best or the least with the airborne dust concentration using statistical approach.

CHAPTER 3

DUST MONITORING SITE, INSTRUMENTATION AND PROCEDURE

3.1 Newmont Gold Company

Newmont Mining Corporation (NYSE & ASX: NEM; TSX: NMC) is the world's largest gold producer with significant assets or operations on five continents. Newmont is also engaged in the exploration for and acquisition of gold properties in some of the world's best gold districts. In addition, Newmont is the world's largest private sector precious metals royalty owner.

Founded in 1921 in New York City, Newmont has been trading on the New York Stock Exchange (NYSE) since 1925. In addition to the NYSE, Newmont trades on the Australian and Toronto stock exchanges. Newmont is headquartered in Denver, Colorado.

With the continued strength in the gold market, for the year 2003, Newmont expects to sell between 7.2 million and 7.4 million ounces of gold at total cash costs of between $198 and $208 per ounce. Newmont offers attractive advantage to a rising gold price; for every $10 change in the gold price, Newmont's annual net income changes by approximately

$58 million and annual cash generated by operating activities by approximately $68 million, assuming all other factors remain constant. Newmont operates core assets in the United States, Peru, Australia, and Indonesia. Newmont employs approximately 14,000 people worldwide and Newmont is committed to the highest standards for environmental management, health and safety for its employees and neighboring communities (www.newmont.com, 2004).

3.2 Ovacık Gold Mine

Ovacık gold mine , 100% owned by Newmont Gold Co. , is in western Turkey, 19 kilometers from the Aegean Sea and 106 kilometers north of the city of Izmir. The location of Ovacık Gold mine is shown in Figure 3.1.

It poured its first gold in May 2001, following more than a decade of exploration, environmental permitting, and construction by Normandy Mining and its predecessors. Since May 2001, 10 tones of gold have been poured.

Ore is mined from both open pit and underground operations and processed through a 330000 tonnes per year grinding circuit and gold recovery plant. The general mine plan is shown in Figure 3.2.

Figure 3.1 Location of Ovacık Gold Mine (www.newmont.com, 2004)

Gold sales in 2002 were 125700 ounces at total cash costs of $122 per ounce. Ovacık is expected to sell approximately 160000 ounces of gold in 2003 at total cash costs of $130 per ounce. In December 31, 2002, Ovacık reported 340,000 ounces of gold reserves.

As part of the environmental management program, the plant incorporates a unique cyanide destruction system for processing fluids, a sealed tailings pond, and a zero discharge system for wastewater. The combination is thought to be the first of its kind in the world. The mine employs approximately 250 people (www.newmont.com, 2004).

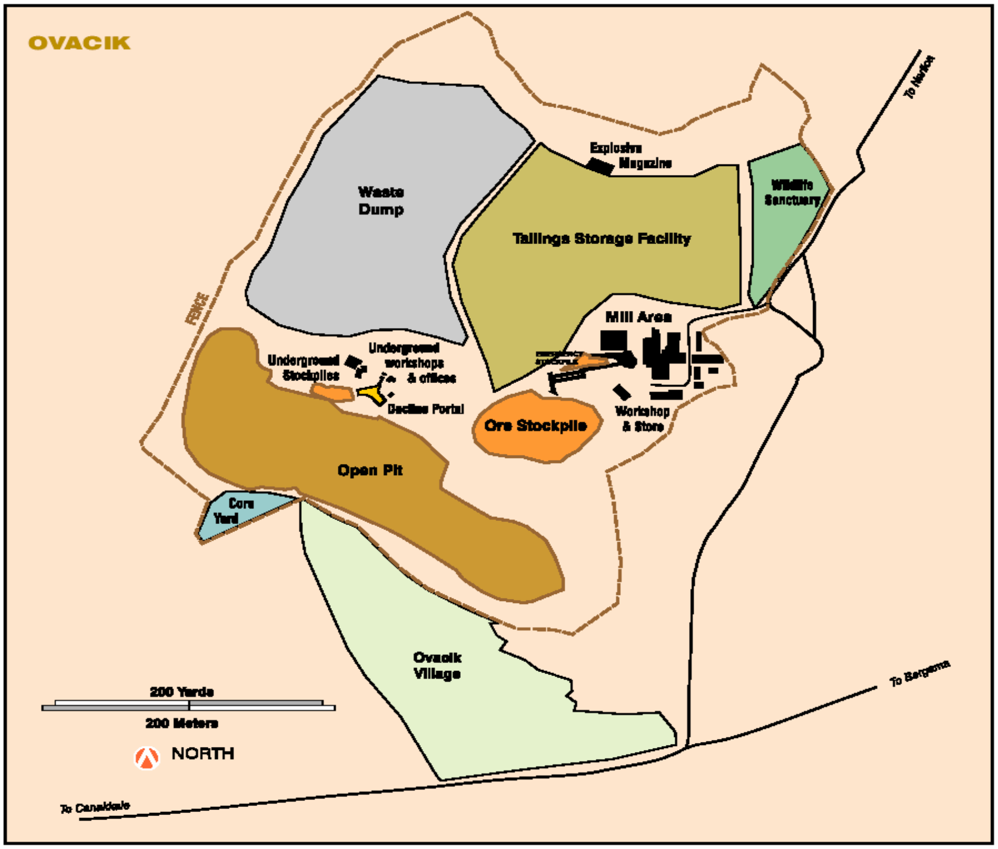


Figure 3.2 Ovacık Gold Mine plan (www.newmont.com, 2004)

The following dust control measures are applied at Ovacık open pit gold mine:

- watering haul roads,
- applying water to blasting area before firing,
- water spraying on crusher,
- watering stockpiles,
- immediate vegetating of waste dumps.

3.3 MP101M Suspended Particulate Beta Gauge Monitor

The MP101M system is used to measure particles below 10 microns particle size suspended in the ambient air. Sampled dust can also be monitored continuously for possibly natural radioactivity, with programmed alarm in the event of a threshold over shoot. Figure 3.3 shows general view of device. The system can come in the form of an indoor by for installation in a closed room, or an outdoor sealed housing, heated and ventilated. The unit is designed to operate separately or as part of a monitoring and alert network. The MP101M forms part of a new generation of beta gauge dust measuring systems. The suspended particles are gathered by vacuuming a definite volume. The particles settle on a filter paper made of glass fiber that is scrolled automatically between the beta source and a GEIGER-MÜLLER counter (GM) (MP101M Technical Manual, 1995).

The difference in the radiation count before and after gathered of the particles represents the measurement of the mass on the filter. The particles are sucked from the volume using a vacuum pump with a sampling head connected to the top of the analyzer.

The Beta gauge consists of a Carbon 14 radioactive source (14C) located in a source holder. The carbon 14 source (14C) is a low intensity source (<100 μCi) with half-life of about 5730 years. The filter ribbon used provides for a high number of particle gathering operations (1200)

Figure 3.3 Photo of MP101 M Suspended Particulate Beta Gauge Monitor (MP101M Technical Manual, 1995)

its high reliability components and easy to use design the MP101M requires very limited maintenance. (MP101M Technical Manual, 1995)

Standard operating mode has seven programmable measurements ranging from 0-100 to 0-10000 μg/m3 with minimum detectable limit of 6 μg/cm2 (counting time = 200s). Parameters affecting metrology and correct operation test are automatically monitored. Measured values are expressed in μg/m3 or μg/cm2

Sampling assembly comprises a standard unidirectional sampling head (AFNOR standard) consisting of a stainless steel cover and a stainless steel protection grid with seal. Sampling head PM 10 has a 2 m stainless steel suction and a 60 mm diameter stainless steel tube protecting the suction conduit. There are two flanges and a seal for tightness with respect to the outside (MP101M Technical Manual, 1995).

Principle of operation of device relates with beta gauge operating principle. A BETA gauge consists of a Carbon 14 source (14C) emitting soft Beta radiation and a radioactive radiation detector: Geiger-Müller (G.M.) tube, The G.M. is mounted at a given distance downstream of the filter ribbon, which collects the particles, suspended in the air. Figure 3.4 gives a sketch about general functional operation.

When determining a mass deposit, at the end of each period or cycle, the source is aligned with the dust deposit and the counter (G.M.). The low-energy Beta rays are absorbed by the matter by collision with the electrons whose number will be proportional to the density. The matter consists of the glass fiber filter, the dust deposited and the air between the source and the G.M. The absorption is given by an exponential law and is independent of the physical-chemical nature of the matter. The measurement consists in calculating the difference in absorption observed on the blank filter at the start of the cycle and on the charged filter at the end of the period or cycle. This differential measurement is used to compensate for the non-uniformity of the filter when calculating the mass of the deposited dust. The monitor also compensates for the variation in temperature of the weight of the air knife. Figure 3.5 gives sketch for Beta gauge.

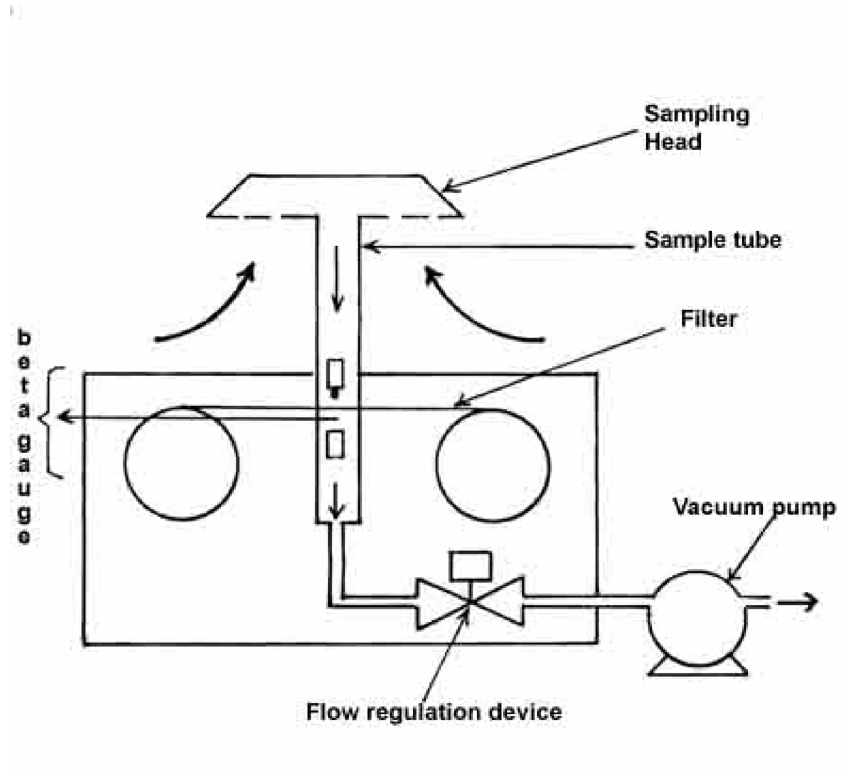


Figure 3.4 General functional diagram
(MP101M Technical Manual, 1995)

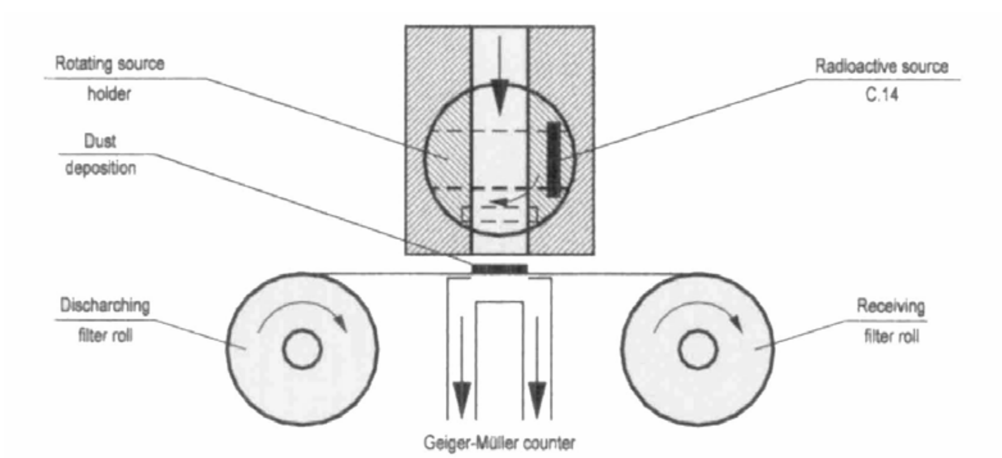


Figure 3.5 Beta gauge (MP101M Technical Manual, 1995)

3.4 Meteorological Parameters

In this thesis, meteorological parameters such as atmospheric pressure, air temperature, relative humidity, rainfall, evaporation, sunshine and wind speed and wind direction are investigated. Data is taken from meteorology stations located at mine site and Bergama.

3.4.1 Atmospheric Pressure

Atmospheric pressure is defined as the force per unit area exerted against a surface by the weight of the air molecules above that surface. In the diagram below, the pressure at point "X" increases as the weight of the air above it increases. The same can be said about decreasing pressure, where the pressure at point "X" decreases if the weight of the air above it also decreases (Figure 3.6).

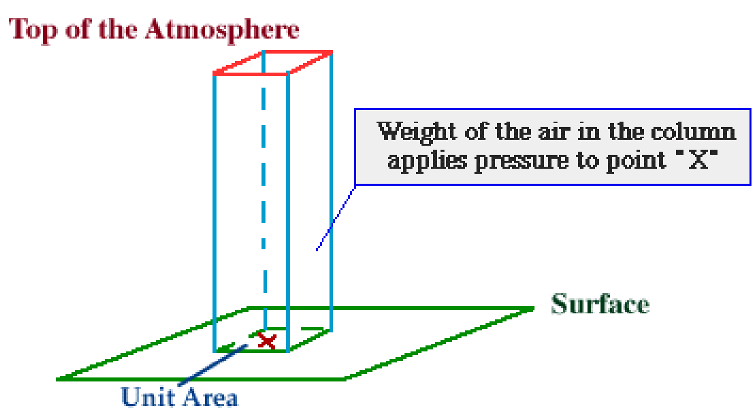


Figure 3.6 Atmospheric pressure (www.atmos.uiuc.edu, 2004)

The atoms and molecules of the gases in the atmosphere, like those of all other matter, are subject to Earth's gravitational pull. Consequently, the atmosphere is much denser near the surface of the Earth than high altitudes. In fact, the density of air decreases very rapidly with increasing distance from Earth. Measurements show that about 50 percent of the atmosphere lies within 6.4 km of Earth's surface, 90 percent within 16 km, and 99 percent within 32 km. Not surprisingly, the denser the air is the greater the pressure it exerts. The force experienced by any area exposed to Earth's atmosphere is equal to the weight of the column of air above it. It is the pressure exerted by this column of air that is referred to as atmospheric pressure. The actual value of atmospheric pressure depends on location, temperature, and weather conditions (Chang, 1994).

If the number of air molecules above a surface increases, there will be more molecules to exert a force on that surface and the pressure increases. The opposite is also true, where a reduction in the number of air molecules above a surface will result in a decrease in pressure. Atmospheric pressure is measured with an instrument called a barometer, which is why atmospheric pressure is also referred to as barometric pressure (www.atmos.uiuc.edu, 2004).

Air pressure can be measured with a mercury barometer, an aneroid barometer, or an aneroid barograph. A standard mercury barometer has a glass column about 30 inches long, closed at one end, with a mercury-filled reservoir. Mercury in the tube adjusts until the weight of the mercury column balances the atmospheric force exerted on the reservoir. High atmospheric pressure forces the mercury higher in the column. Low pressure allows the mercury to drop in the column (www.centennialofflight.gov, 2004).

An aneroid barometer uses a small, flexible metal box called an aneroid cell. The box is tightly sealed after some of the air is removed, so that small changes in external air pressure cause the cell to expand or contract (www.centennialofflight.gov, 2004).

An aneroid barograph consists of a revolving drum on which the air pressure is recorded, a syphon cell that expands or contracts as air pressure rises and falls, and a lever that transfers the movement of the syphon cell to the recording pen that writes on the revolving drum. It is found in weather stations because it provides a permanent record of pressure readings (www.centennialofflight.gov, 2004).

The standard atmospheric pressure (1 atm) is equal to the pressure that supports a column of mercury exactly 760 mm high at 0 °C at sea level. The standard atmosphere thus equals a pressure of 760 mmHg, where mmHg represents the pressure exerted by a column of mercury 1 mm high. The mmHg is also called Torr (Chang, 1994). There are several units to indicate atmospheric pressure. Mainly used ones and conversion factors are given in Table 3.1.

As air becomes thinner, the density of air decreases, and so too does the pressure of air. Many different factors affect the density of air. Most measurably, as altitude increases, air becomes less dense, decreasing atmospheric pressure. This relationship also works inversely. As air becomes less dense, it contains less gases per unit of volume.

Table 3.1 Atmospheric pressure units

1 torr = 1 mmHg
1 atm = 760 mmHg
1 atm =101,325 Pa
1 bar = 0.1 MPa
1 milibar= 100 Pa
1 milibar= 1,013 atm

For the most part, this relationship works quite well. But factors other than altitude also effect the density of air. For one thing, water vapor molecules have less mass than other gas molecules in air; so as water vapor increases, the density of air decreases.

Temperature also changes the density of air. As air gets warmer it expands and becomes less dense, causing atmospheric pressure to fall.

In addition, air within the atmosphere can rise and fall, changing the atmospheric pressure. In fact, meteorologists monitor atmospheric pressure at the Earth's surface in order to determine whether the pressure is rising or falling, which helps to predict weather patterns. High pressure often represents stable air, while low pressure can signify instability. On a cold, sunny day there will be a significantly higher atmospheric pressure than when a big storm is moving in on a hot and humidday.

3.4.2 Air Temperature

Temperature is a familiar concept. Essentially, it is a measure of the level of sensible heat (temperature measured by a thermometer) of matter, whether it is gaseous (air), liquid (water), or solid (rock or dry soil) (www.cimms.ou.edu, 2004).

Temperature is one of the seven SI base standards. The unit of temperature is Celsius (°C) in SI system. The relationship between temperature and volume of the air is given by Charles Law. It states that the same rise of temperature produces the same increase in volume in all gasses if the pressure is constant (Güyagüler and Keskin, 1996).

The earth as a whole receives a constant flow of radiant short-wave energy from the sun. The earth also radiates longwave energy to space. During the day, the flow of short-wave radiation absorbed exceeds longwave energy emitted, and the surface temperature increases.

The temperature of a surface can be raised or lowered by processes other than absorption or emission of radiant energy. At night, this net radiation balance reverses. No short-wave radiation strikes the darkened side of the earth, but long wave energy is still emitted from the surface. Therefore, surface temperatures decrease (www.cimms.ou.edu, 2004).

Because the earth rotates on its axis, incoming solar energy can vary widely throughout the 24 hours period. Insolation is greatest in the middle of the daylight period, when the sun is high in the sky, and falls to zero at night. During the day, net radiation is positive, and the surface gains heat. At night, net radiation is negative, and the surface loses heat by radiating it to the sky and space.

Since the air next to the surface is warmed or cooled as well, air temperatures follow the same cycle. This results in the daily cycle of rising and falling air temperatures. The daily cycle of temperature is controlled by the daily cycle of net radiation.

The minimum daily temperature usually occurs about a half hour after sunrise. Since net radiation has been negative during the night, heat has flowed from the ground surface, and the ground has cooled the air to its lowest temperature. As net radiation becomes positive, the surface warms quickly and transfers heat to the air above. Air temperature rises sharply in the morning hours and continues to rise long after the noon peak of net radiation. Mixing of the lower air by vertical currents distributes heat upward, offsetting the temperature rise. Therefore, the temperature peak usually occurs in the mid-afternoon between 2 and 4 pm. By sunset, air temperature is falling rapidly. It continues to fall, but at a decreasing rate, throughout the night (www.cimms.ou.edu, 2004).

A thermometer measures temperature. Liquid-in-glass thermometers are the most common types of thermometers because they are easy to read and inexpensive to construct.

These thermometers are made from glass and consist of a glass bulb that is attached to a tube that is marked with a temperature scale. The liquid in the thermometer is usually alcohol or mercury. When this liquid warms up, the molecules in the liquid move faster and the volume expands. The expansion of the liquid causes it to move up into the bore and indicate the temperature. When the liquid cools, it contracts and moves back into the bulb, indicating a low temperature. Figure 3.7 shows a simple sketch for a thermometer (www.cimms.ou.edu, 2004).

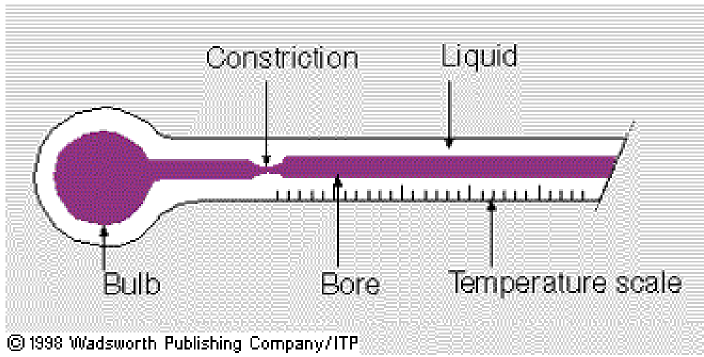


Figure 3.7 Thermometer (www.cimms.ou.edu, 2004)

A liquid-in-glass thermometer with a constriction is used to measure the maximum temperature. These thermometers are also used to measure the body temperature of humans. As the temperature increases, the liquid moves up into the bore; however, as the liquid cools, it cannot freely move downward again because of a constriction in the bore. In order to lower the liquid in the bore, it must be reset by applying a force to the thermometer sufficient to push the liquid bask into the bulb (www.cimms.ou.edu, 2004).

Highly accurate thermometers are electrical. They measure temperature by measuring the electrical resistance of some material. Since the resistance for these materials changes with temperature, the resistance can be measured and calibrated to the temperature.

Temperature is also measured from satellites in space through the use of a radiometer. This instrument measures the intensity of the radiation that impacts the satellite, usually infrared, that was emitted from a particular surface (the earth). The satellite is tuned to measure the amount of radiation emitted at a particular maximum wavelength. Knowing this wavelength for a particular gas (usually water vapor or carbon dioxide), and measuring the intensity of the emitted radiation, the temperature can be inferred.

Temperature measurements are typically taken at 1.5 m above grassy surfaces. The thermometer is housed in an instrument shelter that is away from materials that may absorb heat and affect an accurate air temperature reading. All air temperature readings are done in the shade. This is necessary in order to avoid excessive warming of the liquid in the thermometer because of the absorption of solar radiation. Instrument shelters allow for air to flow freely through the shelter in ensure that air within the shelter is not warmed locally by the shelter itself (www.cimms.ou.edu, 2004).

Daily, monthly and yearly temperature statistics for a station are produced using the daily maximum and minimum temperature. The mean daily temperature is defined as the average of the maximum and minimum daily values.

The general level of the temperature curves varies with the seasons. In the summer, the daily curve is high, showing warm temperatures. In winter, the curve is low, reflecting cold temperatures. In between are the equinoxes, with their intermediate temperatures (www.cimms.ou.edu, 2004)

As the earth revolves around the sun, the tilt of the earth's axis causes an annual cycle of variation in insolation. This causes an annual cycle to occur in mean monthly air temperatures.

Although the annual cycle of net radiation is the most important factor in determining the annual temperature cycle, another important consideration is location - maritime or continental. Places located well inland and far from oceans generally experience a stronger temperature contrast from winter to summer. The annual cycle of net radiation, which results from the variation of insolation with the seasons, drives the annual cycle of air temperatures (www.cimms.ou.edu, 2004).

Cold air is heavier comparing to warm air. Therefore, the heavier air sinks down and lighter air moves up thus creating airflow. (Güyagüler and Keskin, 1996) This airflow may increase dust concentration in air.

3.4.3 Relative Humidity

Humidity is moisture content of air. It has a significant effect on our environment. Humidity measurement gives us an opportunity to control these effects. Humidity is measured in terms of percentage in two different ways such as absolute humidity and relative humidity. Absolute humidity is percentage of moisture in air at a defined temperature (20 °C). Relative humidity is percentage of moisture in air at the ambient temperature. It indicates how moist the air is.

Relative humidity may be defined as the ratio of the water vapor density (mass per unit volume) to the saturation water vapor density, usually expressed in percent in Equation 3.1.

$$\textbf{Relative Humidity (RH)} = \frac{\text{(Actual Vapor Density)}}{\text{(Saturation Vapor Density)}} \times 100\% \quad (3.1)$$

Relative humidity is also approximately the ratio of the actual to the saturation vapor pressure as it is stated in Equation 3.2.

$$\textbf{RH} = \frac{\text{(Actual Vapor Pressure)}}{\text{(Saturation Vapor Pressure)}} \times 100\% \quad (3.2)$$

Actual vapor pressure is a measurement of the amount of water vapor in a volume of air and increases as the amount of water vapor increases. Air that attains its saturation vapor pressure has established equilibrium with a flat surface of water. That means, an equal number of water molecules are evaporating from the surface of the water into the air as are condensing from the air back into the water (www.atmos.uiuc.edu, 2004).

3.4.4 Rainfall

Rain and drizzle are the easiest forms of precipitation to measure. Rain gauges are used to measure liquid water depth and can be as simple as an open bucket with a consistent cross section throughout. Meteorologists however, use more accurate instruments and slightly more sophisticated gauges to measure rainfall.

In Figure 3.8, there is a sketch of standard bucket rain gauge, which magnifies the amount of rainfall through a simple cross sectional area conversion so that, more precise measurements can be made, especially for very small amounts of the rain. Typically the cross sectional area of the collector funnel is 10 times the cross sectional area of the inside tube. This allows rainfall to be magnified 10 times (www.vortex.plymouth.edu, 2004).

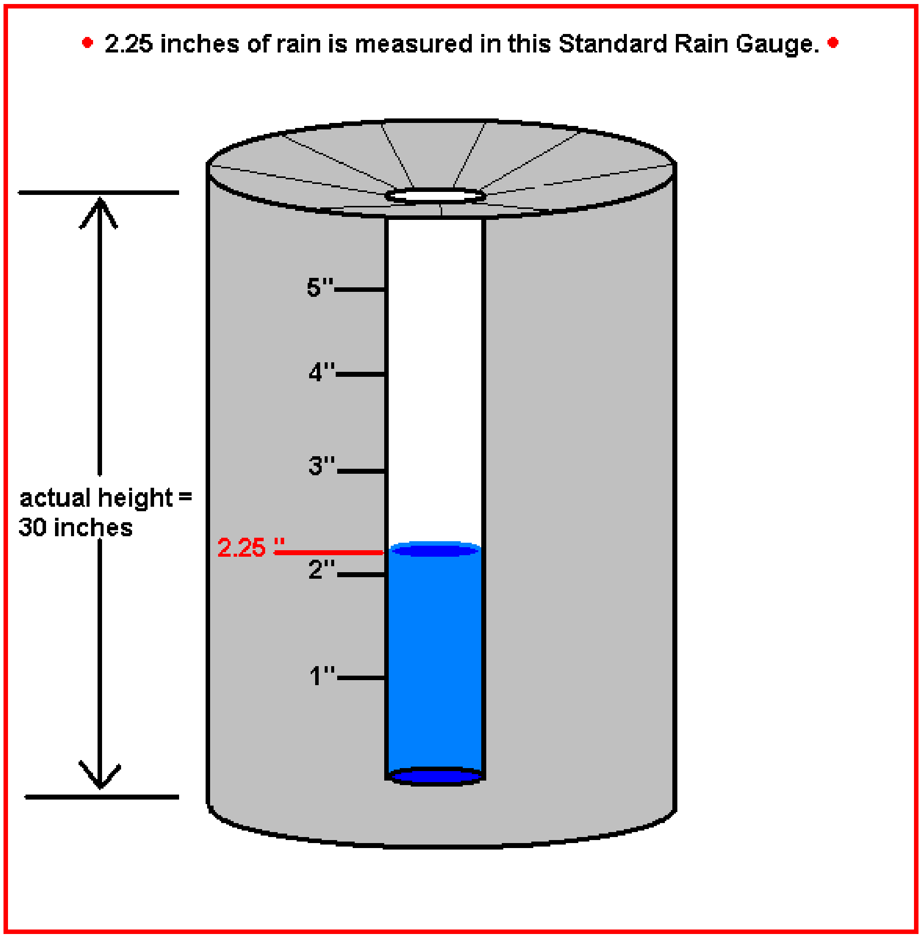


Figure 3.8 Standard bucket rain gauge
(www.vortex.plymouth.edu, 2004)

Another form of rain gauge is the tipping bucket gauge (Figure 3.9). This gauge uses a double sided scoop or bucket that pivots when full to dump out the rainfall. An electronic sensor feels every time the bucket tips each way and records the number of times that the buckets tip. The buckets hold a known amount of rainfall so that the amount of precipitation can be recorded along with the time of occurrence and intensity (amount of rain per unit of time) (www.vortex.plymouth.edu, 2004).

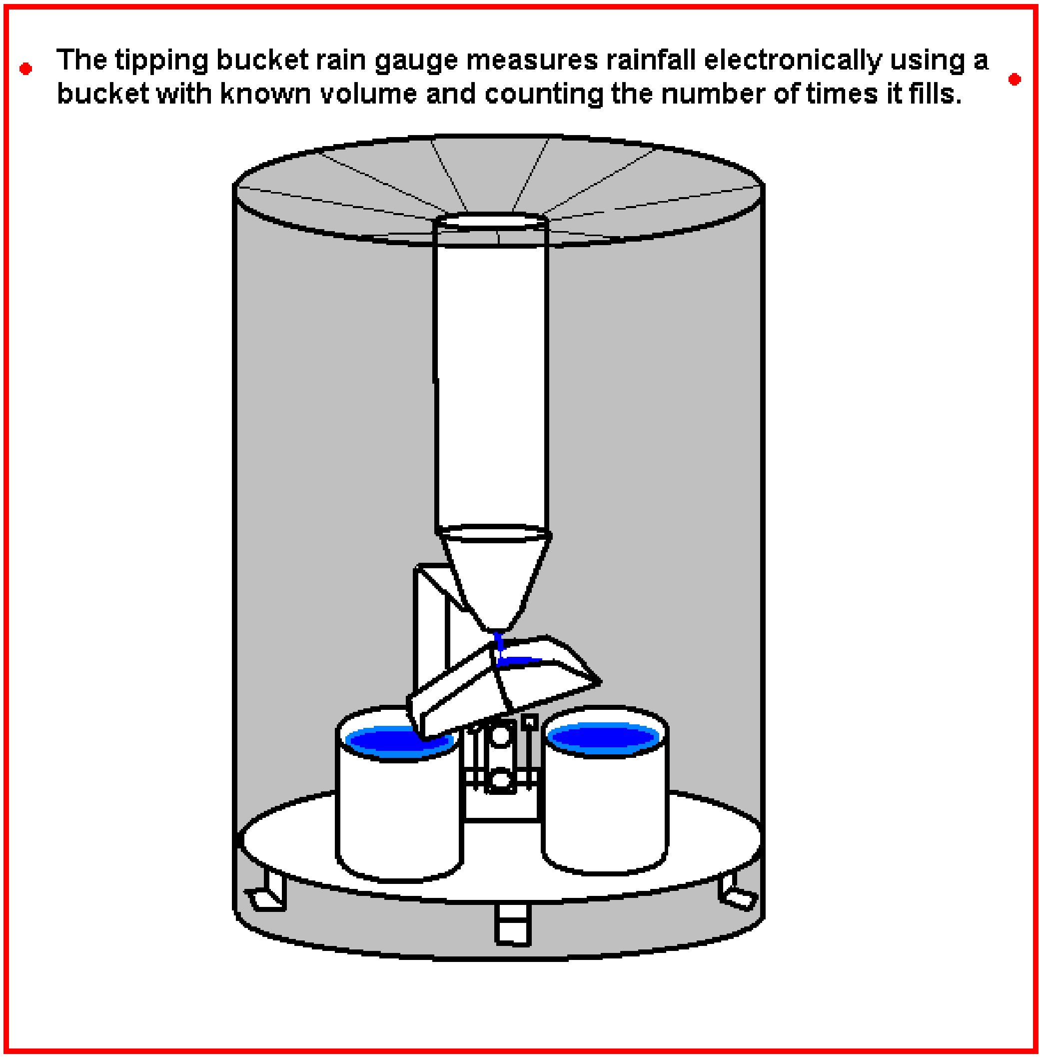


Figure 3.9 Tipping bucket gauge (www.vortex.plymouth.edu, 2004)

It is often useful to know when the most intense rainfall occured and exactly how intense it was. For example this information can allow meteorologists to get a feel for how much rain in a short amount of time will cause a flash flood (www.vortex.plymouth.edu, 2004).

Yet another form of rain gauge measures the weight of rain that has fallen and translates this to a vertical depth. This is called a weighing gauge and is very similar in design to the standard bucket rain gauge except for a weighing-scale located at the base (www.vortex.plymouth.edu, 2004).

3.4.5 Evaporation

At any given temperature, a certain number of the molecules in a liquid posses sufficient kinetic energy to escape from surface. This process is called evaporation or vaporization. (Chang, 1994)

Evaporation, the process by which water changes from a liquid to a gas by absorbing heat, tends to lower the temperature of a wet surface. Figure 3.10 gives a simple sketch for this process. In the case of wet soil, the latent heat absorbed by the liquid water is taken away from the surface as the water vapor molecules leave the soil and moves into the air layer above.

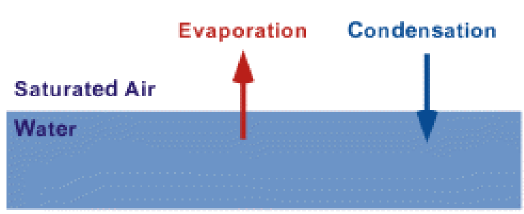


Figure 3.10 Evaporation process (www.atmos.uiuc.edu, 2004)

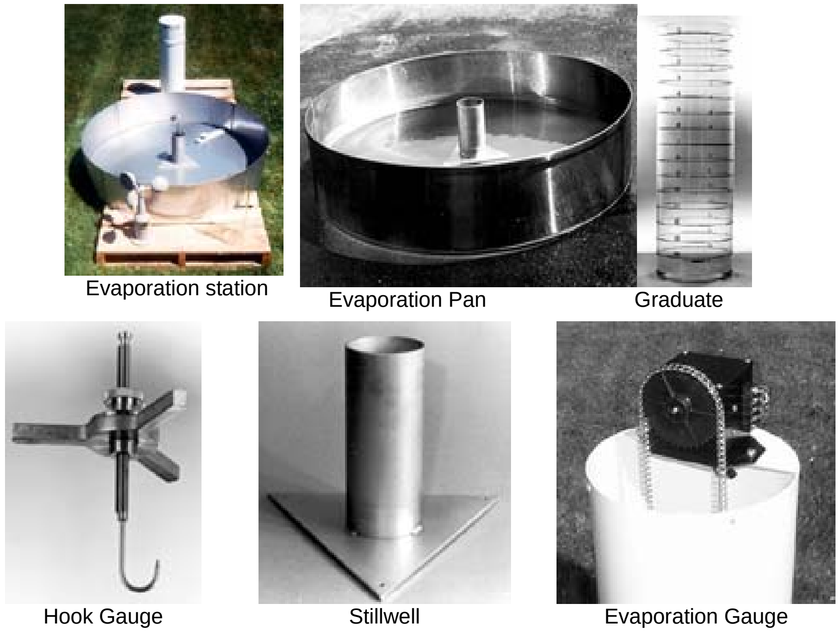


Figure 3.11 Evaporation measurement tools (www.novalynx.com, 2004)

Evaporation is measured in terms of mm, thickness of evaporated water at definite area. Figure 3.11 shows sample photos of evaporation measurement tools used at meteorology stations.

3.4.6 Sunshine

Sunshine Duration is the length of time for which the sun casts an obvious shadow or when a Campbell-Stokes sunshine recorder is recording. The lower limit for bright sunshine (based on a Campbell-Stokes recorder) is between 70 W/m^2 (very dry air) and 280 W/m^2 (very humid air). Sunshine is used interchangeably with the more precise term bright sunshine, when the sun casts an obvious shadow or when a Campbell-Stokes sunshine recorder is recording, usually above 210 W/m^2 (www. rredc.nrel.gov/solar/glossary, 2004).

3.4.7 Wind

Wind is air moving (sometimes with considerable force) from an area of high pressure to an area of low pressure Wind Speed (m/sec) is vector averaged over a 10 minute period. The Wind Speed and Direction are sampled every minute. The Wind Direction for each sample is used to derive the east (u) and north (v) vector magnitude components relative to Magnetic North. Both vector magnitude components are summed and averaged over the 10 minute period and then the resulting average Wind Speed and Wind Direction are calculated from:

$$\text{Wind Speed} = \text{square\_root}\ (u*u + v*v) \qquad (3.3)$$

$$\text{Wind Direction} = \arctan\ (u/v) \qquad (3.4)$$

The Wind Direction is denoted in the 8-points of the compass from which the wind is originating (http://lpo.dt.navy.mil, 2004).

Measurement of wind speed and wind direction is important in air quality monitoring. It can help identify the location of the source of the pollution, and also provide a better overall picture of what's happening in the air.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION OF RESULTS

Seven meteorological parameters, namely atmospheric pressure, air temperature, relative humidity, rainfall, evaporation, sunshine and wind speed are observed for a period of 29 months beginning from July 2001 ending at November 2003 together with airborne dust measured at three different stations. Airborne dust data are analyzed against meteorological parameters by drawing graphs and by statistical analyses.

4.1 Dust Measurement Procedure and Locations of Measurement Stations

At Ovacık Gold mine, dust measurement is done in two ways; suspended particulate dust and deposited dust. Suspended particulate dust measurement is done by using MP101M Beta Gauge. There are three stations, recording the airborne dust data hourly, which are located around the open pit; namely Beta Gauge (BG); BG1, BG2, BG3 (Figure 4.1). The photos of stations are given in Figure 4.2, 4.3 and 4.4. The elevations and the coordinates of suspended particulate dust measurement stations are given in Table 4.1. The sea level is referred to as 1000m elevation. As it is seen from the table, elevation difference between BG1 and BG2 is 28,72m, between BG1 and BG3 is 7.72m and between BG2 and BG3 is 21m. The highest elevation of dumping area is 1137,5 m. The elevation of the pit bottom on November 2003 was 1000m, whereas the highest elevation was 1095m at the beginning of mining operation in 2001.

Table 4.1 Elevation and coordinates of dust measurement stations.

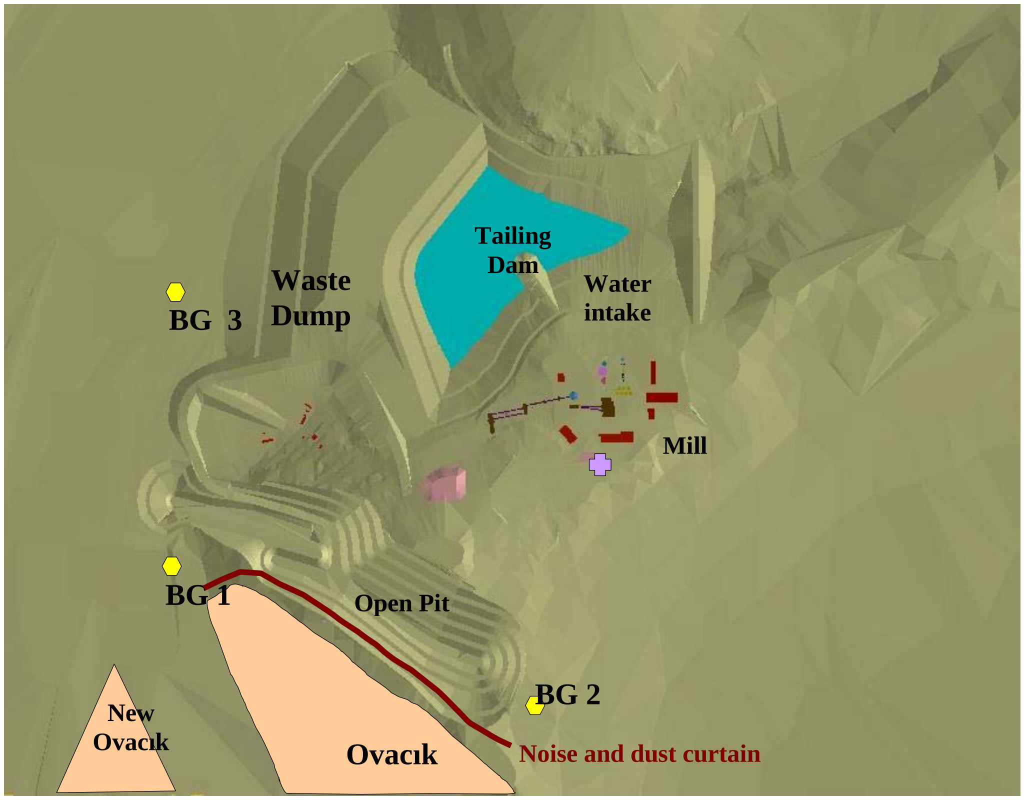
	BG1	BG2	BG3
ELEVATION	1038.28 m	1067.00 m	1046.00 m
X	5922,367	6475,960	5913,066
Y	7196,653	6999,824	7643,991

The airborne dust measuring stations that are shown in Figure 4.1 are marked by yellow color on the map. The elevation of BG2 is higher than the other two. BG1 and BG3 are approximately at the same elevation. There is 500 m long steep haul ramp from BG2 to BG1. Ring road passes by the stations. After the end of October 2003, haulage trucks coming from open pit gave up using ring road passing in front of BG2. As it is seen in Figure 4.1, BG2 is located at a hillside to the south of the eastern corner of the open pit, whereas BG3 is located at the junction of the roads to the south of waste dump. All trucks coming from open pit pass in front of BG3. There is separate MP101M Suspended Particulate Beta Gauge at each station. The gauge is located in a fiberglass guard hut. The height of sensor of gauge is 2,75m from ground level. The dust particles below 10 microns size are measured. It is adjusted for periodic measurement at 0-200 μg/m^3 range. Measurements are done at every hour, and the average of 24 hours data are recorded daily. The dust is measured in terms of micrograms per cubic meter (μg/m^3). The airborne dust data measured at each station are presented in APPENDIX A.

There is a meteorology station located at Ovacık Gold Mine. Meteorological data for the years 2001 and 2003 were taken from this station. However, 2002 data were taken from Bergama Meteorology station, which is 16 km distant to the Ovacık Gold mine, since there was a problem at meteorology station at Ovacık. The elevation and coordinates of meteorology station at mine site are shown in Table 4.2. It is shown by purple symbol in Figure 4.1. Air temperature, sunshine, evaporation, wind direction and speed, rainfall, relative humidity and atmospheric pressure are measured daily. Hourly wind speed and dominant wind direction are recorded. Meteorological data used in this thesis is given in APPENDIX B and C.

Table 4.2 Elevation and coordinates of meteorological data measurement station.

	METEOROLOGICAL DATA MEASUREMENT STATION
ELEVATION	1087
X	6657,350
Y	7382,666



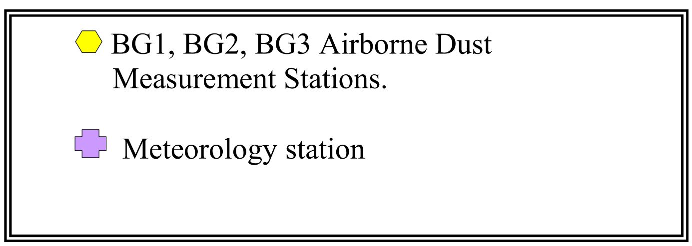


Figure 4.1 Airborne dust measurement stations
(www.ovacik-altin.com,2004)

Figure 4.2 General view of BG1 station

Figure 4.3 General view of BG2 station

Figure 4.4 General view of BG3 station

4.2 Meteorological Data Analysis

Meteorological data were recorded for the period beginning from July 2001 to November 2003 as daily averages. Atmospheric pressure, maximum air temperature, minimum air temperature, average temperature, humidity, maximum evaporation, rainfall, sunshine, maximum wind speed, and average wind speed are analyzed one by one on monthly basis.

In the figures, from Figure 4.5 to 4.12 and Figure 4.15 and 4.16, there is a separate graph drawn for each type of meteorological parameter on monthly basis for the analysis. A single maximum or minimum value obtained may not be representative for all data measured in that month. For that reason, besides absolute maximum or minimum, relative maximum and relative minimum data are also considered. Also monthly average data are shown in each graph.

4.2.1 Atmospheric Pressure

Atmospheric pressure data is daily average of hourly taken data at Ovacık Mine site. According to meteorological data taken from both Ovacık Mine site and Bergama Meteorology stations, atmospheric pressure shows sinusoidal fluctuations as seen in Figure 4.5. When it is analyzed carefully, generally an increase in the atmospheric pressure can be seen from July to January and a decrease from January to July for each year. This trend is observed consistently for all the years. Minimum values are seen in July and August such as 990 milibars (mb) and maximum values are observed in December and January such as 1025 mb on average.

The difference between the monthly relative maximum and relative minimum atmospheric pressures become lower (such as 8-12 mb) during summer months; whereas in winter, the difference becomes higher (such as 20-25 mb). It may be attributed to the various weather conditions such as air turbulence and temperature.

Absolute value of the atmospheric pressure is the highest during winter season whereas it becomes lowest during summer months.

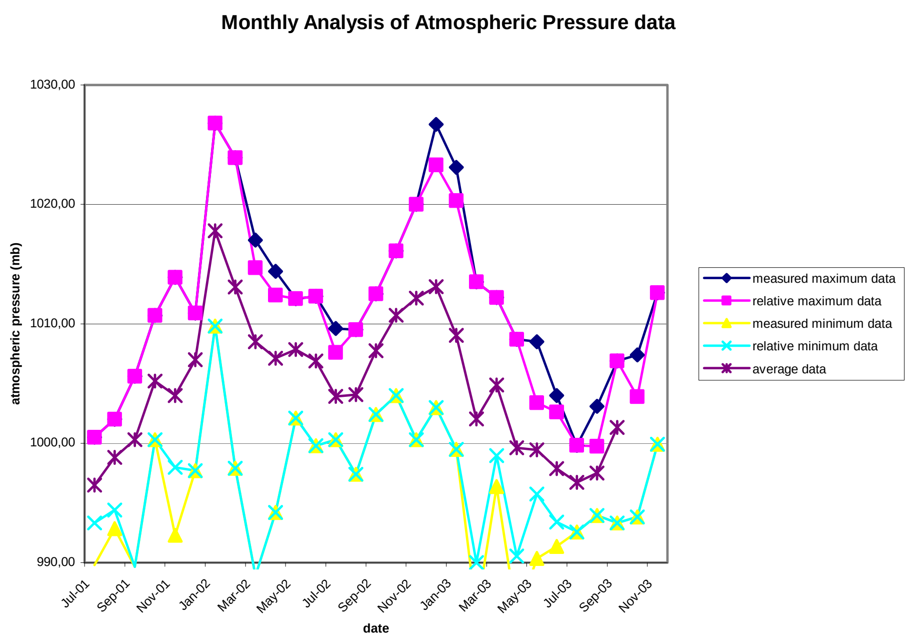


Figure 4.5 Variation of atmospheric pressure.

In hot days during summer the density of air decreases, and so does the pressure of air too. As air gets warmer it expands and becomes less dense, causing atmospheric pressure to fall. High pressure often represents stable air, while low pressure can signify instability.

As it is observed from Figure 4.5, there is higher atmospheric pressure due to denser air during winter months. There is a possibility in that the denser air may carry more particles and thus more suspended particulate dust may be measured. However the winter months represent heavy rainfall period in this region. Therefore, it can be said that the airborne dust concentration depends on several meteorological parameters.

4.2.2 Air Temperature

In terms of air temperature, there are three different data observed such as maximum air temperature, minimum air temperature and average air temperature. Maximum temperature is the maximum value measured on that day. Minimum temperature is the minimum measured value in the same day and average temperature is the average of the hourly measured values in a day.

Figure 4.6 shows monthly change of maximum air temperature measured. A sinusoidal fluctuation in the maximum air temperature is also observed. The measured maximum values are obtained in July and August such as 37, 5 °C on average, whereas the measured minimum values are measured in December and January. Average for the maximum air temperature from November to March is about 12 to 15 °C.

As it is observed from Figure 4.6, the difference between relative maximum and relative minimum in summer months is less than that of winter months due to continental climatic conditions. The monthly difference in maximum air temperature during summer months is about 10 °C, whereas that of winter months is 15°C to 20°C.

When the maximum air temperature rises, air gets hotter and lighter. Therefore, there appears one possibility in that the lighter air while raising creates a local upward air current so it may raise and suspend more dust.

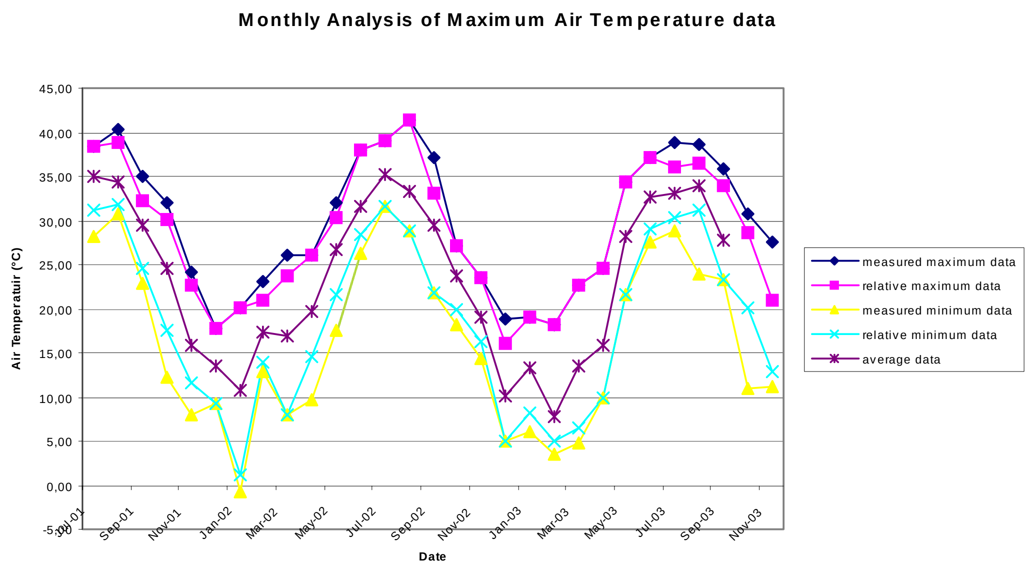


Figure 4.6 Variation of maximum air temperature

According to the airborne dust records, the suspended particulate dust amounts are lower during winter months where the average maximum temperature is about 12 °C to 15°C and they are higher during summer months where the maximum temperature is about 37, 5 °C. This fact supports the above mentioned hypothesis.

Minimum air temperature data is measured just about sunrise in a day. In that period no open pit mining activity take place. Figure 4.7 shows the same sinusoidal fluctuations in the monthly minimum air temperature recorded. A decrease is observed from July to January and an increase is seen from January to August for each year. Highest value is obtained as 26,61 °C in August, whereas the minimum value is seen as -4, 9 °C in January. From November to March, the average minimum air temperature varies between 2,5 °C to 7,5 °C . The difference between the highest and the lowest minimum air temperatures is greater in winter than summer.

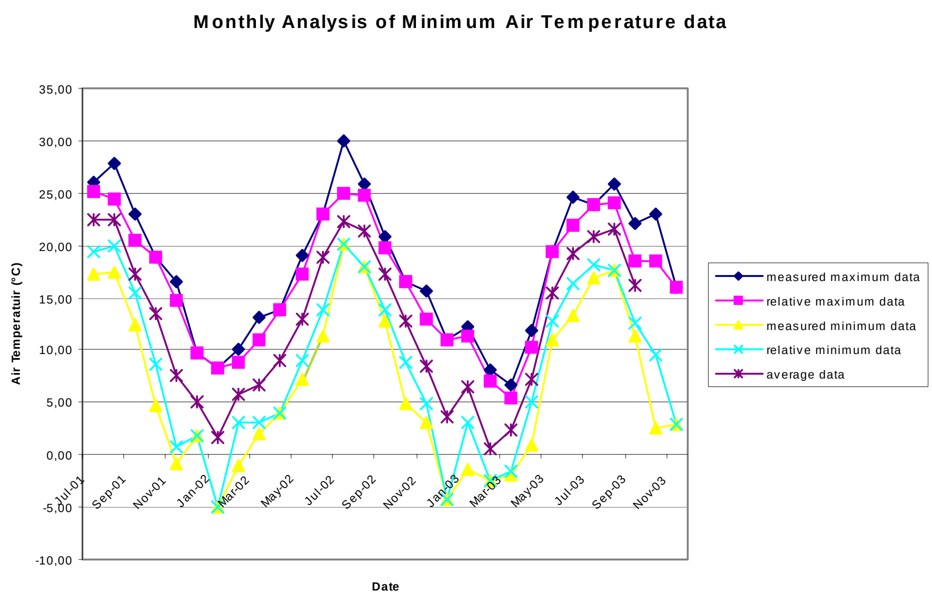


Figure 4.7 Monthly analysis of minimum air temperature data in terms of maximum and minimum per month

In Figure 4.8, which shows the monthly average air temperature variation, almost the same trend is observed with the previous graphs. The average air temperature also decreases from July to January and increases from January to July and August. Maximum value is 31 °C and minimum value is -2°C. Between November and March, the average air temperature does not change much and approximately is about 10 °C.

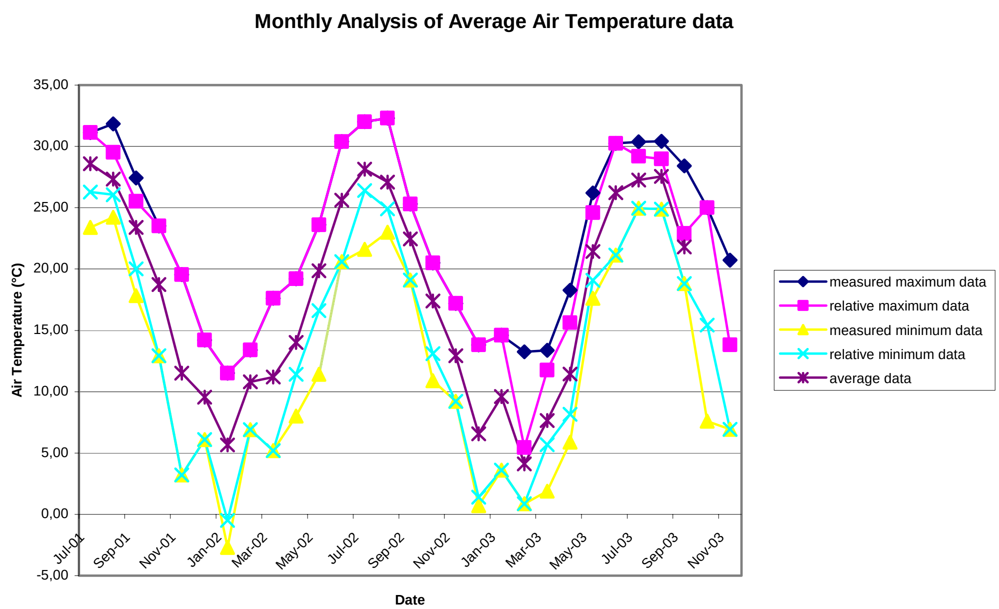


Figure 4.8 Monthly analysis of average air temperature data in terms of maximum and minimum per month

The variation of monthly air temperatures (including maximum, average and minimum) shows the same trends. In another saying, they reach highest absolute values in summer and the lowest absolute values in winter.

4.2.3 Relative Humidity

Humidity is moisture content of air. Although the humidity is measured in terms of percentage in two different ways such as absolute humidity and relative humidity, in this thesis, relative humidity data is used. Relative humidity is percentage of moisture in air at the ambient temperature.

Figure 4.9 shows humidity change in the period from July 2001 to November 2003 in terms of percentage. The same sinusoidal trend is observed periodically. The minimum relative humidity values are observed in July where the measured minimum is about 40%. During summer season, the average relative humidity measured is about 55% to 60%. There is a sharp increase in autumn months. The maximum value is measured on November 2001; the value is 97,34 %. Between November and April, the relative humidity is 75% on average. Relative humidity values are almost stable for both summer and winter periods, with sharp decrease at about May for each year.

When the relative humidity is higher as in the case of winter, the lowest airborne dust concentrations may be expected. Yassen (2000) says that the higher the relative humidity the greater the rate of settling of the dust from the atmosphere. But Yassen (2000) also states that a slight tendency is observed towards an inverse relationship between the two variables. In accordance with this, it can be expected that the airborne dust concentration could be higher in summer where the relative humidity is lower and the dust concentration could be lower in winter where the relative humidity is higher.

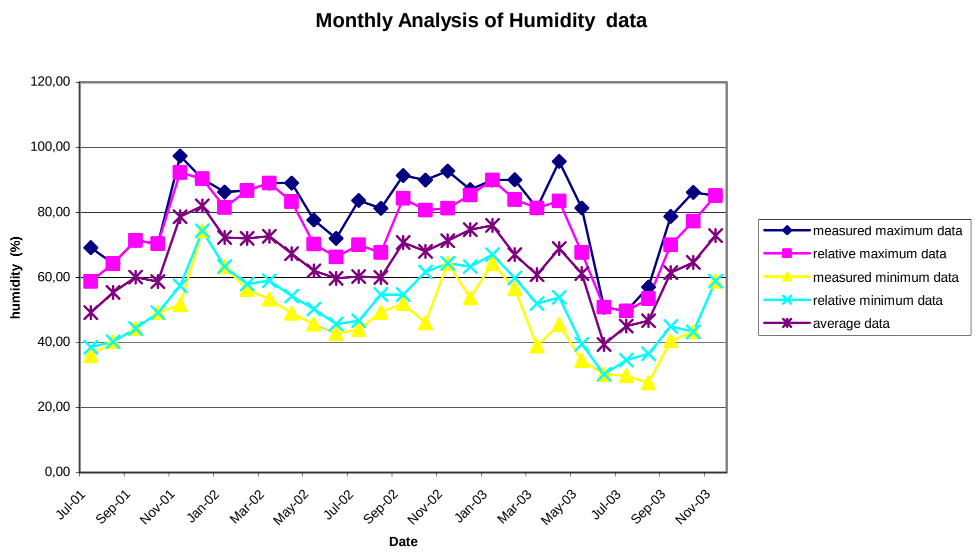


Figure 4.9 Monthly analysis of relative humidity data in terms of maximum and minimum per month

4.2.4 Rainfall

Rainfall is the total amount of rain measured in millimeter at the local station. Total rainfall data from July 2001 to November 2003 is given on monthly basis in Figure 4.10. Rainy season is from October to May. Maximum rainfall is observed in November such as 160 to 180 mm. Although the heaviest rainfall is observed in November and December, moderate rainfall occurs in the spring season. The similar seasonal variation can be observed in terms of total rainfall.

Theoretically it may be expected that the airborne dust amount could be lower during heavy rainfall period due to the fact that less amount of dust is formed at the source because of wetting of the soil, rock etc. materials. In other saying the dust emissions should be lower at the source due to watering by the mother nature. Another reason might be the reduction of the airborne dust through washout process during rainfall.

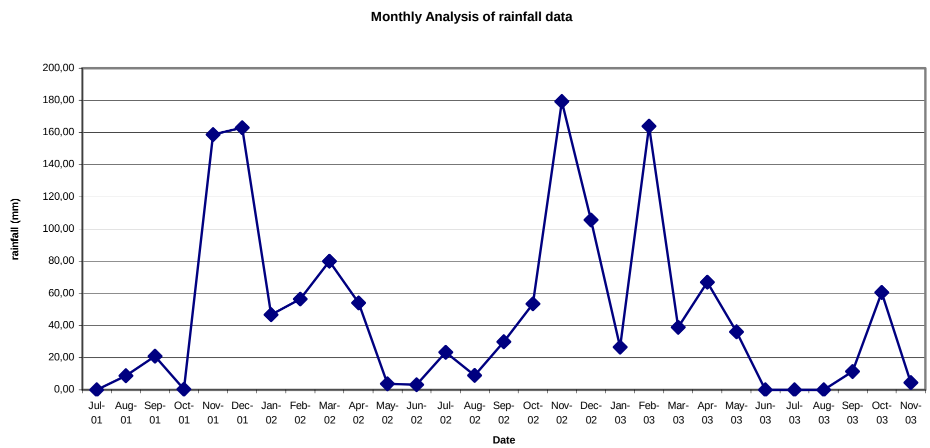


Figure 4.10 Monthly analysis of rainfall data in terms of maximum and minimum per month

4.2.5 Evaporation

Figure 4.11 shows evaporation data on monthly basis. It also approximates sinusoidal curve. There is a decrease from July (10,60mm) to November (1,7 mm). No evaporation is observed in the period from December to April. From April to June evaporation increases such as from 1,30mm to 10,40 mm. in 2002 and from 0,43 mm to 7,96mm in 2003.

As it is seen from Figure 4.11, since no evaporation is observed from December to April, this period corresponds to the heavy to moderate rainfall period (Figure 4.10). In addition, this period coincides with the minimum sunshine period (Figure 4.12).

When evaporation increases, upward air currents occur and it may lead to the better suspension of the dust. In summer days, as air temperature increases, evaporation increases and suspended dust amount may increase accordingly.

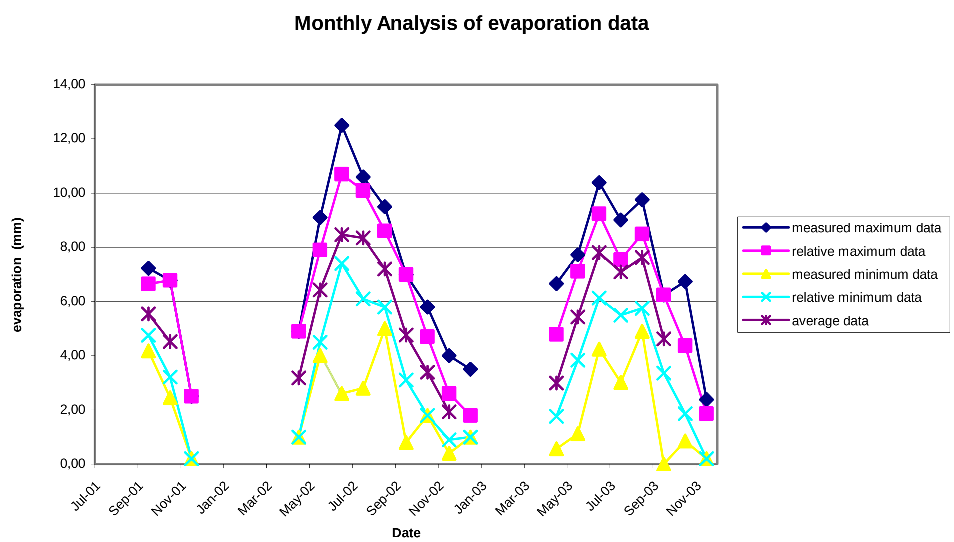


Figure 4.11 Monthly analysis of average evaporation data in terms of maximum and minimum per month

4.2.6 Sunshine

Sunshine data indicates total period of time that sun shines in a day. It is measured in terms of minutes. Figure 4.12 shows data measured during the observation period on monthly basis. A similar sinusoidal curve is obtained. Between September 2001, where the sunshine duration is 548 minutes and November 2001, where the sunshine duration is 180 minutes, there is a decreasing tendency. From January 2002, where the sun shines 150 minutes, to May 2002, where the sun shines 750 minutes, the sunshine duration increases. There is a stable period between May and August 2002 in terms of measured maximum sunshine at about 735 minutes. A decrease begins from the end of August 2002 with a value about 700 minutes to the end of December 2002 in which the sunshine duration is 480 minutes. In 2003 a maximum duration of 900 minutes is observed in March.

As it is seen in the Figure 4.12, from December to February, sunshine duration is low when compared to other months. This period coincides with the heavy rainfall period from December to April. When the sunshine duration gets longer, so does the solar radiation. Thus, the air temperature and the evaporation are expected to increase which may lead to increased amount of airborne dust.

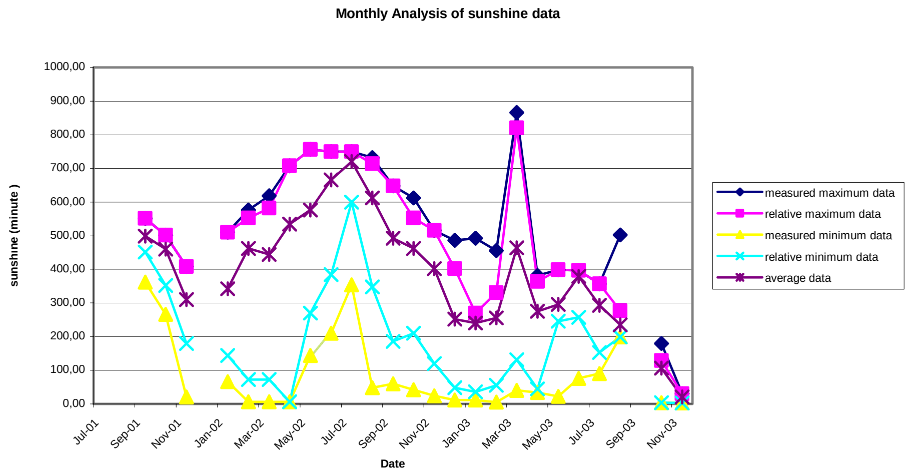


Figure 4.12 Monthly analysis of sunshine data in terms of maximum and minimum per month

4.2.7 Wind

Wind observations and measurements are recorded in terms of wind direction, maximum wind speed, and average wind speed. Wind speed does not have any meaning without direction. Daily dominant wind directions are determined after analyzing hourly wind direction data for 24 hours. Dominant wind directions may be expected to change according to weather conditions and also year by year.

Since the wind direction data was taken from Bergama meteorology station in the year 2002 due to a breakdown at the mine site's meteorology station, they are not considered in the analysis of airborne dust. The reason is that Bergama station is 16 km distant to the mine and it is located at a different topography. After analyzing the wind data for both stations, it is determined that the dominant wind direction is found to be NE and E, for Bergama station and SE and E for mine site station. This difference in the dominant wind directions is attributed to the difference in the topography.

Wind directions are recorded hourly in a day of 24 hours. If the wind blows from a certain direction for 8 hours or more in a day, that direction is defined as dominant wind direction. Hourly wind direction data is given in APPENDIX D.

The dominant wind directions determined at mine site meteorology station are stated below:

- NE dominant wind direction prevails in September and November for both 2001 and 2003,

- NW wind direction dominates in September, October, and November of 2001 and in October of 2003,

- SE was determined as dominant wind direction in March, June, July, August, September, October, and November of 2003,

- SW dominant wind direction prevails in August, October, and November of both 2001 and 2003,

- W wind direction dominates in August, September, October, November of 2001 and September and October of 2003

The statements made above are clarified by drawing a rose diagram (Figure 4.13) given below. Figure 4.13 is based on 425 observations for the daily dominant wind directions measured at mine site. Rose diagram shows the percentage of daily dominant winds blowing in different directions so that the dominant wind directions prevailing at mine site can be determined visually.

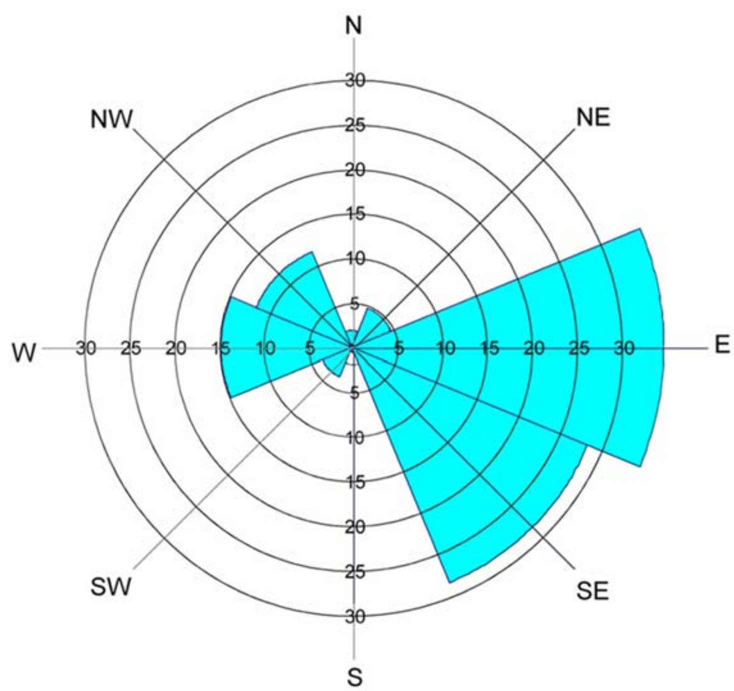


Figure 4.13 Rose diagram showing the dominant wind directions at mine site

As it is seen from the rose diagram, the prevailing wind directions at the mine site are SE and E. The influence of the wind direction on the airborne dust will be analyzed in two ways: one irrespective of the dominant wind direction and the second taking the dominant wind direction into account.

Wind direction is expected to affect the amount of airborne dust with respect to the location of station and dust source. BG1 is located at near to the Southwest corner of the open pit. Therefore, winds blowing from East, Northeast, and North West direction may carry the dust towards BG1. Winds blowing from North West and West may carry the airborne dust towards BG2. Winds blowing from South, South East and East direction may increase the dust amount measured at BG3.

The maximum wind speed is the highest speed among the wind speeds measured in a day at every minute. Average wind speed is the average of the wind speeds measured in a day. They are measured in terms of meter per second. Variation of the maximum and the average wind speeds is explained in Figures 4.14 and 4.15 respectively on monthly basis.

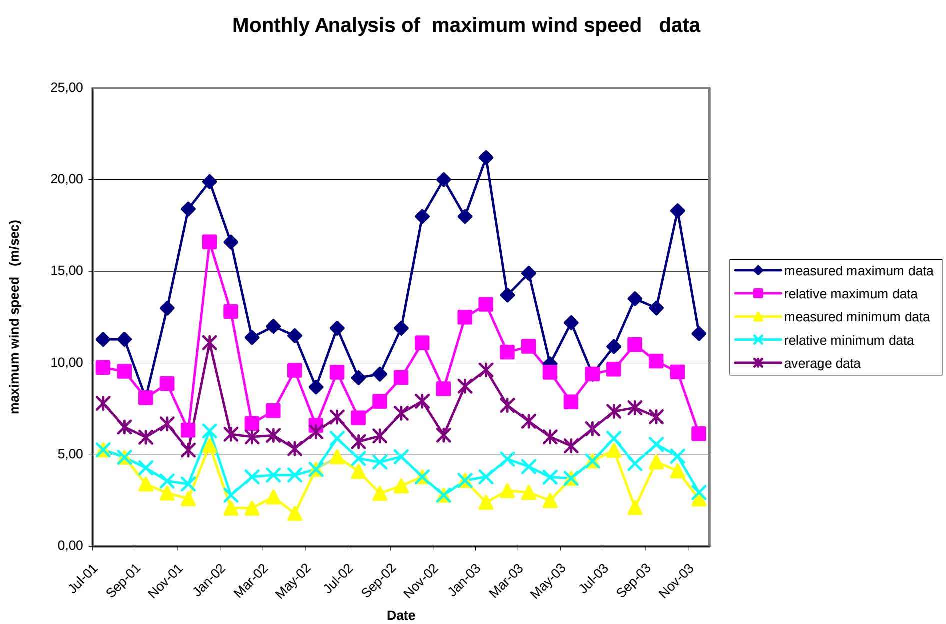


Figure 4.14 Monthly analysis of maximum wind speed data in terms of maximum and minimum per month

As it is seen in Figure 4.14, the highest values of maximum wind speed are observed in the period from November to March. In this period, the difference between measured maximum and measured minimum values is also high.

The maximum wind speed varies seasonally, that is represented by a sinusoidal curve. The highest maximum wind speeds are recorded in November and December as 20 m/sec, which corresponds to 72 km/h. Average of maximum wind speeds is 7 m/sec (25.2 km/h).

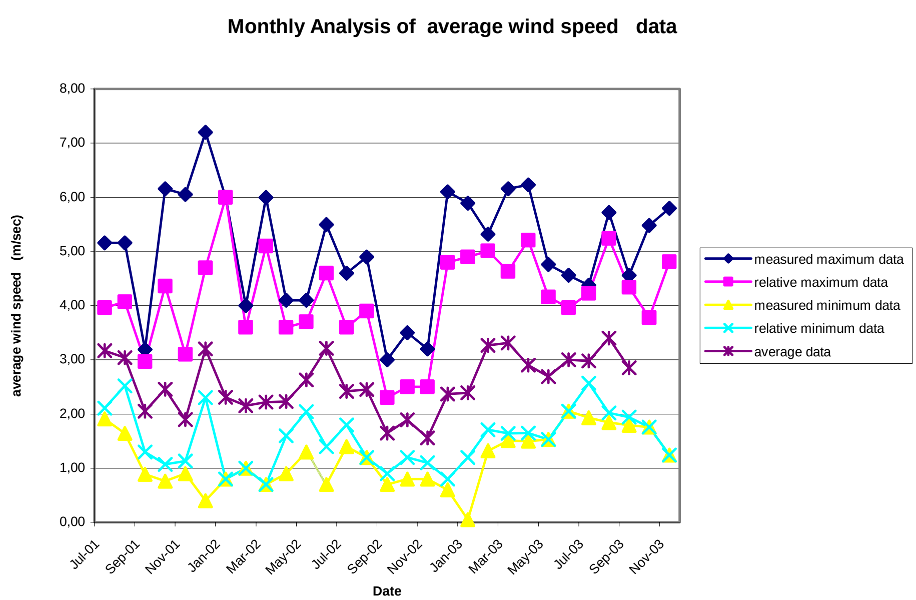


Figure 4.15 Monthly analysis of average wind speed data in terms of maximum and minimum per month

Figure 4.15 illustrates the seasonal change in average wind speed. The mean average wind speed is 2.5 m/sec (9 km/h). The highest average wind speeds are recorded as 6 m/sec (21.6 km/h) and 7 m/sec (25.2 km/h) in November 2001 and March 2003 respectively.

4.3 Airborne Dust Data Analysis

4.3.1 Average Airborne Dust Concentration

The airborne dust amount is measured at every hour at each station. The daily dust amount for each station is the average of 24 records. The average airborne dust concentration prevailing at the mine site can only be provided by combining the airborne dust data from all stations. Therefore, Figure 4.16 is drawn on monthly basis by combining the daily airborne dust amounts from all three stations, namely BG1, BG2 and BG3.

As it is seen from Figure 4.16, the mean average airborne dust amount is 75 $\mu g/m^3$ in July 2001 which corresponds to the start of open pit mining. It falls down to 25 $\mu g/m^3$ in December 2001. This indicates a decrease in average dust amount between summer and winter. The curve drawn for the mean of average airborne dust concentration shows fluctuating trend. In general, the average airborne dust concentrations are comparatively higher during summer months and lower during winter months with some exceptions. The critical months in terms of average dust concentration which either defines the trend or disturbes the trend are shown in Table 4.3. In Table 4.3 red numbers indicate the decrease,

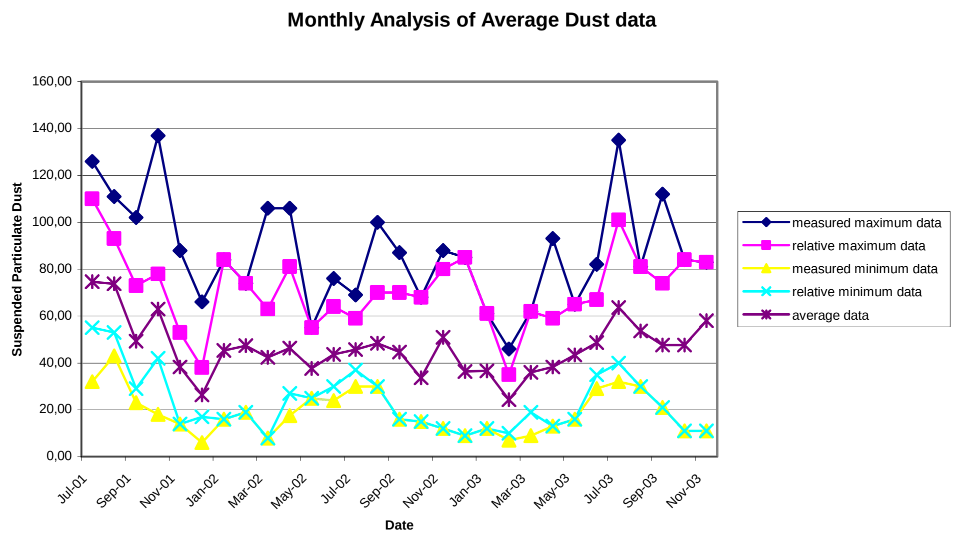


Figure 4.16 Monthly analysis of average dust data in terms of maximum and minimum per month

whereas the black ones show the increase in dust amounts with respect to previous month. On the other hand, the difference, between the highest (measured maximum) and the lowest (measured minimum) average airborne dust concentrations is greater during summer and is smaller in winter season.

Table 4.3 Critical average dust data defining the trend variation

DATE	Average dust concentration(µg/m³)
December 2001	27
August 2002	50
October 2002	34
November 2002	53
February 2003	24
July 2003	63

4.3.2 Airborne Dust Concentration Measured at BG 1

Figure 4.17 shows amount of airborne dust measured at the station BG1. A similar fluctuating trend is observed also in this figure, as in the case of Figure 4.16. In general, comparatively higher amounts of dust is measured during summer months and the lower amount of dust occur during winter months. The average airborne dust amount at station BG1 is about 46 μg/m³.

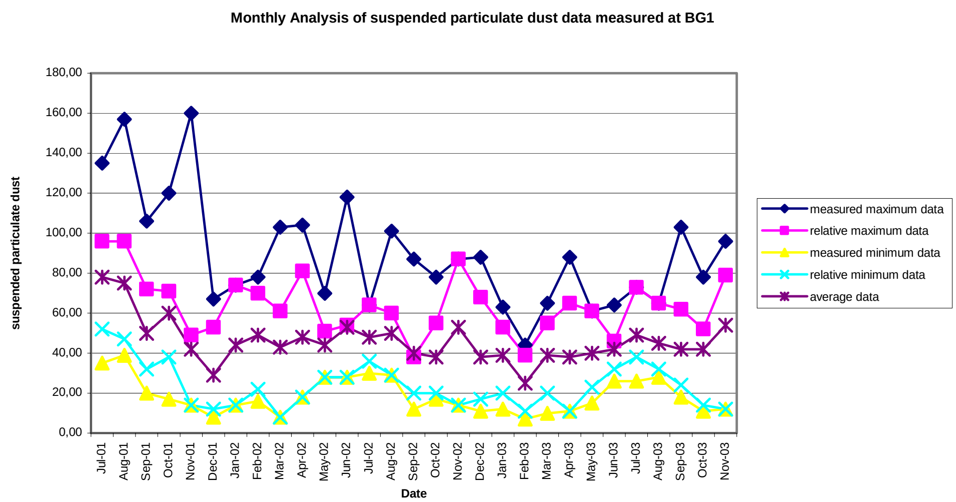


Figure 4.17 Monthly analysis of dust data measured at BG1 in terms of maximum and minimum per month

The critical dust amounts measured at station BG1, which causes fluctuating tendency to occur, are given in Table 4.4.

Table 4.4 Critical average dust data measured at station BG1

DATE	Dust Concentration at BG1 (μg/m³)
December 2001	30
June 2002	54
November 2002	57
February 2003	23
July 2003	45

4.3.3 Airborne Dust Concentration Measured at BG 2

The variation of airborne dust amount measured at station BG2 is shown in Figure 4.18. The station BG2 is located at a higher elevation than the other stations. Probably due to this fact, the average airborne dust amount measured at station BG2 is about 47 μg/m³. The average airborne dust amount measured at station BG2 does not show sharp fluctuations when compared to station BG1. The critical average dust amounts measured at station BG2, which cause local maxima or minima in the curve are given in Table 4.5. When Tables 4.4 and 4.5 are compared, there are four common months in which the average airborne dust amount changes the trend.

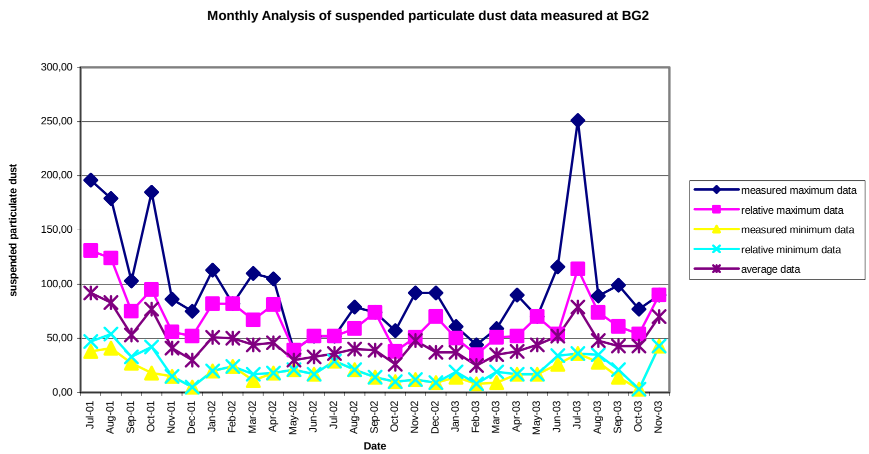


Figure 4.18 Monthly analysis of dust data measured at BG2 in terms of maximum and minimum per month

Table 4.5 Critical average dust data measured at station BG2

DATE	Dust Concentration at BG2 (µg/m³)
December 2001	30
May 2002	30
October 2002	25
November 2002	50
February 2003	25
July 2003	80

4.3.4 Airborne Dust Concentration Measured at BG 3

The variation of airborne dust amount measured at station BG3 is given in Figure 4.19. Although a similar fluctuating trend is observed, it is smoother when compared to that of station BG1. BG3 is located at the junction of roads and next to the waste dump. Probably due to this fact, a comparatively higher average dust amount may be expected. However surprisingly, the mean value for a period of 29 months is found to be 46 μg/m³, which is almost the same with that of other stations.

On the other hand, the measured maximum dust amount for station BG3 is comparatively higher than that of the others.

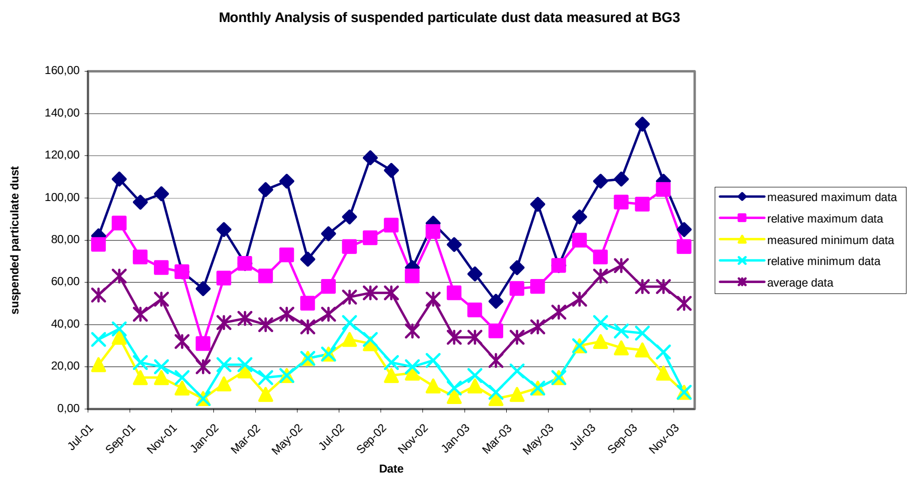


Figure 4.19 Monthly analysis of dust data measured at BG3 in terms of maximum and minimum per month

The critical dust amounts measured at station BG3, which causes fluctuating tendency to occur, are given in Table 4.6. Among the six months given in Table 4.6, which either support or disturb the trend, there are three months, namely December 2001, November 2002 and February 2003, that are commonly observed in the Tables 4.4, 4.5 and 4.6.

Table 4.6 Critical average dust data measured at station BG3

DATE	Dust Concentration at BG3 (µg/m³)
December 2001	20
July 2002	57
October 2002	37
November 2002	52
February 2003	23
August 2003	68

4.3.5 Analysis of Variation of Airborne Dust Amounts with respect to Meteorological Parameters

When the airborne dust data is analyzed in whole, it is seen that the dust amounts are low in some months and high in some other months. These months are called as critical months. The most critical months, in terms of variation of average dust amount at each station, are given in Table 4.7. In Table 4.8 and 4.9, the meteorological parameters measured are presented for the critical months when these variations in dust amounts occur.

In December 2001, low airborne dust concentrations are measured at all three stations with an average of 27 **µg/m³** (Table 4.7). This month also corresponds to heavy rainfall period with a value of 162 mm (Table 4.9). At the same time, the air temperature is at low levels and the relative humidity is at high levels in December 2001 (Table 4.8). In February 2003, the amount of dust is at lowest levels at all three stations

Table 4.7 Critical months in terms of airborne dust amounts

DATE	BG1 (μg/m³)	BG2 (μg/m³)	BG3 (μg/m³)	AVERAGE (μg/m³)
December 2001	30	30	20	27
May 2002	43	30	40	38
June 2002	54	35	45	45
July 2002	48	40	57	48
August 2002	50	43	58	50
October 2002	40	25	37	34
November 2002	57	50	52	53
February 2003	23	25	23	24
July 2003	45	80	63	63
August 2003	43	50	68	54

Table 4.8 Values of meteorological parameters measured in critical months (1)

DATE	Atm.pressure (mb)	Max Air Temp. (°C)	Min Air Temp. (°C)	Avg. Air Temp. (°C)	Humidity (%)
December 2001	1007	14	5	10	81
May 2002	1008	27	13	20	60
June 2002	1007	32	19	25	60
July 2002	1003	35	22	28	60
August 2002	1003	34	21	27	60
October 2002	1011	24	12	17	68
November 2002	1012	19	7	13	70
February 2003	1002	7	1	4	62
July 2003	997	33	21	26	47
August 2003	998	34	22	27	42

with an average value of 24 **μg/m³** (Table 4.7). The rainfall and the relative humidity are high, whereas the air temperature is low in February 2003 as it is the case in December 2001.

In addition to these meteorological parameters, no evaporation is observed in these months (Table. 4.9). Therefore it can be concluded that high rainfall, high humidity, low air temperature and no evaporation are the factors affecting the low dust amount.

Table 4.9 Values of meteorological parameters measured in critical months (2)

DATE	max wind speed (m/sec)	avg wind speed (m/sec)	Evaporation (mm)	Sunshine (min)	Rainfall (mm)
December 2001	10,5	3,1	0	0	162
May 2002	6	2,7	6,43	576	3
June 2002	7	3,2	8,47	666	3
July 2002	6	2,5	8,35	720	23
August 2002	6	2,5	7,21	612	10
October 2002	7,5	1,9	3,39	462	57
November 2002	6	1,5	1,93	402	180
February 2003	7,5	3,3	0	256	164
July 2003	7	3	7,09	293	0
August 2003	7	3,3	7,63	235	0

In May and October 2002 also, comparatively lower dust amounts are observed at all stations (Table 4.7). The specialties of these months are moderate temperature and low rainfall with a relative humidity about 60 %. Evaporation is also moderate. Average wind speed is comparatively low. Therefore, comperatively higher humidity, moderate to low temperature, and comparatively low average wind speed seem to be the affecting parameters leading to low airborne dust.

In June, July, August, and November of 2002, and July and August 2003, average dust amount varies from 45 μg/m³ to 63 μg/m³ as high values (Table 4.7). Except November, these months belong to summer season. The measured values, for some meteorological parameters, are common in each month. In these months air temperature, evaporation, and sunshine are high, whereas the rainfall is minimum except November 2002. Air temperature, evaporation, and sunshine are affecting parameters on dust amount. Increase of dust in November 2002 is probably due to insufficient preventive measures taken in this month.

During summer season, sunshine duration gets longer and solar radiation increases. Due to this fact, the air temperature increases, so that the air gets lighter. The lighter air creates upward air currents. On the other hand, the solar radiation results in increased evaporation. Therefore it is thought that the maximum air temperature correlates best with the suspended dust amount since it controls the local air currents to a greater extend. Accordingly, the highest airborne dust amounts are measured during summer times and the lowest ones are measured during winter times.

When comparing the suspended dust amount with relative humidity, it is clearly observed that, relatively lower or the least amount of suspended dust occurs when the relative humidity is high such as in winter months. The highest airborne dust amounts are measured during summer times when the relative humidity is comparatively lower or the lowest. It is thought that when the dust particles below 10 micron are wetted, they are more likely settled rather than being suspended.

The least amount of suspended dust is measured either in the winter or in the spring, which coincides with the rainy period for North Aegean region. It is thought that the formation of the dust at the source becomes difficult and hence the lower dust emissions could be expected in rainy periods. On the other hand, the airborne dust is washed out when it is raining. Thus the settlement of the suspended dust results in low airborne dust amounts during rainy seasons.

The minimum suspended dust amounts measured in the period from December to February coincide with the no evaporation period. The increased evaporation is measured during summer with the highest observed in July.

When the sunshine is considered, it can be said that it increases the air temperature and the evaporation through solar radiation. During the rise of heated air and evaporation, since there occur local upward air currents, the likelihood of the dust to be kept in suspension increases. Since the higher airborne dust is measured when the sunshine duration is longer, it can be concluded that the sunshine influences the airborne dust amount to some extent.

4.3.6 Analysis of Influence of Wind on Airborne Dust

Measurement of wind speed and wind direction is important in the analysis of airborne dust and in air quality monitoring. It can help identify the location of the dust source, to determine the dispersion patterns and also provide a better overall picture of what's happening in the air at the site under consideration. For this reason, the maximum and the average wind speeds measured at the mine site are analyzed in detail in two ways: one irrespective of the dominant wind direction and the second taking the dominant wind direction into account. The airborne dust concentration is analyzed with respect to average wind speed (Figure 4.20) and maximum wind speed (Figure 4.21) only, without taking the dominant wind direction first. Then the airborne dust concentration is analyzed with respect to average wind speed (Figure 4.22) and maximum wind speed (Figure 4.23) taking the dominant wind direction into account.

It is seen from the Figure 4.20 that, the airborne dust concentration increases slightly but consistently at all stations up to an average wind speed of 2,5-3,0 m/s, beyond this, the measured dust concentration shows a decreasing trend with some exceptions.

The highest airborne dust concentrations are measured at the lowest maximum wind speeds (Figure 4.21). As the maximum wind speed increases the airborne dust concentration begins to decrease first, and then it increases again and it makes a local peak at maximum wind speeds at about 6-7 m/sec. Beyond this value, it decreases consistently at all stations with the increase in maximum wind speed.

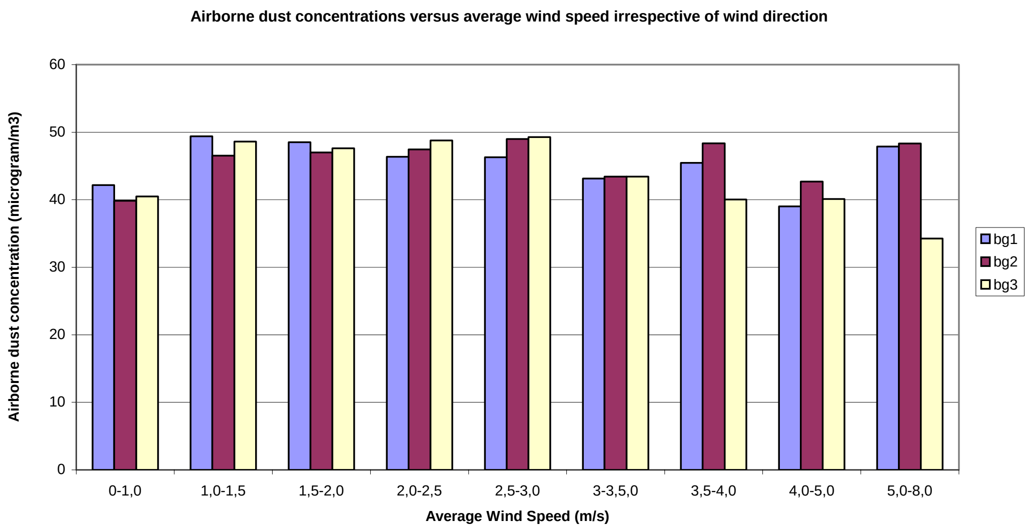


Figure 4.20 Airborne dust concentration versus average wind speed irrespective of wind directions

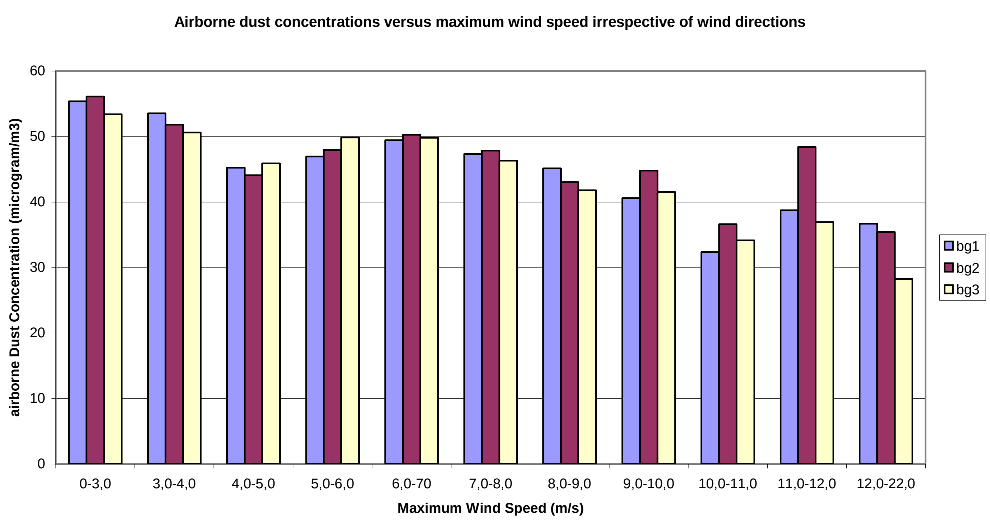


Figure 4.21 Airborne dust concentration versus maximum wind speed irrespective of wind directions

Figure 4.20 and Figure 4.21 show that the airborne dust concentrations at all three stations remain almost the same when the data analyzed irrespective of the wind direction. When the airborne dust concentrations measured at the lowest wind speeds presented in Figure 4.20 and 4.21 are compared, it is concluded that the maximum wind speed is more important than the average wind speed. This is because, maximum wind speed controls the dust to be kept in suspension better, since it creates a turbulence and disturbs the calm air.

When the Figure 4.22 is analyzed, it is seen that the highest airborne dust concentrations are measured at station BG3, which remains at downwind direction. The airborne dust measured at BG2 is always lower than that of BG3, since BG2 remains at the upwind side.

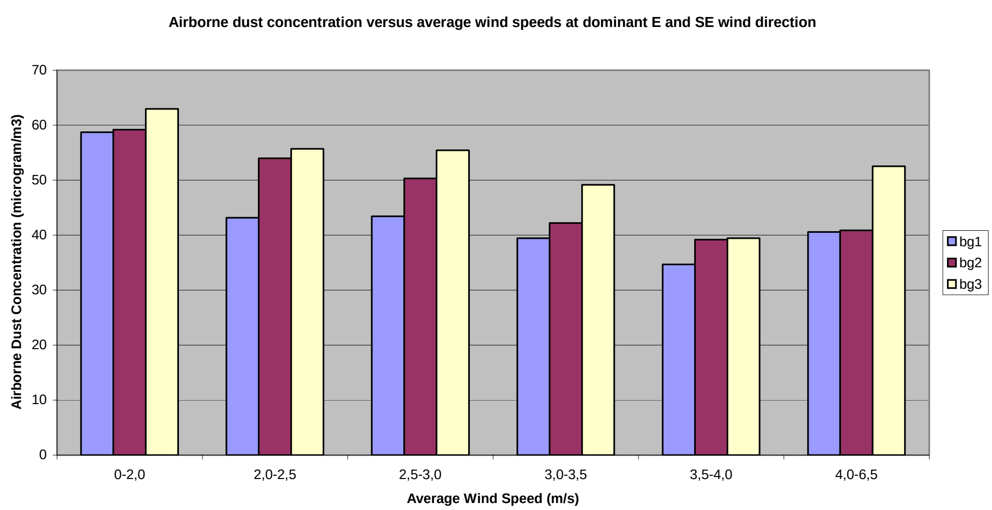


Figure 4.22 Airborne dust concentration versus average wind speed at dominant, E and SE, wind directions

Another finding from the Figure 4.22 is that the measured airborne dust concentrations at all three stations decrease as the average wind speed increases in a consistent manner. This is attributed to the dispersion of the airborne dust at high average wind speeds.

Figure 4.23 explains the variation of airborne dust concentration with the maximum wind speed at dominant, E and SE, wind directions. The figure shows that airborne dust concentration measured at the station BG3 is always greater than that measured at the station BG2. This is due to the fact that BG2 remains at the upwind side, whereas the BG3 falls to the downwind side with respect to dominant wind direction. The same trend was observed in the case of average wind speed (Figure 4.22) also.

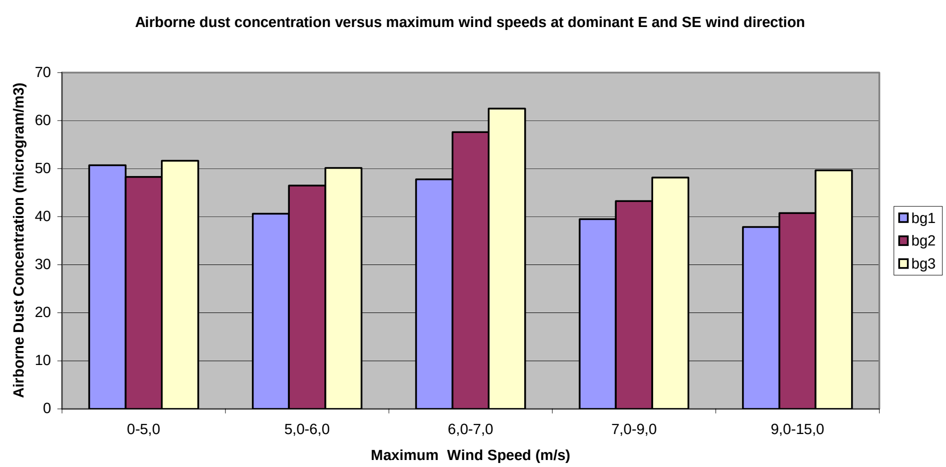


Figure 4.23 Airborne dust concentration versus maximum wind speed at dominant, E and SE, wind directions

The airborne dust concentrations measured at all three stations first begins to decrease and then increases again and reaches a local peak value at maximum wind speed about 6-7 m/s (Figure 4.23). Beyond this maximum wind speed, the dust concentration shows a continuous decrease. This tendency was also observed in Figure 4.21 where the graph is drawn irrespective of the dominant wind direction. This fact leads to the following conclusions:

- The influence of the maximum wind speed is much greater than that of the dominant wind direction.
- The local maximum in the airborne dust concentration occur at a maximum wind speed of 6-7 m/sec both in Figure 4.21, and Figure 4.23. Therefore, it is concluded that :

    - For Ovacık Gold Mine site, the most critical maximum wind speed that keeps the dust in suspension is 6-7 m/s.
    - At maximum wind speeds higher than this, the airborne dust is dispersed and the measured concentrations are decreased.

4.3.7 Analysis of the Relationship Between Airborne Dust Concentration and Open Pit Production

It is expected that the dust concentration is related closely with the production amount including overburden removal, unless there is other affecting parameter such as preventive measure against dust. To analyze this relation, the dust concentration measured at each station is compared with waste and ore production on monthly basis. Figure 4.24 shows monthly waste, ore and total production done during the period from July 2001 to November 2003. Unit for production is bank cubic meter (bcm).

As it seen from Figure 4.24, production increases during summer and decreases in winter due to seasonal effects on mining activities such as rain. The period, in which the production is low (Figure 4.24), corresponds to the heavy rainfall period (Figure 4.10). Ore production shows a stable trend. It depends on vein thickness and amount of overburden to be removed. A sharp decrease in waste volume removed between May 2002 and February 2003 is due to especially rainy season.

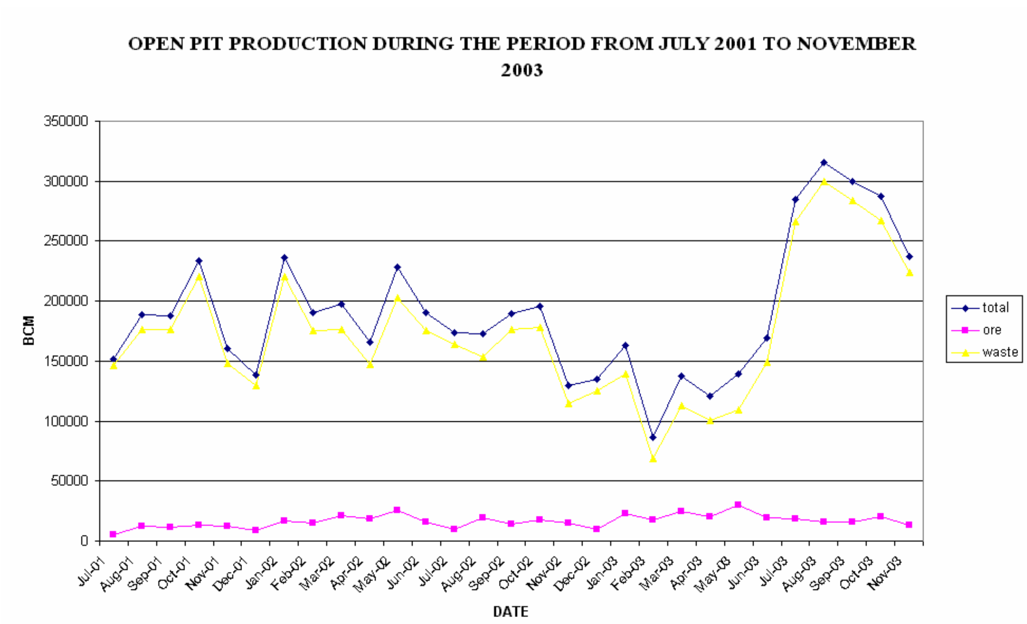


Figure 4.24 Open pit production during the period from July 2001 to November 2003

A sharp increase in overburden excavation is observed between February 2003 and August 2003. Since there is thick and wide overburden overlying the ore, high volume waste excavation took place in this period to supply enough ore to the mill at the defined monthly feeding rate.

Figure 4.25 shows the relation between the dust concentration measured at BG1 and the production. The amount of dust that can be measured at a station depends strongly on the distance between the dust source and the measurement station and the relative position of the station with respect to dust source. The dust station BG1 is located at near to the Southwest corner of the open pit (Figure 4.1). It catches the dust carried towards Ovacık village. At the beginning of mining operations, it is almost at the same elevation with the open pit. High dust amount measured in that period is due to this reason. When the open pit went deeper, the elevation of BG1 became higher with respect to open pit. Haulage road passes just in front of BG1. Dust measured at BG1 is strongly arising from the haulage and the blasting operations.

As it is observed from Figure 4.25, dust concentration is directly proportional to waste excavation during the periods from September 2001 to February 2002 and from December 2002 to July 2003. When the ore production is considered, the dust concentration and the ore production have similar trends in the period from July 2002 to October 2002 in addition to the periods mentioned above for waste excavation.

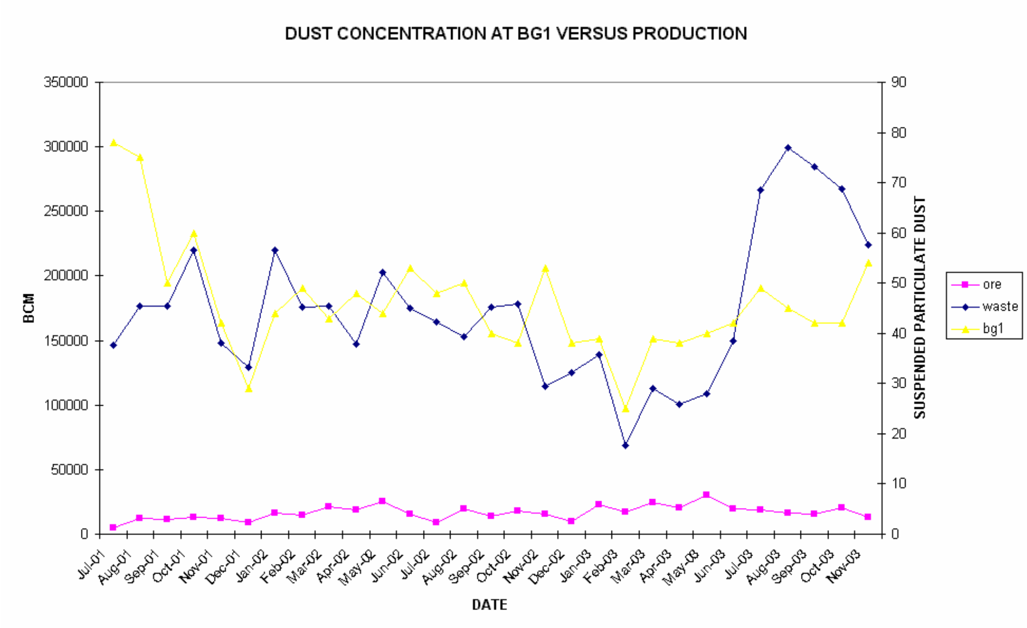


Figure 4.25 Dust concentration at BG1 versus production

Figure 4.26 shows the waste and ore excavation amounts on monthly basis together with the dust concentration measured at station BG2. BG2 is located at near the Southeast corner of open pit (Figure 4.1). It is the station having the highest elevation. It is much closer to the open pit than the other stations.

As it is seen in Figure 4.26, dust concentration is directly proportional to waste production during the periods from September 2001 to February 2002, from December 2002 to March 2002 and from December 2002 to May 2003. In addition to this, during May 2002 and the period from July 2003 to September 2003 dust concentration is also directly proportional to the ore production.

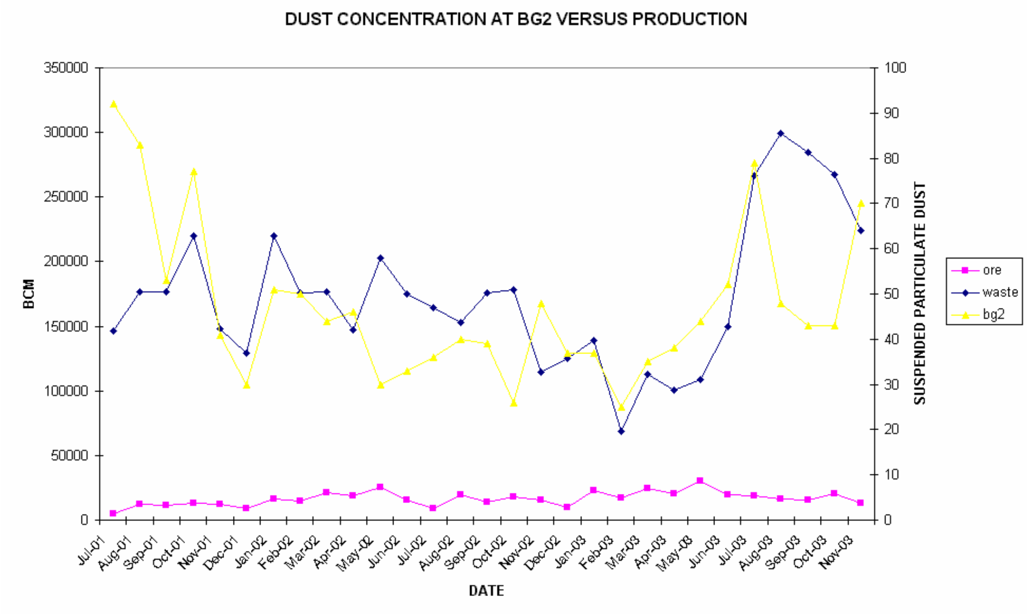


Figure 4.26 Dust concentration at BG2 versus production

Figure 4.27 shows monthly variation in dust concentration at BG3 and open pit production. BG3 is located at the junction of haulage roads and nearest to the waste dump. Operations taking place at waste dump directly affect the dust concentration at BG3.

BG3 shows the highest relationship with waste production. During the periods from September 2001 to February 2002 and from January 2003 to November 2003, a direct relationship is observed between the dust concentration and the waste production on monthly basis. In other saying the increase the waste excavation, the higher the dust concentration or vice versa. During the periods from July 2001 to February 2002, in July 2002, from November 2002 to March 2003, in May 2003, and from August 2003 to November 2003, dust concentration is directly proportional to the ore production.

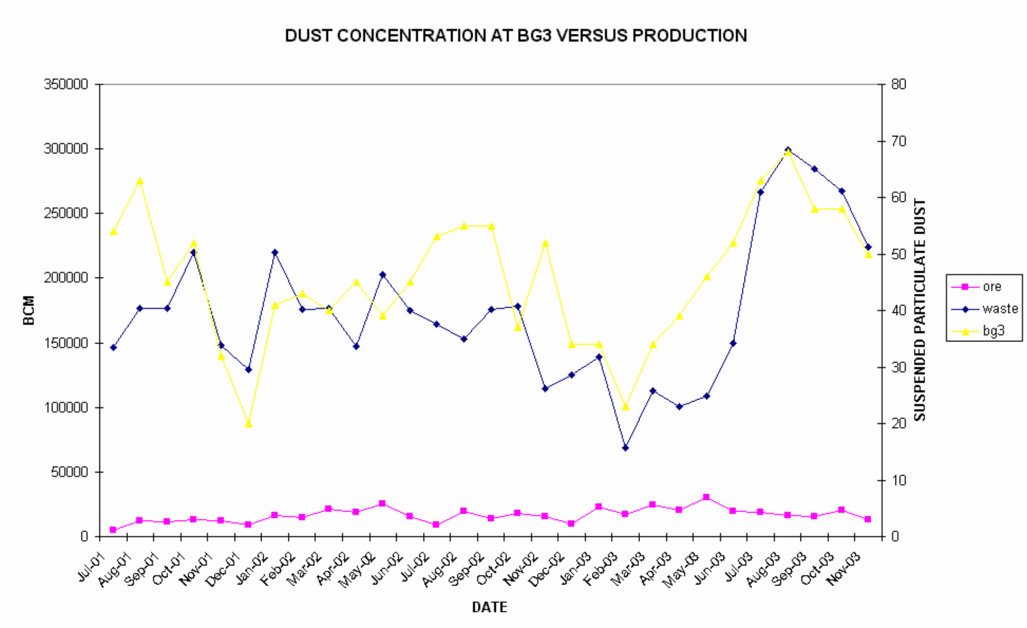


Figure 4.27 Dust concentration at BG3 versus production

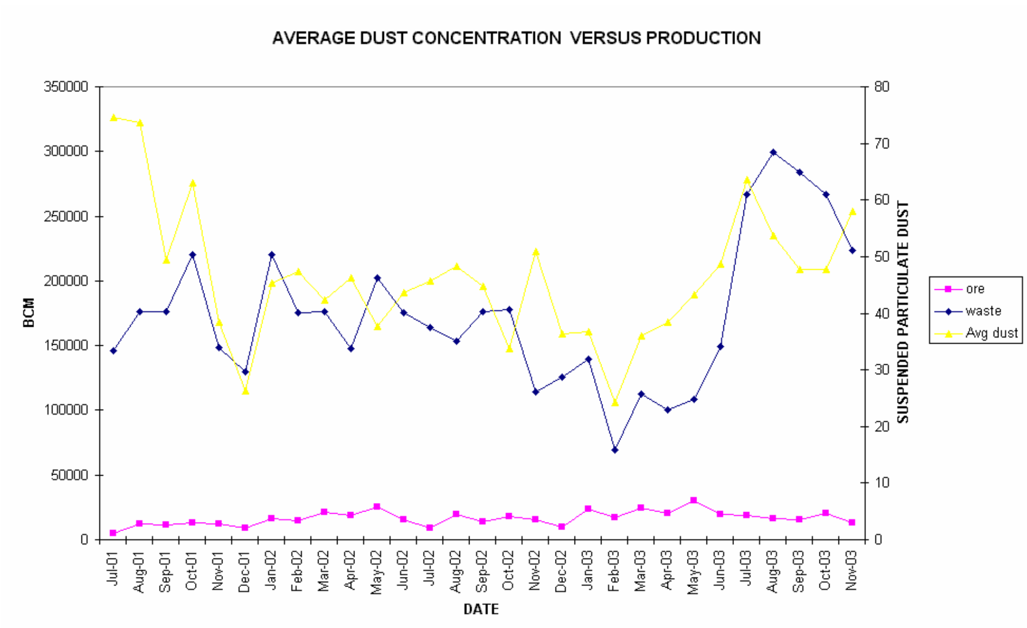


Figure 4.28 Average dust concentration versus production

Figure 4.28 shows the waste and ore excavation amounts on monthly basis together with the average dust amount obtained from all three stations. From the Figures 4.25, 4.26, 4.27 and 4.28 the following conclusions are drawn:

- For some certain periods, the dust concentration measured increases with an increase in the total volume of excavation
- For other periods, the dust concentration measured does not correlate with the production. That is the dust decreases even if the total excavation volume increases. This is attributed to the following reason: During high excavation periods, preventive measures for dust such as watering of roads and watering the blasting site before the firing are made a high rate. Therefore, the relation between the measured airborne dust and the production rate is lower.

4.3 Statistical Analysis of Data

The analysis of airborne dust and meteorological data can be utilized to illustrate certain functional and other statistical relationships. The general approach is to regress dust against independent variables, which include various meteorological data. The correlation and regression analysis techniques are useful in investigating the relationships between an independent data set and a dependent data set.

In this study, regression analyses are made using least squares fitting to the original daily data. Regression analyses were performed to find a relationship, if any, between the airborne dust concentration (dependent variable) and the meteorological parameters (independent variable). For this purpose, in each trial, the airborne dust concentration is correlated with one of the meteorological parameters on monthly basis. Atmospheric pressure, air temperature, relative humidity, evaporation, rainfall, sunshine and wind speed are the independent variables analyzed statistically. The original data set given in Appendix A and B are used in the statistical analysis.

Dust amount measured at each station may be affected and different from each other due to the following reasons:

- Absolute distance between the dust source and each measuring station.
- The relative position of each station (upwind or downwind) with respect to dust source and prevailing wind direction.
- Effectiveness and proximity of dust preventive measures to each station under consideration.

Therefore, to check the possible variation between the airborne dust amounts measured at three different stations, regression analyses are carried out between any pair of stations. The correlation coefficients (r square) obtained from regression analyses for the pairs of measuring stations are given in Table 4.10.

As it is seen in Table 4.10, the great majority of the correlation coefficients are high with a few exceptions. This indicates that the airborne dust is dispersed almost evenly around the open pit mine. The rows marked in yellow color show those months with pretty high correlation coefficients.

Table 4.10 Correlation coefficients for the stations

		BG1-BG2	BG1-BG3	BG2-BG3
2001	Jul-01	0,4766	0,2499	0,1024
	Aug-01	0,0964	0,3472	0,0009
	Sep-01	0,6428	0,8201	0,5797
	Oct-01	0,7327	0,3791	0,2565
	Nov-01	0,7673	0,1494	0,4775
	Dec-01	0,7859	0,6394	0,6327
2002	Jan-02	0,6626	0,8051	0,8229
	Feb-02	0,9054	0,9343	0,9165
	Mar-02	0,9773	0,9453	0,9742
	Apr-02	0,9637	0,9586	0,973
	May-02	0,3803	0,2966	0,3473
	Jun-02	0,4644	0,6553	0,7378
	Jul-02	0,6627	0,3134	0,4817
	Aug-02	0,8832	0,8722	0,8238
	Sep-02	0,2186	0,1434	0,7801
	Oct-02	0,8244	0,8456	0,7589
	Nov-02	0,8925	0,9206	0,848
	Dec-02	0,9447	0,7712	0,7322
2003	Jan-03	0,8502	0,9274	0,7456
	Feb-03	0,8814	0,8531	0,9102
	Mar-03	0,9169	0,8986	0,8693
	Apr-03	0,7764	0,9123	0,1116
	May-03	0,9226	0,8183	0,7836
	Jun-03	0,4879	0,6923	0,5341
	Jul-03	0,261	0,7524	0,3252
	Aug-03	0,5989	0,4572	0,467
	Sep-03	0,7084	0,6876	0,5535
	Oct-03	0,6971	0,6656	0,666
	Nov-03	0	0,9095	0

The highest correlation coefficient is obtained in March 2002 with an r-square value of 0.97. It means that the measured dust concentrations for all three stations are almost the same in March 2002. Although there are other months, with high r-square values, marked in yellow color as well, it is decided to carry the regression analyses for March 2002, to see the effect of meteorological parameters better on airborne dust. The other yellow painted months, which show homogeneous dust dispersion, are March, August, November of 2002, February and March of 2003.

4.4.1 Statistical Analysis of Atmospheric Pressure and Airborne Dust

To examine the likelihood of existence of a possible relationship between the dust concentration and the atmospheric pressure, monthly atmospheric pressure data is analyzed against the suspended particulate dust amount on monthly basis.

Table 4.11 shows the correlation coefficients (r-square) obtained for the relationship between the airborne dust and the atmospheric pressure. Red numbers indicate inverse relationships, whereas the black numbers show direct relationships. Inverse relationship means that the dependent variable decreases as the independent variable increases. The months shaded in yellow color represents higher correlation. Since neither the inverse nor the direct relationship dominates, no relationship exists between the airborne dust and the atmospheric pressure.

Table 4.11 Correlation coefficients of atmospheric pressure

		atmospheric pressure			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,3327	0,0768	0,1746	0,2112
	Aug-01	0,0044	0,0059	0,0231	0,0025
	Sep-01	0,0352	0,1116	0,0212	0,0729
	Oct-01	0,0123	0,0018	0,1358	0,0194
	Nov-01	0,004	0,0171	0,0133	0,0002
	Dec-01	0,3576	0,2773	0,4814	0,3678
2002	Jan-02	0,0697	0,0737	0,0874	0,0848
	Feb-02	0,1728	0,0857	0,0936	0,1182
	Mar-02	0,3082	0,2881	0,284	0,2968
	Apr-02	0,0755	0,0891	0,0652	0,0772
	May-02	0,0152	0,0234	0,0713	0,0483
	Jun-02	0,0107	0,0004	0,0131	0,0003
	Jul-02	0,0508	0,2514	0,0706	0,1204
	Aug-02	0,0186	0,0049	0,0055	0,0095
	Sep-02	0,0613	0,31	0,2607	0,1538
	Oct-02	0,0262	0,0046	0,0007	0,0083
	Nov-02	0,2519	0,1955	0,2853	0,2853
	Dec-02	0,0778	0,0525	0,0517	0,0605
2003	Jan-03	0,0087	0,0677	0,0078	0,0224
	Feb-03	0,2984	0,249	0,2662	0,2819
	Mar-03	0,007	0,0101	0,0004	0,0046
	Apr-03	0,0793	0,1281	0,1286	0,0646
	May-03	0,117	0,092	0,1549	0,1273
	Jun-03	0,0386	0,0019	0,0396	0,0255
	Jul-03	0,109	0,11	0,1047	0,0818
	Aug-03	0,0464	0,1333	0,0011	0,0294
	Sep-03	0,3901	0,2125	0,0803	0,227
	Oct-03	0,1746	0,1384	0,0661	0,188
	Nov-03	0,003	0,9574	0,002	0,0035

4.4.2 Statistical Analysis of Air Temperature and Airborne Dust

As it is seen in Table 4.12, a linear correlation between dust particulates and maximum air temperature yields a moderate positive relationship, r square value ranged from 0.0004 to 0.7321. Yassen (2000) used a linear correlation to model respirable dust particulate and air temperature at Kuala Lumpur and Petaling Jaya, his study yielded r-square value from 0.0004 to 0.3745. The average r square value of three stations in March 2002 is 0.5188. Since the black numbers indicating the direct relationship dominates in Table 4.12 and r-square values are comparatively higher, it can be said that there is a moderate direct relationship between the airborne dust concentration and maximum air temperature.

Table 4.12 Correlation coefficients of maximum air temperature

		MAX TEMP			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,4723	0,2938	0,4862	0,516
	Aug-01	0,28	0,0158	0,3708	0,1703
	Sep-01	0,549	0,3226	0,6156	0,5424
	Oct-01	0,1152	0,0313	0,4146	0,1423
	Nov-01	0,0923	0,1514	0,4081	0,2091
	Dec-01	0,6167	0,6417	0,5266	0,6062
2002	Jan-02	0,1408	0,1639	0,1024	0,1611
	Feb-02	0,1867	0,1863	0,1964	0,1951
	Mar-02	0,5109	0,4798	0,5625	0,5223
	Apr-02	0,3627	0,2997	0,3799	0,3506
	May-02	0,004	0,0001	0,1279	0,0198
	Jun-02	0,0357	0,2683	0,2327	0,1415
	Jul-02	0,0415	0,0979	0,2802	0,1932
	Aug-02	0,3398	0,5008	0,3868	0,4173
	Sep-02	0,0368	0,2175	0,2332	0,3178
	Oct-02	0,3714	0,2569	0,3348	0,3474
	Nov-02	0,214	0,0233	0,213	0,1854
	Dec-02	0,0027	0,0041	0,0708	0,0034
2003	Jan-03	0,395	0,2195	0,4419	0,3673
	Feb-03	0,0010	0,0004	0,0095	0,0008
	Mar-03	0,239	0,2585	0,2842	0,2701
	Apr-03	0,0635	0,4236	0,1013	0,0444
	May-03	0,5531	0,5273	0,5728	0,5838
	Jun-03	0,2072	0,2551	0,2032	0,2675
	Jul-03	0,3649	0,0761	0,2959	0,1762
	Aug-03	0,002	0,0004	0,0151	0,0034
	Sep-03	0,4253	0,3651	0,4024	0,444
	Oct-03	0,5512	0,7321	0,6519	0,5674
	Nov-03	0,4497	0,4668	0,4313	0,448

Table 4.13 shows r square values obtained by a linear correlation between airborne dust and minimum air temperature measured at stations. As it is seen from Figure 4.13, there are a few number of months with high correlation coefficients. Therefore it will not be wrong to say that there is a positive but poor correlation between the airborne dust and the minimum air temperature.

Table 4.13 Correlation coefficients of minimum air temperature

		MIN TEMP			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,4004	0,4345	0,2837	0,5489
	Aug-01	0,1487	0,0954	0,2014	0,2622
	Sep-01	0,1329	0,049	0,1758	0,1079
	Oct-01	0,102	0,1416	0,2171	0,187
	Nov-01	0,045	0,0233	0,0695	0,0517
	Dec-01	0,3268	0,357	0,2096	0,3023
2002	Jan-02	0,0291	0,0432	0,016	0,0395
	Feb-02	0,024	0,0076	0,0032	0,0104
	Mar-02	0,316	0,2649	0,2588	0,2826
	Apr-02	0,0925	0,0824	0,1109	0,0961
	May-02	0,0014	0,006	0,012	0,002
	Jun-02	0,0679	0,1775	0,2275	0,1524
	Jul-02	0,1241	0,1602	0,0613	0,1231
	Aug-02	0,1838	0,266	0,1608	0,2036
	Sep-02	0,0606	0,0796	0,0374	0,0489
	Oct-02	0,0227	0,1169	0,061	0,0605
	Nov-02	0,0796	0,2438	0,103	0,1325
	Dec-02	0,1264	0,1316	0,248	0,1209
2003	Jan-03	0,0309	0,0025	0,02	0,0089
	Feb-03	0,1362	0,1727	0,1275	0,1506
	Mar-03	0,0007	0,0004	5,00E-05	0,0002
	Apr-03	0,0103	0,0938	0,0132	0,0014
	May-03	0,1743	0,1712	0,0408	0,1233
	Jun-03	0,2945	0,2707	0,4402	0,4064
	Jul-03	0,2081	0,0293	0,0736	0,0047
	Aug-03	0,1053	0,0531	0,0028	0,0359
	Sep-03	0,2716	0,1209	0,1602	0,225
	Oct-03	0,45	0,41	0,5099	0,5865
	Nov-03	0,0305	0,7289	0,0044	0,0167

Table 4.14 gives r square values obtained from statistical analyses between airborne dust concentration at each station and average air temperature. The values of r squares range from 0.0004 to 0.7089. The average of yellow painted months is 0.3764. In March, r square is obtained as 0.4741. Since the black numbers are prevailing in Table 4.14, the relation is positive, but due to low r-square values there is a poor relationship between airborne dust and average temperature.

Table 4.14 Correlation coefficients of average air temperature

		AVG TEMP			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,5101	0,3047	0,512	0,5529
	Aug-01	0,4426	0,0133	0,441	0,3866
	Sep-01	0,3543	0,1024	0,3794	0,2634
	Oct-01	0,123	0,0646	0,3899	0,1767
	Nov-01	0,1092	0,1462	0,2942	0,1948
	Dec-01	0,5012	0,5452	0,3759	0,4829
2002	Jan-02	0,1287	0,1602	0,1089	0,1616
	Feb-02	0,0583	0,1056	0,1063	0,0906
	Mar-02	0,4626	0,4451	0,5114	0,4774
	Apr-02	0,3609	0,3002	0,357	0,3426
	May-02	0,0004	0,0217	0,0888	0,0075
	Jun-02	0,0936	0,2336	0,2785	0,1978
	Jul-02	0,0395	0,0476	0,1034	0,0886
	Aug-02	0,2277	0,3765	0,291	0,3025
	Sep-02	0,1454	0,3159	0,3911	0,3964
	Oct-02	0,1265	0,0379	0,086	0,0892
	Nov-02	0,0145	0,0424	0,0078	0,0012
	Dec-02	0,0183	0,0188	0,1618	0,0179
2003	Jan-03	0,2392	0,0654	0,2658	0,1892
	Feb-03	0,0368	0,0551	0,019	0,0364
	Mar-03	0,1998	0,2041	0,2484	0,2255
	Apr-03	0,0522	0,4122	0,0824	0,0356
	May-03	0,5579	0,5361	0,3954	0,5202
	Jun-03	0,3916	0,3569	0,4244	0,4622
	Jul-03	0,473	0,0552	0,3278	0,1881
	Aug-03	0,1352	0,0625	0,0008	0,0278
	Sep-03	0,4824	0,3259	0,3821	0,4537
	Oct-03	0,5895	0,6694	0,7089	0,6885
	Nov-03	0,1811	0,208	0,1446	0,171

4.4.3 Statistical Analysis of Relative Humidity and Airborne Dust

From Table 4.15, it is seen that no significant relationship was found between airborne dust and relative humidity in terms of r-square, however there appears a tendency towards a poor inverse relationship between the two variables.

Table 4.15 Correlation coefficients of relative humidity

		HUMIDITY			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,1891	0,0865	0,2398	0,1914
	Aug-01	0,0034	0,0134	0,0052	3,00E-05
	Sep-01	0,186	0,1008	0,0886	0,1406
	Oct-01	0,0297	0,092	0,001	0,0722
	Nov-01	0,0326	0,1289	0,0381	0,0659
	Dec-01	0,1331	0,0638	0,1749	0,1175
2002	Jan-02	0,0016	0,0026	0,0011	0,0009
	Feb-02	0,0139	0,0099	0,0031	0,0087
	Mar-02	0,2371	0,217	0,206	0,2225
	Apr-02	0,0197	0,0107	0,0142	0,0147
	May-02	0,0049	0,0104	0,0189	2,00E-05
	Jun-02	0,0315	0,0189	0,0268	0,0316
	Jul-02	0,112	0,0541	0,3959	0,2662
	Aug-02	0,1717	0,172	0,27	0,218
	Sep-02	0,0016	0,0247	0,1214	0,1332
	Oct-02	6,00E-06	0,0176	0,0022	0,0032
	Nov-02	0,0371	0,0542	0,0408	0,0531
	Dec-02	0,0124	0,004	0,0327	0,0125
2003	Jan-03	0,0069	0,0118	0,0212	0,0133
	Feb-03	0,1961	0,0937	0,1573	0,1518
	Mar-03	0,0007	2,00E-05	0,0007	0,0003
	Apr-03	0,1829	0,1069	0,2252	0,1717
	May-03	0,1775	0,1722	0,3342	0,2379
	Jun-03	0,051	0,0791	0,0349	0,0668
	Jul-03	0,0125	0,1405	0,0541	0,0688
	Aug-03	2,00E-05	0,0169	0,0099	2,00E-07
	Sep-03	0,0021	0,0162	0,0823	0,0097
	Oct-03	0,0477	0,0151	0,1227	0,0603
	Nov-03	0,0129	0,0064	0,0026	0,009

4.4.4 Statistical Analysis of Evaporation and Airborne Dust

Table 4.16 shows relationship between evaporation and airborne dust at each station in terms of r squares on monthly basis. R square values range from 0.000006 to 0.4709. The average r squares for yellow painted months is 0.2400. No significant relationship was found between dust and evaporation, although there appears a tendency towards a direct relationship between the two variables.

Table 4.16 Correlation coefficients of evaporation

		EVAPORATION			
		BG1	BG2	BG3	AVG
2001	Jul-01	0	0	0	0
	Aug-01	0	0	0	0
	Sep-01	0,0072	0,0893	0,0004	0,0229
	Oct-01	0,0806	0,2335	0,0299	0,1769
	Nov-01	0,0224	0,0818	0,063	0,052
	Dec-01	0	0	0	0
2002	Jan-02	0	0	0	0
	Feb-02	0	0	0	0
	Mar-02	0	0	0	0
	Apr-02	0,0361	0,0207	0,0234	0,0266
	May-02	6,00E-06	0,0098	0,0189	0,0013
	Jun-02	0,1284	0,0564	0,1319	0,1307
	Jul-02	0,1103	0,0207	0,1912	0,1484
	Aug-02	0,1714	0,1247	0,1497	0,1578
	Sep-02	0,1053	0,2145	0,3513	0,4139
	Oct-02	0,0069	0,0058	0,0039	0,001
	Nov-02	0,0722	0,0865	0,1425	0,1215
	Dec-02	0,0053	0,0016	0,2284	0,0125
2003	Jan-03	0	0	0	0
	Feb-03	0	0	0	0
	Mar-03	0	0	0	0
	Apr-03	0,0754	0,4709	0,0905	0,0305
	May-03	0,1134	0,1293	0,2068	0,1604
	Jun-03	0,0208	0,0229	0,0057	0,0002
	Jul-03	0,0951	0,0002	0,0517	0,0245
	Aug-03	0,1248	0,1685	0,1636	0,1935
	Sep-03	0,0003	0,0153	0,0352	0,0117
	Oct-03	0,0925	0,0145	0,0167	0,0284
	Nov-03	0,3032	0	0,2848	0,3174

4.4.5 Statistical Analysis of Rainfall and Airborne Dust

A linear correlation between dust particulates and rainfall yields poor to moderate negative relationship as shown in Table 4.17, the r-square values ranged from 0.000001 to 0.6822. Average r-square value in yellow painted months is 0.4011. In March 2002, average r-square is 0.4046. Yassen (2000) stated that r-squares for rainfall were ranging from -0.0025 to -0.4720 in his study.

Table 4.17 Correlation coefficients of rainfall

		RAINFALL			
		BG1	BG2	BG3	AVG
2001	Jul-01	0	0	0	0
	Aug-01	0,0021	0,0031	0,0082	0,0007
	Sep-01	0,1208	0,0764	0,1079	0,1172
	Oct-01	0,0024	0,0043	0,0152	1,00E-05
	Nov-01	0,0516	0,0374	0,0085	0,0356
	Dec-01	0,089	0,1786	0,0563	0,1447
2002	Jan-02	0,1677	0,2004	0,3719	0,3693
	Feb-02	0,0009	0,2044	0,0212	0,0307
	Mar-02	0,3831	0,4115	0,4158	0,4082
	Apr-02	0,0137	0,0051	0,0065	0,0081
	May-02	0	0	0	0
	Jun-02	0	0	0	0
	Jul-02	0	0	0	0
	Aug-02	0	0	0	0
	Sep-02	0,4711	0,6822	0,4557	0,5813
	Oct-02	0,0903	0,0732	0,1714	0,1405
	Nov-02	0,2652	0,5023	0,1588	0,1907
	Dec-02	0,0803	0,0621	0,0511	0,0889
2003	Jan-03	0,6035	0,3925	0,6453	0,6018
	Feb-03	0,0244	0,0319	0,0234	0,0275
	Mar-03	0,3724	0,3454	0,3137	0,3519
	Apr-03	0,0013	0,022	0,0296	0,0003
	May-03	0,4111	0,3098	0,4572	0,3914
	Jun-03	0	0	0	0
	Jul-03	0	0	0	0
	Aug-03	0	0	0	0
	Sep-03	0	0	0	0
	Oct-03	0,0005	0,4145	0,0019	0,0475
	Nov-03	0	0	0	0

4.3.6 Statistical Analysis of Sunshine and Airborne Dust

Table 4.18 shows correlation coefficients in terms of r-squares obtained from relationship between daily sunshine duration and dust concentration on monthly basis. R squares range from 0.00001 to 0.316. The average value of r-squares obtained in yellow painted months is 0.1725. There is a poor but direct relationship in between the two.

Table 4.18 Correlation coefficients of Sunshine

		SUNSHINE			
		BG1	BG2	BG3	AVG
2001	Jul-01	0	0	0	0
	Aug-01	0	0	0	0
	Sep-01	0,0068	0,0018	0,0136	0,0114
	Oct-01	0,0194	0,0276	0,0259	0,03
	Nov-01	0,0136	0,0456	0,0311	0,0262
	Dec-01	0	0	0	0
2002	Jan-02	0,0001	0,0008	0,0207	0,003
	Feb-02	0,0014	0,0079	0,0059	0,0018
	Mar-02	0,006	0,0013	0,0039	0,0035
	Apr-02	0,0002	0,0007	0,0005	1,00E-05
	May-02	0,0148	0,0598	0,0003	9,00E-05
	Jun-02	0,0275	0,0108	0,0011	0,0056
	Jul-02	0,0511	0,0002	0,0595	0,0595
	Aug-02	0,053	0,083	0,0427	0,0585
	Sep-02	0,0221	0,012	0,0016	0,0471
	Oct-02	0,0188	0,0004	0,0137	0,0102
	Nov-02	0,0408	0,052	0,073	0,0866
	Dec-02	0,0056	0,0085	0,005	0,0193
2003	Jan-03	0,1117	0,1892	0,1255	0,1474
	Feb-03	0,1219	0,0571	0,1333	0,1059
	Mar-03	0,0116	0,0165	0,0053	0,0108
	Apr-03	0,0252	0,3136	0,0394	0,0022
	May-03	0,1512	0,1456	0,1996	0,1752
	Jun-03	0,2149	0,0523	0,1361	0,1379
	Jul-03	0,0006	0,0685	0,0144	0,0284
	Aug-03	0,2497	0,2056	0,0756	0,1721
	Sep-03	0	0	0	0
	Oct-03	0,1733	0,0031	0,0855	0,0836
	Nov-03	0,316	0	0,3085	0,2866

4.4.7 Statistical Analysis of Wind speed and Airborne Dust

A linear correlation between dust particulate and maximum wind speed yields a poor and inverse relationship. The correlation coefficient however is low, r-value ranged between - 0.0000001 and - 0,4973 as shown in Table 4.19. Average of yellow months is - 0,3402. Yassen's (2000) r-square values for wind speed range from 0.0039 to - 0.2601.

Table 4.19 Correlation coefficients of maximum wind speed

	MAX WIND			
	BG1	BG2	BG3	AVG
Jul-01	0,0417	0,0192	0,0436	0,0108
Aug-01	0,0045	0,4159	0,0036	0,1527
Sep-01	0,1496	0,05	0,1567	0,1327
Oct-01	0,0261	0,2828	0,0641	0,0818
Nov-01	0,0093	0,0169	0,2591	0,0185
Dec-01	0,0769	0,028	0,2818	0,0857
Jan-02	0,4973	0,3105	0,4001	0,4424
Feb-02	0,0777	0,0773	0,0878	0,083
Mar-02	0,0312	0,0487	0,0704	0,0492
Apr-02	0,0197	0,0242	0,0347	0,0262
May-02	0,1636	0,0031	0,0092	0,0129
Jun-02	0,2507	0,0277	0,0655	0,146
Jul-02	0,0456	0,0029	0,0428	0,0012
Aug-02	0,0374	0,0001	0,0082	0,0105
Sep-02	0,0265	0,1043	0,1133	0,093
Oct-02	0,1029	0,0814	0,2183	0,1402
Nov-02	0,312	0,2076	0,1565	0,1563
Dec-02	0,3281	0,3946	0,0053	0,3444
Jan-03	0,0397	0,1334	0,0141	0,054
Feb-03	0,3009	0,3821	0,3106	0,3441
Mar-03	0,104	0,1665	0,133	0,1373
Apr-03	0,0019	0,0596	1,00E-07	0,0005
May-03	0,0529	0,0258	0,014	0,0296
Jun-03	0,0039	1,00E-06	0,0849	0,0139
Jul-03	0,303	0,1036	0,2721	0,182
Aug-03	0,0157	0,013	3,00E-05	0,0048
Sep-03	0,0038	0,1211	0,0108	0,0247
Oct-03	0,0059	0,0914	0,0033	0,0106
Nov-03	0,4491	0	0,4718	0,4617

Average wind speed and airborne dust concentration relationship is also analyzed statistically. As it is seen in Table 4.20, r-square values range from 0.000009 to - 0.4436. The average r-square values obtained in yellow painted months is 0.27545. Similar to the maximum wind speed, there is also a poor and negative relationship between airborne dust and average wind speed. In other saying, the dust amount decreases when the wind speed increases.

Table 4.20 Correlation coefficients of average wind speed

		AVG WIND			
		BG1	BG2	BG3	AVG
2001	Jul-01	0,1092	0,1742	0,0089	0,121
	Aug-01	0,0361	0,4093	0,0614	0,268
	Sep-01	0,1404	0,0073	0,1407	0,0881
	Oct-01	0,0588	0,3198	0,0376	0,1128
	Nov-01	0,0861	0,0043	0,2551	0,0006
	Dec-01	0,0524	0,0336	0,4016	0,1242
2002	Jan-02	0,2786	0,157	0,2363	0,2471
	Feb-02	0,0355	0,021	0,0424	0,033
	Mar-02	0,0059	0,0115	0,0358	0,0155
	Apr-02	0,0709	0,0866	0,1096	0,0895
	May-02	0,057	0,0312	0,0449	0,0021
	Jun-02	0,2357	0,0105	0,0374	0,1148
	Jul-02	0,0824	0,0006	0,0043	0,0022
	Aug-02	0,0772	0,0267	0,0303	0,0453
	Sep-02	0,0055	0,195	0,1769	0,09
	Oct-02	0,0897	0,0674	0,1185	0,0988
	Nov-02	0,1072	0,032	0,104	0,114
	Dec-02	0,2055	0,2499	0,0278	0,2116
2003	Jan-03	0,161	0,2452	0,1175	0,1795
	Feb-03	0,1117	0,1962	0,138	0,153
	Mar-03	0,1456	0,1885	0,204	0,1849
	Apr-03	0,0086	0,3025	9,00E-06	0,0001
	May-03	0,0006	0,0056	0,0221	0,0053
	Jun-03	0,151	0,0865	0,0238	0,0917
	Jul-03	0,3045	0,3694	0,4294	0,4436
	Aug-03	0,0455	0,0448	0,015	0,0365
	Sep-03	0,0849	0,1488	0,0016	0,038
	Oct-03	0,038	0,1559	0,0031	0,0286
	Nov-03	0,3887	0	0,4367	0,4211

4.5 Assessment of Compliance of Airborne Dust to the Regulation

The airborne dust data measured at each station, which is presented in APPENDIX A, is analyzed and the average, the maximum and the minimum values are determined (Table 4.21) with respect to the stations.

Table 4.21 Average, maximum and minimum airborne dust concentrations

	Airborne Dust Concentration (µg/m^3)		
	Station BG1	Station BG2	Station BG3
Maximum Value	160	251	135
Date Measured	03.11.2001	03.07.2003	01.09.2003
Average Value	45.93	46.49	45.67
Minimum Value	7	3	3
Date Measured	02.02.2003	09.10.2003	17.12.2001

The average values calculated for the period between July 1, 2001 and November 30, 2003 are below 50 µg/m^3. Therefore, it is concluded that the long term limit, dictated by Turkish Air Control Regulation, which is 150 µg/m^3, is not exceeded. Among the maximum values determined for the period between July 1, 2001 and November 30, 2003, the highest is 251 µg/m^3 and recorded at station BG2. Since this value is below the short-term limit, dictated by Turkish Air Control Regulation, which is 300 µg/m^3, is not exceeded. According to the above mentioned evaluations, the operations at Ovacık Gold Mine comply with Turkish Air Quality Control Regulation (1986).

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The major conclusions drawn from this study and recommendations for future studies are presented as follows:

- The mining operations at Ovacık Gold Mine results in relatively low airborne dust concentrations due to preventive measures taken. The measured airborne dust amounts comply with Turkish Air Quality Control Regulation in terms of both short and long period limits.

- Minimum atmospheric pressures are seen in July and August, whereas the maximum values are observed in December and January each year. This trend is observed consistently for all years. The lower airborne dust concentration are measured when the atmospheric pressure is highest in general. However, as the statistical analyses revealed, no relationship is found between airborne dust concentration and atmospheric pressure.

- The highest temperatures are measured in July and August. On the other hand, the lowest values are observed in

December and January. Similarly for the airborne dust, the highest values are reached in July and August and the lowest ones occur in December and January in general. Therefore, there is a direct relation in between the two. Airborne dust correlates best with maximum temperature showing a moderate positive relationship. However, both minimum and average temperatures recorded indicate a positive but poor relationship with the airborne dust.

- Relative humidity values are moderate in spring and autumn, with the lowest observed in July and the highest in winter. Statistical analyses yielded poor negative relationship between airborne dust concentration and relative humidity.

- Lowest rainfall occur from June to September, whereas the highest rainfall is observed from November to February in general. The lowest measured airborne dust concentrations coincides with heavy rainfall period or vice versa. There is a poor to moderate negative relationship between the airborne dust concentration and rainfall.

- Meteorological observations indicate that no evaporation occur between January and April, whereas the highest evaporation is observed from June to September. No significant relationship was found between airborne dust and evaporation, although there appears a tendency towards a direct relationship between two variables.

- In general, the sunshine duration is the longest from May to September, and it is low from December to April. The low sunshine period coincides with heavy rainfall period. As the sunshine duration gets longer, so does the solar radiation and hence the air temperature and the evaporation increases. There is a poor but direct relationship between airborne dust concentration and sunshine duration.

- Highest wind speeds are observed from December to March in terms of both maximum and average wind speed, in which coincides with low airborne dust concentration. During summer months, both the maximum wind and the average wind speeds are lower, in which the average airborne dust amounts are comparatively higher. It can be concluded that the higher wind speed results in more dispersion and low airborne dust concentration. A poor inverse relationship is determined between the airborne dust and the wind speed.

Some recommendations can be given for further research:

To arrive at better relationships between airborne dust and the meteorological parameters, in addition to the ore production and stripping amounts, the following parameters must be also recorded :

- Preventive measures taken daily for airborne dust
- Type of mining operation conducted daily
- Elevations of benches of open pit monthly.

REFERENCES

-Air Quality Control Regulation, 1986, 02.11.1986 dated and 19269 numbered Official Gazette.

- Calviac, G., Vesovic,V., 1998, Modelling dispersion of particulate matter in the mining environment, Symp. On Environmental Issues and Waste Management in Energy and Mineral Production, Ankara, Turkey, pp. 143-148

-Chang, R., 1994, Chemistry, Mc Graw Hill, pp 163-165

-Cochrane, T.S., 1972 , Routine dust measurements and standards, CIM BULLETIN, January, pp.46-50

-Değerli, E., 2001, Evaluation of dust dispersion in open pits by a computer program. Master of Science thesis, Hacettepe University, Ankara, Turkey, 157 pages

-Dickson R. R., 1960, Meteorological factors affecting particulate air pollution of a city. Bulletin of American Meteor. Soc. **42**: 556-560.

- Environment Australia, 1998, Best Practice Environmental Management in mining , ISBN 0642545707 where available www.deh.gov.au/industry/industry-performance/minerals/booklets/dust

-Güyagüler, T., Keskin, S. 1996 , Mine Ventilation, METU Mining Engineering Department, Ankara, Turkey, pp. 3-7 , 57-59

-Güyagüler,T., 2002, Mine Safety and Environment Lecture Notes Mining Engineering Department, METU, Ankara, Turkey.

-Hamzaoğlu, A. , Kayın, S. , Tuncel, G.,Yurteri, C., 1998 , Fugitive dust modelling: A case study for Seyitömer coal-fired power plant, Symp. on Environmental Issues and Waste Management in Energy and Mineral Production, Ankara, Turkey, pp. 137-142

-Hanna, S.R., 1993 Uncertainties in air quality model predictions, Bound- Layer Meteor, issue 62 , pp. 3-20.

- Idriss, A., 2003, Air Quality Model Guideline, Science and Standards Branch Alberta Environment Pub. No: T/689 ISBN 0 77 85 2488 4 where available www3.gov.ab.ca/env/air/airqual/airmodelling.html

- Johnston, P.R., Durucan, S., 1998, Air pollution modelling in practice: The advantages and limitations of current models, Symp. on Environmental Issues and Waste Management in Energy and Mineral Production, Ankara, Turkey, pp. 149-153

- Karakaş, A., 2002, Investigation of the Sources and the Control Methods of Dust Around a Longwall Face at Çayırhan Lignite Mine, Master of science thesis, Department of Mining Engineering, Middle East Technical University, Ankara, Turkey, 118 pages

- MP101M, 1995, MP101M Suspended Particulate Gauge Technical Manual

- Sham S., 1979, Aspect of air pollution climatology in a tropical city. A case of Kuala Lumpur- Petaling Jaya, Area Malaysia. Bangi, UKM press, Malaysia.

- Yassen M. E., 2000, Analysis of climatic conditions and air quality observations in Kuala Lumpur and Petaling Jaya, Malaysia, during 1983-1997. MPhil Thesis University Kebangsaan Malaysia, Malaysia

- http://lpo.dt.navy.mil, 2004, NSWC Naval Surface Warfare Center

- www. rredc.nrel.gov/solar/glossary, 2004, RReDC Renewable Resource Data Center

- www.atmos.uiuc.edu, 2004 , University of Illinois

- www.centennialofflight.gov, 2004, U.S. Centennial of Flight Commission

- www.cimms.ou.edu, 2004, Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma

- www.epa.gov, 2004, Environmental Protection Agency

- www.newmont.com, 2004, Newmont Gold Co.

- www.novalynx.com, 2004, NovaLynx Corporation .

- www.Ovacik-altin.com, 2004, Ovacık Gold Mine

- www.vortex.plymouth.edu, 2004, Plymouth State University

APPENDIX A

AIRBORNE DUST DATA

Table A Airborne dust data

DATE	BG1 ($\mu g/m^3$)	BG2 ($\mu g/m^3$)	BG3 ($\mu g/m^3$)
July 1, 2001	35	40	21
July 2, 2001	58	56	46
July 3, 2001	36	38	27
July 4, 2001	44	47	33
July 5, 2001	53	73	40
July 6, 2001	59	63	39
July 7, 2001	67	61	39
July 8, 2001	59	55	59
July 9, 2001	83	111	57
July 10, 2001	93	166	55
July 11, 2001	79	150	35
July 12, 2001	75	100	37
July 13, 2001	107	173	45
July 14, 2001	92	111	41
July 15, 2001	78		
July 16, 2001	78	77	56
July 17, 2001	77	64	75
July 18, 2001	135	104	82
July 19, 2001	125	150	56
July 20, 2001	93	80	65
July 21, 2001	60	68	68
July 22, 2001	59	51	56
July 23, 2001	67	61	57
July 24, 2001	63	60	57
July 25, 2001	91	63	61
July 26, 2001	52	117	78
July 27, 2001	96	132	73

July 28, 2001	71	96	74
July 29, 2001	92	78	54
July 30, 2001	106	196	77
July 31, 2001	85	131	63
August 1, 2001	66	96	56
August 2, 2001	93	179	61
August 3, 2001	67	96	87
August 4, 2001	72	75	107
August 5, 2001	79	82	69
August 6, 2001	71	57	73
August 7, 2001	80	62	78
August 8, 2001	157	97	88
August 9, 2001	129	91	104
August 10, 2001	96	74	109
August 11, 2001	77	71	83
August 12, 2001	88	89	75
August 13, 2001	71	88	66
August 14, 2001	94	105	64
August 15, 2001	65	110	53
August 16, 2001	86	100	55
August 17, 2001	62	89	55
August 18, 2001	52	68	40
August 19, 2001	47	43	39
August 20, 2001	49	41	46
August 21, 2001	64	54	52
August 22, 2001	82	60	61
August 23, 2001	70	85	55
August 24, 2001	61	54	42
August 25, 2001	63	101	47
August 26, 2001	82	68	34
August 27, 2001	66	124	38
August 28, 2001	56	88	47
August 29, 2001	76	77	62
August 30, 2001	52	105	46
August 31, 2001	39	59	60
September 1, 2001	46	44	50
September 2, 2001	62	50	51
September 3, 2001	54	43	46

September 4, 2001	42	41	30
September 5, 2001	44	45	44
September 6, 2001		32	30
September 7, 2001	35	31	22
September 8, 2001	26	27	26
September 9, 2001	42	39	32
September 10, 2001	46	46	44
September 11, 2001	43	40	56
September 12, 2001	38	45	41
September 13, 2001	51	73	35
September 14, 2001	46	64	36
September 15, 2001	41	33	36
September 16, 2001	59	53	55
September 17, 2001	52	53	51
September 18, 2001	51	45	46
September 19, 2001	69	69	72
September 20, 2001	72	102	72
September 21, 2001	59	92	55
September 22, 2001	45	45	45
September 23, 2001	52	56	46
September 24, 2001	85	75	60
September 25, 2001	106	103	98
September 26, 2001	59	70	65
September 27, 2001	20	35	15
September 28, 2001	44	69	38
September 29, 2001	32	44	29
September 30, 2001	38	36	25
October 1, 2001	60	58	44
October 2, 2001	64	68	47
October 3, 2001	73	75	66
October 4, 2001	63	66	61
October 5, 2001	55	69	50
October 6, 2001	69	64	58
October 7, 2001	70	91	62
October 8, 2001	59	96	54
October 9, 2001	61	81	49
October 10, 2001	72	78	52
October 11, 2001	95	126	49

October 12, 2001		172	102
October 13, 2001		84	39
October 14, 2001	30	39	23
October 15, 2001	48	94	32
October 16, 2001	62	95	40
October 17, 2001	120	142	54
October 18, 2001	38	59	29
October 19, 2001	52	62	56
October 20, 2001	73	72	37
October 21, 2001	55	52	51
October 22, 2001	83	83	67
October 23, 2001	71	85	65
October 24, 2001	45	64	31
October 25, 2001	113	185	40
October 26, 2001	44	62	27
October 27, 2001	43	76	27
October 28, 2001	17	18	20
October 29, 2001	29	42	15
October 30, 2001	51	56	40
October 31, 2001	68	71	52
November 1, 2001	73	74	57
November 2, 2001	40	49	29
November 3, 2001	160	86	18
November 4, 2001	30	30	10
November 5, 2001	37	31	26
November 6, 2001	32	28	22
November 7, 2001	47	52	45
November 8, 2001	38	33	27
November 9, 2001	44	37	37
November 10, 2001	37	34	29
November 11, 2001	43	41	37
November 12, 2001	82	70	65
November 13, 2001	72	70	62
November 14, 2001	49	50	60
November 15, 2001		47	39
November 16, 2001	17		
November 17, 2001	28	40	18
November 18, 2001	21	23	20

November 19, 2001	40	56	47
November 20, 2001	18	20	17
November 21, 2001	26	33	23
November 22, 2001	39	47	37
November 23, 2001	41	45	32
November 24, 2001	24	24	22
November 25, 2001	14	15	15
November 26, 2001	32	35	25
November 27, 2001	35	35	29
November 28, 2001	49	47	41
November 29, 2001	23	24	22
November 30, 2001	14	18	10
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December 2, 2001	12	11	6
December 3, 2001	23	29	8
December 4, 2001	19	31	8
December 5, 2001	31	33	14
December 6, 2001	24	31	13
December 7, 2001	53	45	15
December 8, 2001	36	28	9
December 9, 2001	12	12	9
December 10, 2001	26	35	13
December 11, 2001	24	34	12
December 12, 2001	29	42	19
December 13, 2001	32	21	23
December 14, 2001	22	25	17
December 15, 2001	43	32	21
December 16, 2001	50	44	48
December 17, 2001		8	3
December 18, 2001	14	14	6
December 19, 2001	29	24	21
December 20, 2001	67	75	57
December 21, 2001	48	61	45
December 22, 2001	8	5	5
December 23, 2001	28	29	25
December 24, 2001	16	18	15
December 25, 2001	27	27	27
December 26, 2001	34	41	30

December 27, 2001	47	52	46
December 28, 2001	17	19	16
December 29, 2001	32	38	31
December 30, 2001	30	24	22
December 31, 2001	30	26	31
January 1, 2002	14	26	16
January 2, 2002	20		12
January 3, 2002	51	20	48
January 4, 2002	26	31	23
January 5, 2002	29	34	22
January 6, 2002	26	24	21
January 7, 2002	35	39	36
January 8, 2002	43	49	37
January 9, 2002	18	20	29
January 10, 2002	36	39	28
January 11, 2002	38	44	37
January 12, 2002	54	64	49
January 13, 2002	74	81	72
January 14, 2002	71	82	71
January 15, 2002	52	61	47
January 16, 2002	67	79	62
January 17, 2002	54	113	85
January 18, 2002	42	51	37
January 19, 2002	38	34	29
January 20, 2002	32	34	31
January 21, 2002	34	37	35
January 22, 2002	48	49	43
January 23, 2002	50	55	46
January 24, 2002	65	68	55
January 25, 2002	51	62	47
January 26, 2002	40	44	38
January 27, 2002	32	39	25
January 28, 2002	47	58	42
January 29, 2002	46	49	38
January 30, 2002	61	67	55
January 31, 2002	64	76	57
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February 2, 2002	57	58	49

February 3, 2002	63	57	56
February 4, 2002	76	59	69
February 5, 2002	78	76	69
February 6, 2002	61	56	53
February 7, 2002	51	51	43
February 8, 2002	62	62	54
February 9, 2002	75	82	66
February 10, 2002	61	65	62
February 11, 2002	70	74	63
February 12, 2002	34	29	23
February 13, 2002	44	45	35
February 14, 2002	46	47	40
February 15, 2002	63	64	55
February 16, 2002	40	40	27
February 17, 2002	31	27	28
February 18, 2002	63	64	55
February 19, 2002	67	77	62
February 20, 2002	40	38	35
February 21, 2002	22	24	22
February 22, 2002	37	41	36
February 23, 2002	32	37	30
February 24, 2002	26	31	28
February 25, 2002	16	24	18
February 26, 2002	38	29	21
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February 28, 2002	23	27	24
March 1, 2002	36	36	31
March 2, 2002	40	42	36
March 3, 2002	32	34	35
March 4, 2002	52	55	51
March 5, 2002	61	67	63
March 6, 2002	96	100	93
March 7, 2002	103	110	104
March 8, 2002	94	103	91
March 9, 2002	70	58	46
March 10, 2002	56	60	61
March 11, 2002	53	54	46
March 12, 2002	20	21	17

March 13, 2002	27	26	23
March 14, 2002	32	33	35
March 15, 2002	35	36	37
March 16, 2002	56	50	45
March 17, 2002	48	46	40
March 18, 2002	33	36	26
March 19, 2002	34	33	33
March 20, 2002	61	63	51
March 21, 2002	42	43	46
March 22, 2002	36	38	32
March 23, 2002	14	17	16
March 24, 2002	8	8	7
March 25, 2002	10	11	11
March 26, 2002	19	22	19
March 27, 2002	17	23	15
March 28, 2002	33	36	28
March 29, 2002	45	49	43
March 30, 2002	27	28	24
March 31, 2002	36	39	32
April 1, 2002	21	21	17
April 2, 2002	18	18	16
April 3, 2002	34	35	31
April 4, 2002	53	52	49
April 5, 2002	60	54	49
April 6, 2002	44	49	51
April 7, 2002	28	31	28
April 8, 2002	34	34	36
April 9, 2002	42	43	41
April 10, 2002	55	52	49
April 11, 2002	64	62	63
April 12, 2002	62	64	57
April 13, 2002	74	74	70
April 14, 2002	81	81	80
April 15, 2002	104	105	108
April 16, 2002	49	48	45
April 17, 2002	30	29	21
April 18, 2002	35	37	35
April 19, 2002	30	31	28

April 20, 2002	37	26	27
April 21, 2002	28	27	25
April 22, 2002	49	45	39
April 23, 2002	79	81	73
April 24, 2002	77	72	69
April 25, 2002	43	35	36
April 26, 2002	44	37	40
April 27, 2002	45	39	38
April 28, 2002	50	43	45
April 29, 2002	38	34	37
April 30, 2002	41	33	36
May 1, 2002	44	42	37
May 2, 2002	46	34	33
May 3, 2002	47	27	34
May 4, 2002	46	31	35
May 5, 2002	31	21	26
May 6, 2002	43	31	38
May 7, 2002	57	35	41
May 8, 2002	45	37	42
May 9, 2002	44	37	50
May 10, 2002	41	28	46
May 11, 2002	37	28	38
May 12, 2002	38	32	38
May 13, 2002	47	39	36
May 14, 2002	42	22	29
May 15, 2002	42	22	32
May 16, 2002	44	30	37
May 17, 2002	41	23	43
May 18, 2002	42	30	39
May 19, 2002	33	26	33
May 20, 2002	48	36	64
May 21, 2002	50	41	43
May 22, 2002	70	34	42
May 23, 2002	51	30	34
May 24, 2002	37	26	31
May 25, 2002	51	39	46
May 26, 2002	38	29	38
May 27, 2002	34	23	24

May 28, 2002	63	33	43
May 29, 2002	57	36	71
May 30, 2002	30	22	27
May 31, 2002	28	21	27
June 1, 2002	28	21	25
June 2, 2002	35	27	31
June 3, 2002	39	32	40
June 4, 2002	32	29	29
June 5, 2002	39	25	31
June 6, 2002	54	37	48
June 7, 2002	60	45	54
June 8, 2002	40	37	47
June 9, 2002	52	39	49
June 10, 2002	88	52	83
June 11, 2002	42	16	31
June 12, 2002	31	17	26
June 13, 2002	118	38	73
June 14, 2002	42	27	35
June 15, 2002	60	32	51
June 16, 2002	35	23	38
June 17, 2002	45	25	35
June 18, 2002	53	33	43
June 19, 2002	48	28	41
June 20, 2002	76	36	42
June 21, 2002	96	42	52
June 22, 2002	50	29	43
June 23, 2002	51	36	48
June 24, 2002	74	46	74
June 25, 2002	62	43	58
June 26, 2002	51	37	45
June 27, 2002	52	35	49
June 28, 2002	43	32	41
June 29, 2002	42	30	40
June 30, 2002	50	37	46
July 1, 2002	45	30	50
July 2, 2002	51	29	34
July 3, 2002	51	32	44
July 4, 2002	41	31	55

July 5, 2002	54	37	53
July 6, 2002	52	41	68
July 7, 2002	49	35	45
July 8, 2002	51	33	48
July 9, 2002	62	51	58
July 10, 2002	45	36	41
July 11, 2002	40	40	44
July 12, 2002	44	35	54
July 13, 2002	44	34	60
July 14, 2002	53	35	46
July 15, 2002	48	37	73
July 16, 2002	55	46	77
July 17, 2002	64	52	91
July 18, 2002	54	40	83
July 19, 2002	39	30	48
July 20, 2002	52	41	63
July 21, 2002	39	32	42
July 22, 2002	41	32	34
July 23, 2002	56	43	53
July 24, 2002	48	33	49
July 25, 2002	51	41	68
July 26, 2002	58	44	57
July 27, 2002	58	42	47
July 28, 2002	48	34	42
July 29, 2002	38	30	46
July 30, 2002	30	26	33
July 31, 2002	36	29	46
August 1, 2002	37	37	45
August 2, 2002	43	39	43
August 3, 2002	53	44	69
August 4, 2002	48	46	54
August 5, 2002	57	44	65
August 6, 2002	59	51	62
August 7, 2002	71	59	76
August 8, 2002	33	27	34
August 9, 2002	32	28	43
August 10, 2002	41	35	45
August 11, 2002	55	46	57

August 12, 2002	101	79	119
August 13, 2002	71	54	78
August 14, 2002	44	34	51
August 15, 2002	30	23	57
August 16, 2002	32	23	33
August 17, 2002	33	27	33
August 18, 2002	29	28	31
August 19, 2002	37	29	37
August 20, 2002	32	21	37
August 21, 2002	41	32	40
August 22, 2002	37	37	54
August 23, 2002	44	37	48
August 24, 2002	61	48	72
August 25, 2002	61	45	59
August 26, 2002	79	51	81
August 27, 2002	61	46	61
August 28, 2002	54	44	59
August 29, 2002	60	36	62
August 30, 2002	59	44	64
August 31, 2002	40	31	37
September 1, 2002	28	23	27
September 2, 2002	29	26	29
September 3, 2002	32	25	30
September 4, 2002	37	29	40
September 5, 2002	38	26	38
September 6, 2002	35	26	39
September 7, 2002	57	46	65
September 8, 2002	66	55	72
September 9, 2002	84	67	92
September 10, 2002	87	67	105
September 11, 2002	64	46	64
September 12, 2002	71	56	76
September 13, 2002	58	46	62
September 14, 2002	38	44	54
September 15, 2002			
September 16, 2002			16
September 17, 2002		14	42
September 18, 2002	12	22	29

September 19, 2002	23	23	25
September 20, 2002	29	25	34
September 21, 2002	28	27	74
September 22, 2002	32	47	55
September 23, 2002	31	44	87
September 24, 2002	20	62	110
September 25, 2002	20	69	84
September 26, 2002	22	74	113
September 27, 2002	15	28	39
September 28, 2002		49	40
September 29, 2002		17	22
September 30, 2002		22	30
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October 2, 2002	18	15	19
October 3, 2002	25	19	21
October 4, 2002	23	17	29
October 5, 2002	29	21	29
October 6, 2002	32	27	31
October 7, 2002	25	15	26
October 8, 2002	27	16	20
October 9, 2002	40	24	50
October 10, 2002	46	30	52
October 11, 2002	56	33	59
October 12, 2002	56	38	52
October 13, 2002	36	24	29
October 14, 2002	24	11	24
October 15, 2002	17	11	17
October 16, 2002	20	14	20
October 17, 2002	43	30	40
October 18, 2002	55	40	63
October 19, 2002	49	34	46
October 20, 2002	29	21	22
October 21, 2002	24	19	25
October 22, 2002	47	34	44
October 23, 2002	69	51	57
October 24, 2002	78	57	67
October 25, 2002	44	10	31
October 26, 2002	33	24	31

October 27, 2002	35	31	32
October 28, 2002	52	38	44
October 29, 2002	32	24	32
October 30, 2002	27	22	35
October 31, 2002	41	33	48
November 1, 2002	42	38	43
November 2, 2002	60	42	69
November 3, 2002	55	51	59
November 4, 2002	57	46	66
November 5, 2002	30	25	27
November 6, 2002	14	12	11
November 7, 2002	31	15	25
November 8, 2002			51
November 9, 2002			23
November 10, 2002			26
November 11, 2002	18		16
November 12, 2002	45		38
November 13, 2002	44		27
November 14, 2002	64		60
November 15, 2002	73		77
November 16, 2002	76		77
November 17, 2002	58		77
November 18, 2002	87	92	84
November 19, 2002	83	70	81
November 20, 2002	81	71	88
November 21, 2002	73	79	75
November 22, 2002	56	49	59
November 23, 2002	34	38	32
November 24, 2002	25	21	23
November 25, 2002	37	37	38
November 26, 2002	48	44	47
November 27, 2002	61	53	65
November 28, 2002	54	53	59
November 29, 2002	50	51	61
November 30, 2002	70	77	76
December 1, 2002	65	68	69
December 2, 2002	55	56	53
December 3, 2002	22	24	18

December 4, 2002	21	19	17
December 5, 2002	12	13	11
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December 7, 2002	23	17	16
December 8, 2002	11	9	6
December 9, 2002	26	19	28
December 10, 2002	18	14	32
December 11, 2002	25	25	28
December 12, 2002	38	35	30
December 13, 2002	64	63	40
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December 15, 2002	36	24	10
December 16, 2002	36	34	34
December 17, 2002	42	37	46
December 18, 2002	46	54	45
December 19, 2002	17	18	15
December 20, 2002	17	19	15
December 21, 2002	39	40	39
December 22, 2002	59	67	55
December 23, 2002	84	92	78
December 24, 2002	40	50	32
December 25, 2002	21	21	15
December 26, 2002	29	24	27
December 27, 2002	68	70	73
December 28, 2002	88	78	78
December 29, 2002	37	37	34
December 30, 2002	25	25	21
December 31, 2002	31	31	30
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January 2, 2003	12	14	11
January 3, 2003	38	41	35
January 4, 2003	52	50	44
January 5, 2003	62	54	61
January 6, 2003	54	47	46
January 7, 2003	38	33	38
January 8, 2003	63	50	55
January 9, 2003	50	45	47
January 10, 2003	63	54	64

January 11, 2003	60	60	46
January 12, 2003	38	39	33
January 13, 2003	20	20	21
January 14, 2003	39	38	35
January 15, 2003	43	61	36
January 16, 2003	44	46	45
January 17, 2003	52	50	47
January 18, 2003	43	44	40
January 19, 2003	22	22	18
January 20, 2003	28	20	16
January 21, 2003	35	32	29
January 22, 2003	53	55	45
January 23, 2003	32	34	23
January 24, 2003	35	37	30
January 25, 2003	25	23	20
January 26, 2003	20	19	18
January 27, 2003	20	19	18
January 28, 2003	23	28	16
January 29, 2003	41	35	39
January 30, 2003	40	31	43
January 31, 2003	35	35	31
February 1, 2003	26	23	18
February 2, 2003	7	8	5
February 3, 2003	10	14	10
February 4, 2003	35	32	32
February 5, 2003	20	16	22
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February 13, 2003	14	10	12
February 14, 2003	17	16	13
February 15, 2003	23	24	20
February 16, 2003	36	36	29
February 17, 2003	38	32	30

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February 21, 2003	34	32	29
February 22, 2003	25	18	23
February 23, 2003	20	21	18
February 24, 2003	31	29	29
February 25, 2003	29	24	20
February 26, 2003	23	23	23
February 27, 2003	37	35	34
February 28, 2003	44	44	51
March 1, 2003	54	53	54
March 2, 2003	50	49	43
March 3, 2003	64	58	67
March 4, 2003	64	62	57
March 5, 2003	10	9	7
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March 7, 2003	33	29	33
March 8, 2003	43	44	39
March 9, 2003	54	48	43
March 10, 2003	52	47	43
March 11, 2003	55	45	46
March 12, 2003	45	34	39
March 13, 2003	65	51	56
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March 22, 2003	22	25	17
March 23, 2003	23	22	18
March 24, 2003	37	30	22
March 25, 2003	23	19	33
March 26, 2003	47	37	47
March 27, 2003	51	42	38

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March 29, 2003	33	32	29
March 30, 2003	41	47	40
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April 2, 2003	21	26	33
April 3, 2003	39	40	41
April 4, 2003	40	43	40
April 5, 2003	31	36	26
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April 7, 2003	24	24	24
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April 10, 2003	29	31	29
April 11, 2003	32	23	30
April 12, 2003	33	31	34
April 13, 2003	49	-	55
April 14, 2003	27	33	23
April 15, 2003			
April 16, 2003	55		46
April 17, 2003	58	47	58
April 18, 2003	16	21	16
April 19, 2003	11	19	10
April 20, 2003	34	67	37
April 21, 2003	88		97
April 22, 2003	81	90	80
April 23, 2003	40	47	43
April 24, 2003	34	35	37
April 25, 2003	49	46	52
April 26, 2003	36	35	33
April 27, 2003	52	52	48
April 28, 2003	52	52	48
April 29, 2003	32	35	44
April 30, 2003	33	33	44
May 1, 2003	42	42	48
May 2, 2003	46	53	58
May 3, 2003	49	55	66
May 4, 2003	61	70	63

May 5, 2003	57	66	64
May 6, 2003	41	48	45
May 7, 2003	35	37	51
May 8, 2003	28	31	44
May 9, 2003	36	41	52
May 10, 2003	53	49	53
May 11, 2003	48	52	46
May 12, 2003	51	53	68
May 13, 2003	57	56	65
May 14, 2003	50	54	55
May 15, 2003	59	63	63
May 16, 2003	48	54	50
May 17, 2003	51	61	47
May 18, 2003	39	49	42
May 19, 2003	41	47	46
May 20, 2003	36	37	44
May 21, 2003	43	50	46
May 22, 2003	45	48	49
May 23, 2003	31	38	37
May 24, 2003	15	20	17
May 25, 2003	15	17	15
May 26, 2003	24	19	21
May 27, 2003	30	24	28
May 28, 2003	23	22	24
May 29, 2003	26	30	34
May 30, 2003	30	36	41
May 31, 2003	34	38	35
June 1, 2003	27	28	30
June 2, 2003	45	39	39
June 3, 2003	31	36	45
June 4, 2003	35	34	39
June 5, 2003	36	44	59
June 6, 2003	33	51	41
June 7, 2003	36	42	36
June 8, 2003	33	43	34
June 9, 2003	44	48	50
June 10, 2003	35	39	45
June 11, 2003	39	48	51

June 12, 2003	34	51	58
June 13, 2003	45	50	42
June 14, 2003	39	46	60
June 15, 2003	35	44	41
June 16, 2003	42	44	56
June 17, 2003	47	52	61
June 18, 2003	27	26	35
June 19, 2003	26	48	32
June 20, 2003	38	54	50
June 21, 2003	32	52	36
June 22, 2003	40	42	42
June 23, 2003	57	53	61
June 24, 2003	55	114	64
June 25, 2003	55	116	77
June 26, 2003	58	98	91
June 27, 2003	64	64	80
June 28, 2003	55		79
June 29, 2003	46		45
June 30, 2003	64		71
July 1, 2003	47		54
July 2, 2003	48		63
July 3, 2003	65	251	91
July 4, 2003	64	149	91
July 5, 2003	73	114	98
July 6, 2003	41	99	45
July 7, 2003	43	83	58
July 8, 2003	45	89	64
July 9, 2003	39	111	46
July 10, 2003	47	137	60
July 11, 2003	62	134	109
July 12, 2003	56	85	72
July 13, 2003	26	52	41
July 14, 2003	45	52	58
July 15, 2003	41	87	51
July 16, 2003	49	60	61
July 17, 2003	52	65	67
July 18, 2003	56	92	64
July 19, 2003	52	56	51

July 20, 2003	40	41	44
July 21, 2003	48	37	56
July 22, 2003	50	52	66
July 23, 2003	49	41	43
July 24, 2003	44	35	70
July 25, 2003	67	68	68
July 26, 2003	38	40	43
July 27, 2003	30	36	32
July 28, 2003	38	43	41
July 29, 2003	44	42	53
July 30, 2003	50	57	70
July 31, 2003	70	81	108
August 1, 2003	59	67	79
August 2, 2003	53	74	72
August 3, 2003	33	40	37
August 4, 2003	53	61	98
August 5, 2003	63	71	109
August 6, 2003	33	44	47
August 7, 2003	46	42	59
August 8, 2003	41	34	48
August 9, 2003	33	28	51
August 10, 2003	28	28	33
August 11, 2003	42	48	74
August 12, 2003	42	47	106
August 13, 2003	36	33	66
August 14, 2003	32	33	75
August 15, 2003	46	40	59
August 16, 2003	58	52	94
August 17, 2003	40	38	39
August 18, 2003	44	36	59
August 19, 2003	47	42	62
August 20, 2003	42	38	74
August 21, 2003	45	39	59
August 22, 2003	43	35	47
August 23, 2003	44	35	44
August 24, 2003	28	35	29
August 25, 2003	38	68	86
August 26, 2003	46	45	72

August 27, 2003	60	89	86
August 28, 2003	56	71	80
August 29, 2003	43	48	79
August 30, 2003	48	64	85
August 31, 2003	65	70	85
September 1, 2003	103	99	135
September 2, 2003	57	60	95
September 3, 2003	37	40	55
September 4, 2003	28	18	42
September 5, 2003	26	34	37
September 6, 2003	33	58	41
September 7, 2003	18	25	
September 8, 2003	28	33	
September 9, 2003	48	56	52
September 10, 2003	56	59	57
September 11, 2003	56	36	41
September 12, 2003	56	46	60
September 13, 2003	33	39	44
September 14, 2003	24	14	31
September 15, 2003	27	51	37
September 16, 2003	26	21	36
September 17, 2003	36	34	70
September 18, 2003	48	44	70
September 19, 2003	49	46	97
September 20, 2003	30	26	59
September 21, 2003	24	25	28
September 22, 2003	52	40	61
September 23, 2003	53	61	90
September 24, 2003	62	74	87
September 25, 2003	47	50	69
September 26, 2003	37	34	41
September 27, 2003	42	35	49
September 28, 2003	37	34	41
September 29, 2003	41	48	49
September 30, 2003	49	58	51
October 1, 2003	43	38	51
October 2, 2003	36	28	48
October 3, 2003	39	44	69

October 4, 2003	65	54	108
October 5, 2003	64	31	73
October 6, 2003	78	77	96
October 7, 2003	73	40	102
October 8, 2003	50	48	71
October 9, 2003	20	3	37
October 10, 2003	20	6	31
October 11, 2003	15	6	44
October 12, 2003	13	7	17
October 13, 2003	22	12	35
October 14, 2003	37	12	52
October 15, 2003	26	14	47
October 16, 2003	41	13	52
October 17, 2003	33		46
October 18, 2003	26		41
October 19, 2003	22		27
October 20, 2003	45	40	79
October 21, 2003	44	35	87
October 22, 2003	34	39	104
October 23, 2003	52		101
October 24, 2003	49		91
October 25, 2003	40		55
October 26, 2003	15		19
October 27, 2003	26		51
October 28, 2003	14		
October 29, 2003	11		
October 30, 2003	27		
October 31, 2003	48		48
November 1, 2003	75	90	63
November 2, 2003	49	43	42
November 3, 2003	96	76	77
November 4, 2003	79		83
November 5, 2003	44		34
November 6, 2003	13		9
November 7, 2003	15		15
November 8, 2003	15		8
November 9, 2003	25		19
November 10, 2003	12		10

November 11, 2003	29		25
November 12, 2003	34		34
November 13, 2003	39		43
November 14, 2003	50		41
November 15, 2003	67		63
November 16, 2003	60		53
November 17, 2003	69		61
November 18, 2003	78		72
November 19, 2003	39		48
November 20, 2003	50		53
November 21, 2003	65		73
November 22, 2003	68		54
November 23, 2003	66		53
November 24, 2003	56		55
November 25, 2003	60		55
November 26, 2003	74		61
November 27, 2003	70		65
November 28, 2003	71		71
November 29, 2003	77		85
November 30, 2003	68		65

APPENDIX B

METEOROLOGICAL DATA PART 1

Table B Meteorological data part 1

DATE	Average Air Pressure (mb)	Air Temperature ©			Average Humidity (%)	Rain Fall (mm)
		Max	Min	Avg.		
7.1.2001	998,55	31,04	18,25	24,78	52,54	0
7.2.2001	997,17	31,16	19,46	25,08	55,15	0
7.3.2001	996,43	28,21	20,47	23,39	69,12	0
7.4.2001	998,91	31,19	17,32	24,84	58,8	0
7.5.2001	999,24	33,87	20,57	27,39	39,36	0
7.6.2001	999,2	34,49	20,51	27,96	42,14	0
7.7.2001	1000,5	31,81	20,67	26,69	48,19	0
7.8.2001	1000	35,03	21,88	28,26	45,81	0
7.9.2001	996,59	36,72	21,85	29,34	41,03	0
7.10.2001	996,99	36,48	24,9	30,33	35,94	0
7.11.2001	996,6	35,46	23,3	27,53	47,92	0
7.12.2001	994,54	33,68	24,32	29,68	46,58	0
7.13.2001	995,21	35,26	23,5	28,58	53,05	0
7.14.2001	996,13	35,92	22,34	29,23	51,1	0
7.15.2001	997,54	38,04	23,59	30,224	50,55	0
7.16.2001	997,74	36,48	23,28	29,8	49,4	0
7.17.2001	995,42	36,45	24,32	30,15	40,02	0
7.18.2001	989,81	38,36	21,46	30,64	39,93	0
7.19.2001	993,4	37,56	25,15	31,14	38,18	0
7.20.2001	995,72	38,38	23,28	30,52	43,1	0
7.21.2001	993,33	35,91	22,45	29,62	43,68	0
7.22.2001	994,36	31,78	20	26,8	48,13	0
7.23.2001	995,7	32,13	20,59	26,29	56,3	0
7.24.2001	995,93	33,69	21,24	27,94	47,44	0
7.25.2001	996,74	35,25	24,06	29,25	49,2	0
7.26.2001	997,38	37,17	23,42	30,22	43,73	0
7.27.2001	996,77	36,96	23,89	30,03	38,56	0
7.28.2001	997,84	37,36	24,14	30,59	41,4	0
7.29.2001	997,33	36,12	24,64	30,72	41,64	0
7.30.2001	996,5	35,34	24,19	29,65	51,1	0
7.31.2001	995,69	34,49	26,04	29,34	55,26	0
8.1.2001	994,59	32,73	26,61	29,12	59,12	1,20

8.2.2001	996,46	32,58	23,21	28,25	59,42	0,20
8.3.2001	999,52	32,05	23,72	27,5	57,22	0,00
8.4.2001	1001,10	34,47	23,95	28,43	49,48	0,00
8.5.2001	999,53	37,04	20,93	28,45	53,59	0,00
8.6.2001	997,57	36,47	21,27	28,67	52,68	0,00
8.7.2001	995,71	37,96	21,61	29,33	50,60	0,00
8.8.2001	997,66	36,15	22,25	28,98	52,04	0,00
8.9.2001	998,29	38,78	23,36	30,8	45,59	0,00
8.10.2001	999,15	40,43	27,77	31,83	46,14	0,00
8.11.2001	996,46	37,14	24,36	29,18	62,21	0,00
8.12.2001	992,85	36,75	23,84	29,51	60,76	0,00
8.13.2001	994,41	30,42	23,20	26,92	64,26	0,00
8.14.2001	1000,30	32,89	25,16	29,34	49,62	0,00
8.15.2001	1002,00	33,73	23,29	27,76	50,78	0,60
8.16.2001	1000,40	34,82	23,26	28,15	53,18	0,20
8.17.2001	998,57	34,70	22,39	27,98	54,90	0,00
8.18.2001	996,42	33,16	21,82	27,31	53,64	0,00
8.19.2001	995,92	33,69	22,11	27,47	53,62	0,00
8.20.2001	997,60	32,37	20,58	26,55	55,96	0,00
8.21.2001	999,73	32,97	21,27	27,22	55,42	0,00
8.22.2001	1000,50	34,48	19,93	27,85	43,56	0,00
8.23.2001	999,07	34,11	21,34	28,30	48,20	8,00
8.24.2001	998,44	34,53	21,00	27,67	58,12	0,00
8.25.2001	998,47	34,26	22,73	27,88	60,94	0,00
8.26.2001	998,81	32,16	22,69	27,12	51,42	0,00
8.27.2001	996,43	33,45	22,17	26,76	42,37	0,00
8.28.2001	995,21	34,55	20,43	26,96	46,52	0,00
8.29.2001	995,28	33,71	21,76	27,71	41,14	0,00
8.30.2001	995,39	31,77	19,89	26,05	51,90	0,00
8.31.2001	999,86	30,64	17,35	24,23	40,26	0,00
9.1.2001	999,44	32,48	18,47	24,65	45,25	0,00
9.2.2001	999,13	31,74	18,75	25,25	52,05	0,00
9.3.2001	1000,20	30,61	22,95	27,43	44,27	0,00
9.4.2001	1001,10	30,72	16,90	24,94	50,77	0,00
9.5.2001	996,55	31,01	18,02	24,57	48,19	2,20
9.6.2001	989,65	27,84	20,08	25,52	63,66	11,00
9.7.2001	992,59	25,16	18,91	22,32	69,68	0,00
9.8.2001	997,64	27,07	15,29	21,35	65,49	0,00
9.9.2001	999,92	28,75	14,26	22,06	55,27	0,00
9.10.2001	998,44	28,74	16,15	23,34	61,82	0,00
9.11.2001	996,55	28,63	18,92	24,42	70,76	0,00
9.12.2001	998,87	27,76	18,36	24,02	67,75	0,00
9.13.2001	1002,30	27,93	15,16	21,80	58,74	0,00
9.14.2001	999,30	29,78	16,13	22,29	45,06	0,00
9.15.2001	999,06	28,09	16,52	21,78	59,28	0,00
9.16.2001	997,84	27,82	15,38	21,60	62,53	0,00
9.17.2001	998,35	29,65	15,98	23,24	62,18	0,00
9.18.2001	1002,50	30,34	16,50	23,98	65,27	0,00
9.19.2001	1003,10	35,01	17,25	25,51	55,29	0,00
9.20.2001	1001,80	34,23	20,15	26,46	50,17	0,00
9.21.2001	999,66	32,11	20,45	24,80	60,37	0,00

9.22.2001	1000,30	30,50	18,77	23,78	60,80	0,00
9.23.2001	1001,70	30,80	17,80	23,62	60,12	0,00
9.24.2001	1002,20	32,38	16,08	24,49	45,49	0,00
9.25.2001	999,33	34,23	19,12	26,23	51,85	0,00
9.26.2001	997,19	32,17	18,33	25,28	55,73	0,00
9.27.2001	996,89	24,66	15,73	20,58	71,37	7,80
9.28.2001	1003,70	22,86	13,98	17,82	63,90	0,00
9.29.2001	1004,30	25,80	13,11	18,83	54,84	0,00
9.30.2001	1005,60	27,11	12,33	20,02	48,76	0,00
10.1.2001	1005,40	28,67	11,49	21,11	50,72	0,20
10.2.2001	1006,00	29,49	15,97	21,49	60,82	0,00
10.3.2001	1004,80	32,09	16,34	22,48	61,43	0,00
10.4.2001	1000,30	28,51	16,84	22,36	64,53	0,00
10.5.2001	1000,30	28,00	15,04	21,87	70,33	0,00
10.6.2001	1001,50	28,53	14,13	21,51	64,13	0,00
10.7.2001	1002,20	28,23	16,94	22,08	65,20	0,00
10.8.2001	1003,60	27,31	17,71	21,66	63,74	0,00
10.9.2001	1003,40	28,71	17,73	22,36	67,89	0,00
10.10.2001	1005,30	28,53	18,88	22,70	68,37	0,00
10.11.2001	1006,00	30,17	18,33	23,52	52,27	0,00
10.12.2001	1005,10	28,42	17,46	22,34	48,92	0,00
10.13.2001	1004,90	23,87	17,02	19,90	53,52	0,00
10.14.2001	1002,70	24,01	15,99	19,04	61,02	0,00
10.15.2001	1002,50	23,80	15,38	19,11	61,02	0,00
10.16.2001	1004,80	24,58	14,04	19,09	59,64	0,00
10.17.2001	1005,90	22,09	14,62	18,21	59,12	0,00
10.18.2001	1005,40	22,70	11,50	16,39	57,26	0,00
10.19.2001	1004,60	24,57	11,72	16,91	59,74	0,00
10.20.2001	1005,10	24,40	8,68	16,76	54,16	0,00
10.21.2001	1003,90	24,01	9,12	16,96	56,62	0,00
10.22.2001	1001,40	25,62	11,78	18,83	54,51	0,00
10.23.2001	1000,90	25,58	14,07	19,70	59,85	0,20
10.24.2001	1005,10	23,61	12,66	17,84	55,57	0,00
10.25.2001	1006,30	17,45	11,52	14,32	55,04	0,00
10.26.2001	1005,20	17,99	9,68	13,06	49,15	0,00
10.27.2001	1006,30	18,10	9,04	13,20	56,50	0,00
10.28.2001	1008,60	12,27	9,03	12,94	68,42	0,00
10.29.2001	1008,50	17,97	9,16	13,60	58,72	0,00
10.30.2001	1009,00	19,05	4,67	12,92	56,69	0,00
10.31.2001	1010,70	21,43	10,86	16,32	54,52	0,00
11.1.2001	1007,90	22,73	9,71	16,69	57,43	0,00
11.2.2001	1005,10	12,26	9,82	13,02	79,28	4,40
11.3.2001	1001,90	13,28	8,15	10,97	71,87	0,40
11.4.2001	998,59	14,55	11,37	12,98	79,09	10,00
11.5.2001	998,91	14,62	11,45	12,84	96,35	4,80
11.6.2001	1004,60	17,06	10,14	13,05	87,41	0,00
11.7.2001	1003,90	18,12	8,31	13,85	86,28	4,20
11.8.2001	998,22	15,81	13,91	14,71	97,21	11,00
11.9.2001	998,23	21,56	12,52	17,19	85,33	0,60
11.10.2001	1006,20	22,18	14,66	17,81	85,06	0,20
11.11.2001	1012,50	20,87	12,78	15,96	85,67	0,00

11.12.2001	1008,10	21,15	9,86	15,74	78,89	0,00
11.13.2001	999,75	24,20	12,80	19,11	60,40	0,00
11.14.2001	999,74	21,11	16,62	19,55	78,68	5,60
11.15.2001	1009,80	22,01	10,23	15,36	83,90	0,00
11.16.2001	1011,80	15,39	8,40	11,62	75,58	0,00
11.17.2001	1013,30	11,50	5,40	8,12	59,84	0,00
11.18.2001	1013,30	11,86	1,66	6,63	51,60	0,00
11.19.2001	1006,70	13,54	0,41	7,56	70,04	39,40
11.20.2001	997,99	14,32	6,37	10,24	97,34	25,40
11.21.2001	1010,00	8,43	1,64	5,81	58,47	0,20
11.22.2001	1012,60	9,93	-0,92	4,38	63,83	0,00
11.23.2001	1001,20	14,30	0,22	7,36	72,65	4,80
11.24.2001	992,30	20,80	6,60	11,80	79,70	4,90
11.25.2001	1005,40	8,70	1,90	3,20	80,70	11,00
11.26.2001	1008,70	8,00	0,70	4,30	92,30	3,80
11.27.2001	1014,40	16,80	4,50	5,00	76,30	5,40
11.28.2001	1013,90	16,00	3,00	10,80	73,70	
11.29.2001	1000,60	13,00	10,00	11,70	91,30	19,80
11.30.2001	1002,90	11,70	6,80	8,20	75,30	2,80
12.1.2001						0
12.2.2001						0
12.3.2001						1.0
12.4.2001						0
12.5.2001						0
12.6.2001						0
12.7.2001						0
12.8.2001						0
12.9.2001						1,9
12.10.2001						0,1
12.11.2001						0
12.12.2001						0
12.13.2001						0
12.14.2001						0
12.15.2001						0
12.16.2001						4,8
12.17.2001						48,7
12.18.2001						10,3
12.19.2001						1,3
12.20.2001						0
12.21.2001						0,2
12.22.2001						57,7
12.23.2001	1010,9	11,7	1,9	8,4	87,3	2,2
12.24.2001	1008,9	16,1	9,7	14,2	82	6,3
12.25.2001	998,5	17,7	7,5	10,6	80,3	5,3
12.26.2001	1006,5	12,7	1,8	6,1	74,3	17,2
12.27.2001	997,7	9,2	4,4	8,5	90,3	6,9
12.28.2001						
12.29.2001						
12.30.2001						
12.31.2001						
1.1.2002	1012,9	15,3	2,3	5,8	81,5	3,1

1.2.2002	1016,3	3,1	-2,4	-0,8	64,3	30,7
1.3.2002	1014,6	1,3	-4,9	-0,8	78,3	
1.4.2002	1009,8	1,1	-1,8	-0,5	71,7	3,4
1.5.2002	1016,3	-0,8	-3,9	-2,7	64	0,3
1.6.2002	1012,9	1,9	-3,1	0,4	63,7	
1.7.2002	1016,9	5	-3,2	1,2	65,7	
1.8.2002	1022,4	6,3	0,1	3	68	
1.9.2002	1026	2,5	-0,9	1	64	
1.10.2002	1026,8	4,6	-2,4	2	65	
1.11.2002	1025,1	8	0	2,6	67,7	
1.12.2002	1021,7	10,1	-0,9	3,4	63,3	
1.13.2002	1021,3	9,2	-0,4	3,3	73,7	
1.14.2002	1019,8	8,1	1,1	4,9	71,3	
1.15.2002	1017,3	7,8	1,9	3,8	68,7	
1.16.2002	1018,6	11	0	5,2	69	
1.17.2002	1018,8	13,4	1,9	8,9	73,3	
1.18.2002	1014,5	11,1	7,7	9,5	86,3	0,7
1.19.2002	1011,8	13,6	7	9,1	85	7,4
1.20.2002	1014,8	11	6	7,2	80,3	
1.21.2002	1014,4	13,4	2,2	7,6	74,3	
1.22.2002	1012,7	15,3	4,8	8,6	70,3	
1.23.2002	1016,2	17	1,9	8,4	68,7	
1.24.2002	1017	14,9	2,6	8,4	74,3	
1.25.2002	1015,4	15,7	5,1	11	79,3	
1.26.2002	1020,6	18	8,3	11,5	77	1,2
1.27.2002	1015,3	18	4,7	10,7	80	
1.28.2002	1015,1	17,9	4,7	10,5	74,7	
1.29.2002	1021,8	19,1	3,9	10,3	72,7	
1.30.2002	1022,8	20,3	4	10,6	72,3	
1.31.2002	1021,4	20,1	4,5	10,9	69,3	
2.1.2002	1019,8	19,3	3,7	11,5	76	
2.2.2002	1023,5	19,6	8	13,2	66,7	
2.3.2002	1022,9	18,1	6,2	11	63,7	
2.4.2002	1018,4	19,5	4,8	10,5	70	
2.5.2002	1018	14,1	4	9,8	81	
2.6.2002	1014,5	17,8	7	11,6	78,7	
2.7.2002	1014,6	19,1	5	11,3	71,3	
2.8.2002	1014,3	23	5,5	12,5	67,7	
2.9.2002	1012,2	19,2	5,9	12,2	68,7	
2.10.2002	1005,3	15	5,9	10	68,7	
2.11.2002	1000,6	14,2	7,9	10	68,3	
2.12.2002	1010	15,1	7	9,6	61	
2.13.2002	1011	19,7	6,8	11,5	64	
2.14.2002	1011	21	4,8	13,4	72	
2.15.2002	1019	20	8	11,6	73,2	
2.16.2002	1022,6	13	4,9	7,1	58,7	
2.17.2002	1023,9	14,9	2,1	7,9	56,3	
2.18.2002	1021	19,2	0,5	9,4	58	
2.19.2002	1016,9	20	4,9	13,1	63,7	
2.20.2002	1009,6	16,7	8,7	11,7	81,3	
2.21.2002	1004,9	17,1	10	12,1	79	39,5

2.22.2002	1006,2	20,1	5,6	12,3	69,7	
2.23.2002	1003,6	12,6	7,8	9,9	86,7	
2.24.2002	997,9	16,8	8,9	12,4	76,3	8,6
2.25.2002	1004,6	12,9	3	6,8	63	7,2
2.26.2002	1015,2	14	-1	6,9	75	
2.27.2002	1013,4	16,2	3,4	10,8	74	
2.28.2002	1011,7	15,1	10	12,2	85	1,2
3.1.2002	1013,90	20,50	6,70	13,00	74,70	
3.2.2002	1013,60	21,80	8,00	13,80	69,70	
3.3.2002	1011,70	21,80	6,90	14,00	72,30	
3.4.2002	1011,60	22,00	8,00	14,80	66,70	
3.5.2002	1015,00	23,10	9,90	15,80	60,70	
3.6.2002	1017,00	26,00	9,50	16,90	70,00	
3.7.2002	1015,00	26,10	10,40	16,90	59,70	
3.8.2002	1012,10	21,20	9,50	17,60	59,30	
3.9.2002	1015,20	21,10	13,20	15,20	53,30	
3.10.2002	1008,80	23,80	9,00	17,00	59,00	
3.11.2002	1004,00	17,00	12,20	10,80	78,70	
3.12.2002	1008,10	15,10	10,90	12,20	86,70	8,40
3.13.2002	1012,30	14,10	8,10	10,80	78,00	18,80
3.14.2002	1015,00	18,00	5,40	11,60	78,00	
3.15.2002	1009,40	21,60	6,80	13,60	72,70	
3.16.2002	1009,60	21,20	8,00	12,60	67,30	
3.17.2002	1011,30	12,00	7,00	8,70	68,30	
3.18.2002	1001,40	10,10	5,80	7,60	63,70	
3.19.2002	1006,80	16,30	2,70	9,20	63,70	
3.20.2002	1004,20	14,20	3,90	5,20	89,00	2,30
3.21.2002	1007,20	18,30	5,00	11,50	72,70	2,30
3.22.2002	1003,10	18,20	7,00	13,50	66,70	
3.23.2002	988,90	13,90	6,80	8,80	88,00	22,40
3.24.2002	991,20	10,60	3,50	7,00	67,30	18,10
3.25.2002	994,40	8,00	4,10	6,10	85,70	
3.26.2002	1004,00	9,00	3,90	5,90	77,30	1,00
3.27.2002	1010,00	8,00	3,10	6,00	66,70	
3.28.2002	1012,20	10,10	3,00	6,70	68,30	
3.29.2002	1014,70	12,10	2,10	7,20	70,00	
3.30.2002	1013,30	13,00	2,90	7,60	67,30	
3.31.2002	1008,20	13,30	3,00	9,40	70,70	6,70
4.1.2002	1004,50	9,70	6,40	8,00	83,30	6,00
4.2.2002	1009,10	17,50	7,30	11,40	63,30	
4.3.2002	1006,40	20,40	5,90	13,80	61,30	0,60
4.4.2002	1002,00	16,10	10,40	12,30	74,00	2,10
4.5.2002	994,20	18,80	8,80	13,60	83,20	2,10
4.6.2002	1006,00	19,70	11,00	13,80	78,00	1,40
4.7.2002	1009,90	19,10	8,00	13,50	74,70	3,00
4.8.2002	1014,40	18,00	4,00	8,80	56,70	1,80
4.9.2002	1011,30	19,10	4,80	12,20	49,00	
4.10.2002	1008,00	24,10	6,80	15,60	54,30	
4.11.2002	1009,60	21,00	8,90	13,60	67,30	
4.12.2002	1009,10	18,80	7,90	14,80	74,30	1,40
4.13.2002	1004,10	22,40	13,60	18,00	78,00	

4.14.2002	1003,50	26,10	12,80	19,20	66,70	
4.15.2002	1001,00	26,00	13,80	18,60	70,30	4,90
4.16.2002	997,00	17,80	12,10	14,50	77,00	6,70
4.17.2002	1002,20	16,80	10,80	13,40	75,30	1,30
4.18.2002	1003,40	14,50	9,80	12,00	89,00	2,10
4.19.2002	1004,70	15,10	9,30	12,20	79,70	20,10
4.20.2002	1008,90	16,00	10,90	13,30	77,00	0,50
4.21.2002	1012,40	15,20	10,90	12,20	71,70	
4.22.2002	1012,10	16,80	7,90	12,30	57,30	
4.23.2002	1010,00	21,90	5,80	13,80	60,30	
4.24.2002	1007,90	21,00	6,90	13,70	57,70	
4.25.2002	1011,00	19,90	5,10	13,00	65,70	
4.26.2002	1009,70	22,70	11,90	15,20	59,30	
4.27.2002	1009,80	22,20	7,90	15,40	63,70	
4.28.2002	1010,70	23,10	9,10	16,70	70,30	0,10
4.29.2002	1011,30	24,60	11,70	17,20	70,30	
4.30.2002	1009,30	26,10	11,00	18,30	64,00	
5.1.2002	1009,10	17,50	7,30	11,40	63,30	
5.2.2002	1008,90	26,00	10,10	18,90	56,70	
5.3.2002	1009,60	28,00	10,11	19,80	56,70	
5.4.2002	1009,70	26,10	11,00	19,00	62,00	
5.5.2002	1009,70	25,20	11,00	18,60	60,00	
5.6.2002	1010,60	26,40	11,80	18,40	61,30	
5.7.2002	1012,00	25,40	10,00	19,00	55,30	
5.8.2002	1012,00	25,50	11,00	19,40	62,30	
5.9.2002	1009,10	26,80	14,90	20,00	59,70	
5.10.2002	1008,10	25,90	9,00	18,30	56,70	
5.11.2002	1007,10	26,60	9,80	18,70	67,00	
5.12.2002	1007,40	30,00	11,80	21,10	57,30	
5.13.2002	1006,40	24,00	14,20	16,60	77,70	3,70
5.14.2002	1009,20	21,60	11,80	17,20	65,70	
5.15.2002	1011,60	24,50	9,80	19,20	53,00	
5.16.2002	1012,10	26,90	12,50	20,90	45,70	
5.17.2002	1011,20	29,00	13,70	21,80	46,30	
5.18.2002	1009,00	29,10	13,20	21,00	55,30	
5.19.2002	1007,90	30,40	12,40	22,20	50,30	
5.20.2002	1005,80	31,90	14,90	22,80	53,30	
5.21.2002	1004,50	29,30	13,90	21,40	62,00	
5.22.2002	1006,70	22,50	15,10	17,90	68,30	
5.23.2002	1006,70	24,20	14,10	18,90	59,70	
5.24.2002	1005,90	30,30	11,00	21,20	52,70	
5.25.2002	1005,90	32,00	15,10	23,60	52,30	
5.26.2002	1003,60	26,40	19,10	21,90	60,70	
5.27.2002	1004,50	25,80	16,80	20,10	70,30	
5.28.2002	1004,20	28,00	17,20	22,60	65,30	
5.29.2002	1002,10	28,20	15,00	22,00	66,30	
5.30.2002	1004,20	26,30	19,10	21,50	67,00	
5.31.2002	1008,80	25,20	15,80	20,20	69,30	
6.1.2002	1009,90	27,90	14,00	21,80	61,70	0,70
6.2.2002	1005,30	29,10	14,50	22,20	59,30	
6.3.2002	1006,20	26,30	15,60	20,60	72,00	2,40

6.4.2002	1005,40	28,60	14,90	21,30	63,00	
6.5.2002	1006,00	30,00	13,80	22,60	58,30	
6.6.2002	1009,10	32,10	16,00	24,70	57,00	
6.7.2002	1009,40	33,10	18,90	26,20	52,70	
6.8.2002	1006,70	34,50	19,70	26,70	48,00	
6.9.2002	1002,90	37,90	21,90	29,50	42,00	
6.10.2002	999,79	33,00	19,80	26,60	54,70	
6.11.2002	1000,40	28,80	19,00	23,90	60,30	
6.12.2002	1006,30	28,10	17,70	23,60	65,70	
6.13.2002	1008,30	29,90	18,90	24,90	57,70	
6.14.2002	1006,90	30,00	18,90	25,20	60,30	
6.15.2002	1006,60	32,30	18,90	26,50	45,70	
6.16.2002	1007,50	32,00	19,70	25,90	47,00	
6.17.2002	1006,00	35,00	19,50	28,40	42,70	
6.18.2002	1008,70	30,20	21,00	25,40	53,70	
6.19.2002	1011,20	29,00	11,40	24,10	52,70	
6.20.2002	1012,30	29,40	17,00	24,60	52,70	
6.21.2002	1009,10	31,10	18,90	26,00	53,70	
6.22.2002	1007,00	32,00	21,90	27,50	53,30	
6.23.2002	1008,30	35,10	21,10	29,50	54,00	
6.24.2002	1007,90	37,10	22,50	30,40	56,70	
6.25.2002	1005,40	36,90	22,90	27,80	66,30	
6.26.2002	1007,10	31,30	21,90	25,80	64,70	
6.27.2002	1006,80	28,30	21,60	24,40	64,70	
6.28.2002	1007,10	31,90	20,90	26,10	62,00	
6.29.2002	1006,60	34,30	18,90	27,40	59,70	
6.30.2002	1006,90	35,60	21,90	28,60	54,70	
7.1.2002	1006,70	33,60	21,50	26,80	60,00	
7.2.2002	1007,70	31,60	20,60	26,40	65,30	
7.3.2002	1009,60	34,30	20,00	27,70	57,00	
7.4.2002	1005,80	36,80	20,00	28,50	52,70	
7.5.2002	1005,10	36,90	29,90	29,60	53,70	
7.6.2002	1004,60	32,20	21,40	21,40	59,30	
7.7.2002	1002,90	36,20	21,60	21,60	62,00	
7.8.2002	1000,50	33,20	20,90	28,20	64,00	
7.9.2002	1000,30	33,30	24,10	28,80	62,70	
7.10.2002	1001,50	34,10	22,10	27,10	70,00	
7.11.2002	1002,30	33,10	21,90	24,80	83,70	11,90
7.12.2002	1002,90	33,90	20,90	27,80	67,30	11,40
7.13.2002	1003,80	36,00	23,00	30,00	56,30	
7.14.2002	1005,80	37,00	22,20	30,80	57,00	
7.15.2002	1006,10	38,70	23,80	31,40	44,00	
7.16.2002	1004,60	39,10	25,00	32,00	46,70	
7.17.2002	1001,90	38,20	23,90	30,40	47,70	
7.18.2002	1000,90	34,80	22,10	28,50	50,70	
7.19.2002	1003,70	36,60	20,90	28,60	55,70	
7.20.2002	1003,70	37,20	23,70	30,50	61,70	
7.21.2002	1002,90	34,20	24,00	29,30	64,00	
7.22.2002	1002,00	35,10	23,70	29,60	55,00	
7.23.2002	1002,90	36,00	22,00	29,10	54,00	
7.24.2002	1004,70	33,40	21,80	27,60	59,30	

7.25.2002	1002,30	36,00	20,10	28,90	49,00	
7.26.2002	1000,30	35,80	22,80	28,80	58,70	
7.27.2002	1003,70	34,40	22,60	28,50	66,00	
7.28.2002	1007,60	33,30	22,80	26,80	65,00	
7.29.2002	1005,70	35,70	21,10	27,80	60,30	
7.30.2002	1004,90	34,20	20,90	27,40	63,00	
7.31.2002	1004,10	34,00	21,10	27,60	65,00	
8.1.2002	1005,00	33,80	21,70	27,50	67,30	
8.2.2002	1004,80	34,50	20,80	29,00	66,00	
8.3.2002	1004,60	34,00	23,10	28,90	61,30	
8.4.2002	1003,90	36,70	25,90	30,40	55,00	
8.5.2002	1002,80	37,10	23,10	30,00	59,70	
8.6.2002	1003,00	38,40	23,60	30,40	60,30	
8.7.2002	997,40	37,40	22,90	30,70	58,30	
8.8.2002	997,80	32,00	23,80	27,40	59,00	
8.9.2002	1003,00	33,70	20,90	27,40	65,30	
8.10.2002	1005,30	34,60	20,50	28,20	67,70	
8.11.2002	1004,70	39,40	22,90	31,50	52,30	
8.12.2002	1001,30	41,30	24,80	32,30	49,30	
8.13.2002	1000,40	34,40	25,90	28,80	66,00	
8.14.2002	1001,40	32,40	22,00	27,40	57,00	
8.15.2002	1001,00	32,30	19,60	27,20	54,70	
8.16.2002	999,40	31,20	20,40	26,00	58,70	
8.17.2002	999,80	31,20	19,90	25,00	63,70	4,90
8.18.2002	1002,60	29,20	19,80	23,00	81,30	4,10
8.19.2002	1004,50	30,20	19,40	24,60	65,30	
8.20.2002	1005,80	29,40	20,90	25,00	66,00	
8.21.2002	1005,80	30,10	21,70	25,30	61,70	
8.22.2002	1006,80	30,40	17,90	24,60	57,70	
8.23.2002	1008,10	33,00	18,40	26,10	60,70	
8.24.2002	1008,90	32,80	19,90	26,60	61,30	
8.25.2002	1009,00	32,00	21,70	26,40	60,30	
8.26.2002	1009,50	31,40	21,40	25,20	60,70	
8.27.2002	1007,50	31,00	20,90	25,00	62,30	
8.28.2002	1006,60	32,70	18,60	25,50	61,70	
8.29.2002	1006,10	33,70	17,90	25,80	60,00	
8.30.2002	1004,90	31,30	20,80	24,90	65,70	
8.31.2002	1004,40	28,90	20,90	23,60	77,30	
9.1.2002	1005,30	29,20	19,00	23,20	77,70	0,40
9.2.2002	1009,30	28,90	19,60	23,50	76,30	
9.3.2002	1010,00	29,10	18,80	22,70	73,30	0,20
9.4.2002	1007,20	30,00	17,20	23,00	73,70	0,70
9.5.2002	1006,40	28,70	17,80	22,20	77,70	2,20
9.6.2002	1006,70	30,20	17,90	24,00	67,00	1,80
9.7.2002	1007,60	31,40	17,90	24,20	60,00	
9.8.2002	1007,20	33,00	18,90	25,10	60,70	
9.9.2002	1007,20	32,10	19,70	25,30	60,30	
9.10.2002	1004,80	31,00	18,60	23,80	61,30	
9.11.2002	1003,40	30,80	16,90	23,80	58,30	
9.12.2002	1006,50	30,60	17,10	22,00	68,30	
9.13.2002	1010,50	28,90	16,20	22,20	70,70	

9.14.2002	1007,30	28,10	17,90	20,30	84,30	
9.15.2002	1006,10	24,20	17,30	21,40	82,30	6,80
9.16.2002	1005,10	26,00	18,10	20,40	78,30	6,10
9.17.2002	1009,30	26,10	14,90	19,60	68,30	
9.18.2002	1010,00	27,10	13,90	20,10	54,30	
9.19.2002	1012,50	37,20	12,70	20,60	55,70	
9.20.2002	1011,70	27,20	14,20	21,00	52,00	
9.21.2002	1010,20	29,20	14,50	22,00	54,70	
9.22.2002	1007,50	31,30	14,40	22,40	58,00	
9.23.2002	1005,30	31,30	15,70	24,20	58,00	
9.24.2002	1007,10	31,00	19,00	24,60	61,70	
9.25.2002	1006,70	28,30	17,10	22,60	75,30	
9.26.2002	1002,40	35,00	18,60	24,60	65,70	
9.27.2002	1006,50	29,00	20,90	23,20	60,70	
9.28.2002	1011,10	28,00	15,50	20,40	74,00	
9.29.2002	1011,60	21,80	18,10	19,10	91,30	7,80
9.30.2002	1009,90	29,00	17,20	22,20	68,30	4,00
10.1.2002	1008,60	25,20	16,20	18,80	75,00	
10.2.2002	1014,00	20,00	12,20	15,50	69,00	4,70
10.3.2002	1012,50	21,10	12,80	16,60	65,30	
10.4.2002	1013,10	24,10	12,00	17,30	67,00	
10.5.2002	1011,70	25,10	11,90	18,00	64,30	
10.6.2002	1007,00	25,00	11,90	19,00	69,00	
10.7.2002	1004,00	26,10	15,90	20,10	73,30	5,30
10.8.2002	1008,60	25,00	15,60	19,40	76,70	21,10
10.9.2002	1012,50	23,70	16,20	19,40	79,30	0,10
10.10.2002	1015,30	27,00	13,70	19,40	68,70	0,10
10.11.2002	1011,30	26,80	14,20	20,10	67,70	
10.12.2002	1005,00	27,20	15,90	20,50	66,70	
10.13.2002	1004,80	24,20	15,70	16,50	90,00	7,10
10.14.2002	1004,50	22,10	15,10	19,10	80,70	12,60
10.15.2002	1009,10	21,10	16,50	17,80	71,30	0,30
10.16.2002	1010,60	21,90	14,90	17,30	68,00	
10.17.2002	1009,50	26,90	11,40	18,40	70,70	
10.18.2002	1009,70	26,20	11,90	18,60	77,00	
10.19.2002	1008,90	25,10	12,20	18,90	74,70	
10.20.2002	1010,50	22,90	15,00	16,90	69,70	0,60
10.21.2002	1016,10	20,40	12,00	14,40	57,30	
10.22.2002	1011,30	24,80	8,80	15,60	57,00	
10.23.2002	1009,40	25,00	10,90	18,40	62,70	
10.24.2002	1008,40	26,10	13,00	20,20	71,30	
10.25.2002	1012,00	22,80	15,00	17,30	68,00	1,50
10.26.2002	1013,00	23,20	11,80	16,20	65,70	
10.27.2002	1015,00	22,10	13,10	16,40	66,30	
10.28.2002	1011,20	25,30	8,90	16,20	61,70	
10.29.2002	1015,30	17,90	9,90	12,80	46,00	
10.30.2002	1015,60	18,10	6,30	10,90	55,70	
10.31.2002	1013,90	23,00	4,90	13,10	52,00	
11.1.2002	1015,40	20,30	8,90	13,60	67,30	
11.2.2002	1013,80	22,10	8,70	14,00	72,00	
11.3.2002	1009,90	21,30	8,00	14,70	74,30	

11.4.2002	1008,30	21,10	12,90	17,20	70,70	
11.5.2002	1006,00	21,40	15,60	16,00	92,70	3,50
11.6.2002	1010,20	15,90	11,10	13,00	85,30	43,90
11.7.2002	1006,20	20,40	12,20	16,90	71,30	57,00
11.8.2002	1003,10	17,70	12,30	14,90	77,30	17,50
11.9.2002	1000,30	19,40	11,90	13,80	78,70	5,80
11.10.2002	1000,90	18,30	11,80	14,70	81,30	10,30
11.11.2002	1007,90	14,40	7,00	9,30	67,70	33,20
11.12.2002	1013,30	16,00	3,00	9,20	65,30	0,40
11.13.2002	1015,30	16,90	6,00	10,50	64,30	
11.14.2002	1015,70	19,30	4,90	11,60	67,70	
11.15.2002	1017,40	21,40	7,90	13,60	71,00	
11.16.2002	1019,00	22,10	8,00	13,30	70,00	
11.17.2002	1020,00	23,00	7,00	13,10	72,30	
11.18.2002	1017,70	23,50	8,00	13,70	68,70	
11.19.2002	1015,70	23,10	8,00	13,60	66,70	
11.20.2002	1015,50	21,00	7,10	13,60	77,70	
11.21.2002	1012,90	16,80	7,90	12,60	77,70	
11.22.2002	1008,00	17,30	7,10	13,20	77,70	
11.23.2002	1008,70	20,10	11,30	14,50	79,00	6,20
11.24.2002	1016,50	19,00	6,90	11,40	69,00	1,50
11.25.2002	1017,10	17,10	6,10	10,80	70,00	
11.26.2002	1015,90	16,10	5,80	10,00	75,70	
11.27.2002	1013,30	16,00	8,00	10,80	76,00	
11.28.2002	1013,30	17,20	7,70	11,60	71,30	
11.29.2002	1014,10	17,90	6,10	11,20	69,70	
11.30.2002	1012,70	16,20	4,90	11,50	78,70	
12.1.2002	1010,20	18,80	9,10	13,70	72,30	
12.2.2002	1004,70	12,70	10,00	11,20	78,30	
12.3.2002	1003,90	15,50	9,00	12,80	78,70	5,70
12.4.2002	1008,30	16,00	10,80	13,80	81,00	1,00
12.5.2002	1005,30	15,00	11,00	12,00	87,00	5,10
12.6.2002	1008,10	14,40	8,90	11,90	79,70	18,40
12.7.2002	1006,20	12,00	9,10	10,20	85,30	
12.8.2002	1003,00	12,00	7,00	8,60	72,70	30,90
12.9.2002	1011,60	7,30	3,30	4,70	66,00	0,20
12.10.2002	1019,00	6,30	2,60	3,80	60,00	
12.11.2002	1022,40	7,20	-0,30	2,80	66,00	
12.12.2002	1026,70	6,90	-0,10	2,10	70,70	
12.13.2002	1023,30	5,30	-3,00	2,70	68,70	
12.14.2002	1016,90	5,90	3,70	4,60	80,70	
12.15.2002	1019,50	9,90	1,90	5,60	69,70	
12.16.2002	1018,30	9,10	1,80	5,30	67,70	
12.17.2002	1015,30	9,00	3,90	5,20	66,30	
12.18.2002	1012,50	7,70	0,30	4,60	82,00	
12.19.2002	1005,40	6,90	3,40	5,50	74,70	10,80
12.20.2002	1015,90	5,20	-0,10	1,60	53,70	3,00
12.21.2002	1018,50	5,10	-2,20	0,70	65,00	
12.22.2002	1017,20	7,80	-4,10	1,40	67,70	
12.23.2002	1013,10	8,10	-1,60	4,30	67,00	
12.24.2002	1013,20	9,00	3,40	5,40	77,30	0,70

12.25.2002	1017,40	6,10	1,90	3,20	66,70	
12.26.2002	1016,30	5,80	-0,10	1,40	60,00	
12.27.2002	1015,00	5,30	-1,00	3,60	63,30	
12.28.2002	1014,90	13,50	4,30	8,50	74,70	
12.29.2002	1009,10	16,30	5,30	10,10	83,00	
12.30.2002	1006,80	14,40	8,80	10,60	84,00	29,80
12.31.2002	1008,00	16,10	4,80	11,30	80,00	
1.1.2003	1001,90	15,30	10,80	11,80	88,70	
1.2.2003	1008,00	11,00	6,00	7,80	78,30	
1.3.2003	1005,00	13,80	7,10	11,50	78,70	
1.4.2003	1002,30	18,70	11,20	13,40	85,00	
1.5.2003	999,50	17,60	9,90	14,60	80,00	
1.6.2003	1006,30	18,20	11,20	13,30	74,00	
1.7.2003	1007,70	18,00	7,90	14,20	67,30	
1.8.2003	1009,10	18,20	12,20	13,30	77,30	
1.9.2003	1011,90	14,10	5,60	11,90	83,00	0,10
1.10.2003	1010,20	19,10	8,80	13,80	70,70	
1.11.2003	1007,10	14,40	10,00	11,70	76,70	
1.12.2003	1007,10	16,60	4,20	8,20	75,70	1,10
1.13.2003	1007,80	6,10	3,30	4,40	75,30	6,70
1.14.2003	1019,40	8,10	2,90	4,40	71,00	
1.15.2003	1023,10	9,90	-1,40	3,60	67,00	
1.16.2003	1019,70	13,70	-0,10	6,60	72,70	
1.17.2003	1020,30	12,90	2,90	7,30	72,70	
1.18.2003	1019,20	11,00	3,10	7,60	64,30	
1.19.2003	1008,30	9,50	5,40	8,50	90,00	5,60
1.20.2003	1007,20	9,40	6,90	7,90	74,70	
1.21.2003	1008,20	10,10	6,60	8,30	77,30	
1.22.2003	1008,60	11,40	3,60	8,50	79,70	
1.23.2003	1008,10	12,70	8,50	10,00	87,00	5,00
1.24.2003	1012,90	14,00	6,20	10,00	81,70	
1.25.2003	1016,10	11,20	8,70	9,60	76,00	
1.26.2003	1010,00	11,10	7,00	8,20	71,30	
1.27.2003	1004,40	9,20	6,40	7,20	69,30	
1.28.2003	1004,70	8,70	3,60	5,70	68,30	
1.29.2003	1002,60	12,70	-0,10	9,40	72,30	
1.30.2003	1003,50	17,10	11,30	13,60	69,70	0,60
1.31.2003	1000,00	15,30	9,90	11,40	80,30	7,40
2.1.2003	993,61	13,91	7,02	10,21	83,89	34,20
2.2.2003	985,66	11,08	3,46	7,64	83,90	11,40
2.3.2003	997,19	5,78	1,07	3,01	74,09	
2.4.2003	998,04	10,99	-0,98	5,02	73,86	0,20
2.5.2003	989,99	18,27	8,02	13,24	68,15	41,00
2.6.2003	992,36	15,71	6,91	11,64	72,47	32,40
2.7.2003	991,11	11,11	0,11	4,51	90,05	34,40
2.8.2003	1001,20	4,69	-0,14	2,28	72,11	
2.9.2003	1003,00	5,50	-0,58	1,94	80,69	0,20
2.10.2003	1005,70	6,30	-0,68	2,59	66,95	
2.11.2003	1004,70	5,55	0,98	3,39	66,48	1,80
2.12.2003	1000,00	5,97	2,80	4,56	76,45	0,20
2.13.2003	998,39	6,94	1,98	5,21	73,58	0,40

2.14.2003	1003,50	5,60	1,35	2,86	68,99	
2.15.2003	1006,50	6,83	-0,90	5,59	68,09	
2.16.2003	1009,50	6,30	-1,83	2,34	66,12	
2.17.2003	1005,90	5,67	2,15	3,94	65,49	7,80
2.18.2003	993,01	5,70	1,91	4,27	69,59	
2.19.2003	993,13	5,61	-0,12	2,35	65,98	
2.20.2003	997,31	6,04	-0,58	1,69	66,99	
2.21.2003	1005,50	6,55	-1,09	2,48	61,99	
2.22.2003	1012,50	4,74	-1,30	1,31	59,80	
2.23.2003	1013,20	5,26	-1,70	1,50	62,70	
2.24.2003	1008,90	6,02	-2,60	0,85	60,25	
2.25.2003	1009,50	3,50	-1,60	1,25	61,27	
2.26.2003	1012,20	4,94	-1,26	1,51	63,22	
2.27.2003	1011,80	8,62	-2,44	2,68	64,23	
2.28.2003	1013,50	12,87	-1,83	5,43	56,55	
3.1.2003	1011,30	14,70	1,26	7,81	57,83	
3.2.2003	1004,00	14,95	4,62	9,42	61,75	
3.3.2003	1000,40	15,00	1,95	8,40	61,89	
3.4.2003	998,70	8,53	2,01	5,68	81,31	14,80
3.5.2003	996,37	8,05	5,42	6,87	76,17	0,60
3.6.2003	1001,10	9,95	4,15	6,46	76,42	
3.7.2003	1006,70	16,08	3,12	7,98	76,47	0,40
3.8.2003	1007,20	14,88	2,81	8,07	75,05	
3.9.2003	1010,10	14,89	0,95	7,03	61,85	
3.10.2003	1010,60	15,49	1,04	7,90	55,43	
3.11.2003	1010,70	14,02	1,93	7,24	58,98	
3.12.2003	1007,50	13,49	0,55	7,79	60,99	
3.13.2003	998,97	17,91	3,24	11,12	66,65	17,20
3.14.2003	1000,80	12,15	2,05	7,12	79,41	
3.15.2003	1008,40	12,02	1,74	6,54	67,46	0,20
3.16.2003	1006,70	12,31	3,79	7,11	63,52	
3.17.2003	998,95	8,60	4,45	6,18	70,17	3,00
3.18.2003	1000,00	9,77	3,61	6,73	60,79	
3.19.2003	1012,20	10,22	0,92	6,18	57,82	0,20
3.20.2003	1002,60	11,42	-0,69	6,26	62,77	0,20
3.21.2003	1000,10	13,78	1,90	7,08	67,70	0,20
3.22.2003	1008,10	6,89	-0,21	3,02	52,00	
3.23.2003	1008,20	6,53	-2,00	1,93	48,01	
3.24.2003	1004,50	4,81	-1,16	1,89	54,04	0,40
3.25.2003	1002,70	11,62	2,37	6,64	44,18	
3.26.2003	1003,90	17,65	2,44	10,24	38,57	0,20
3.27.2003	1007,60	17,67	6,63	11,35	39,88	0,40
3.28.2003	1007,20	19,75	4,47	10,76	40,01	0,20
3.29.2003	1005,20	21,56	1,94	11,23	38,89	
3.30.2003	1005,20	21,10	3,65	11,76	48,75	
3.31.2003	1004,90	22,67	3,05	13,36	55,81	0,80
4.1.2003	1000,30	11,02	8,01	9,00	69,44	10,00
4.2.2003	1001,90	10,90	7,51	9,06	60,23	1,00
4.3.2003	1000,30	10,40	6,09	8,15	63,41	
4.4.2003	990,33	12,30	7,06	9,53	73,84	
4.5.2003	985,43	13,48	8,04	10,50	79,74	

4.6.2003	990,68	12,57	5,62	9,32	70,78	1,00
4.7.2003	990,56	16,09	9,53	11,03	77,68	11,00
4.8.2003	999,45	10,51	2,46	5,99	77,99	11,00
4.9.2003	1007,50	12,17	0,97	5,88	62,92	1,20
4.10.2003	1008,00	16,46	0,88	9,48	55,07	
4.11.2003	1005,90	18,36	9,27	13,44	73,08	1,20
4.12.2003	1002,40	21,83	9,27	15,53	69,51	2,00
4.13.2003	995,91	18,31	11,58	14,82	79,39	
4.14.2003	995,35	13,36	7,50	11,06	80,61	
4.15.2003	1000,40	17,00	8,35	12,03	68,69	2,00
4.16.2003	1004,40	13,53	7,55	10,63	68,89	
4.17.2003	1003,70	16,12	7,22	11,73	59,42	4,00
4.18.2003	991,87	9,96	7,68	8,96	83,44	10,00
4.19.2003	991,15	10,40	6,66	9,00	87,90	5,40
4.20.2003	1001,40	13,67	5,04	9,28	62,86	
4.21.2003	1003,20	16,21	3,99	10,22	55,19	
4.22.2003	999,45	17,19	6,99	12,29	56,84	
4.23.2003	997,36	12,99	9,16	11,19	95,69	6,80
4.24.2003	996,31	19,86	9,15	14,63	74,73	
4.25.2003	997,09	14,22	7,13	10,91	66,68	
4.26.2003	1003,10	19,82	7,05	13,46	53,93	
4.27.2003	1005,40	21,08	7,51	14,18	45,48	
4.28.2003	1003,60	23,78	9,14	15,62	49,00	0,40
4.29.2003	1007,60	24,61	10,23	17,80	56,00	
4.30.2003	1008,70	24,61	11,91	18,27	56,28	
5.1.2003	1008,50	29,24	13,60	21,05	54,75	
5.2.2003	1005,50	32,32	12,85	22,88	47,04	
5.3.2003	1003,60	34,13	15,51	23,19	50,31	
5.4.2003	1002,90	30,36	15,76	22,90	56,53	
5.5.2003	1002,20	29,92	16,09	22,52	41,66	
5.6.2003	1002,60	27,84	14,71	20,87	35,54	
5.7.2003	1003,40	27,27	12,19	19,44	40,19	
5.8.2003	1003,10	28,49	10,99	19,27	38,18	
5.9.2003	1001,40	31,08	13,40	21,95	34,52	
5.10.2003	1001,70	33,09	17,06	24,20	39,52	
5.11.2003	1001,90	34,31	19,45	26,21	55,19	
5.12.2003	1000,40	30,39	16,73	22,48	49,60	
5.13.2003	998,49	28,85	17,10	21,71	54,30	
5.14.2003	996,42	27,67	15,04	21,16	67,21	
5.15.2003	996,00	29,81	15,54	22,50	60,90	
5.16.2003	997,57	31,25	18,66	24,58	48,28	
5.17.2003	999,73	31,68	18,11	24,06	53,75	0,20
5.18.2003	1000,10	27,41	15,46	20,90	63,54	0,20
5.19.2003	999,94	24,28	14,73	19,31	67,47	
5.20.2003	999,59	28,48	15,70	21,54	49,39	
5.21.2003	998,06	28,27	15,98	21,53	49,79	
5.22.2003	996,08	28,06	13,99	21,60	57,90	
5.23.2003	996,04	23,87	14,91	19,93	65,26	3,40
5.24.2003	995,86	21,53	14,37	17,61	81,35	21,80
5.25.2003	998,26	23,01	13,22	18,53	67,70	6,40
5.26.2003	999,80	24,08	13,20	19,45	66,17	

5.27.2003	998,65	22,35	15,35	19,08	70,49	
5.28.2003	995,73	25,71	15,34	19,97	70,19	2,00
5.29.2003	990,36	26,79	15,57	21,24	59,52	2,00
5.30.2003	991,62	25,27	17,77	20,96	61,20	
5.31.2003	997,34	26,74	17,95	21,66	55,97	
6.1.2003	997,74	27,31	14,93	21,14	48,89	
6.2.2003	998,63	27,49	13,25	21,64	48,11	
6.3.2003	1000,60	30,21	13,85	22,96	44,10	
6.4.2003	1002,60	31,57	16,29	24,99	38,60	
6.5.2003	1004,00	30,80	19,38	25,31	39,39	
6.6.2003	1001,50	31,44	16,29	23,59	38,25	
6.7.2003	998,64	33,01	17,28	25,15	36,87	
6.8.2003	997,52	33,72	19,96	26,48	30,49	
6.9.2003	998,28	32,68	19,84	25,81	50,05	
6.10.2003	998,62	31,53	18,41	25,05	46,43	
6.11.2003	998,09	31,45	18,48	25,02	42,37	
6.12.2003	998,12	32,39	19,54	26,41	37,72	
6.13.2003	999,41	34,74	19,86	27,83	37,67	
6.14.2003	997,47	34,23	20,96	27,72	29,95	
6.15.2003	994,65	37,32	20,72	29,09	30,23	
6.16.2003	991,35	37,14	23,07	29,78	38,13	
6.17.2003	994,45	33,35	21,59	27,40	49,22	
6.18.2003	999,37	31,82	19,21	25,28	40,77	
6.19.2003	997,27	30,31	17,28	23,98	41,97	
6.20.2003	995,78	29,09	18,39	23,65	50,82	
6.21.2003	993,83	31,64	17,50	25,01	41,50	
6.22.2003	997,51	31,78	20,57	26,37	34,07	
6.23.2003	1001,70	33,05	16,95	26,47	31,48	
6.24.2003	1002,00	35,54	20,08	28,76	32,11	
6.25.2003	997,95	36,47	24,59	30,26	33,30	
6.26.2003	994,73	34,58	21,46	28,77	41,25	
6.27.2003	995,53	33,54	23,33	28,66	38,92	
6.28.2003	997,77	33,30	21,83	28,43	33,11	
6.29.2003	997,87	34,52	18,67	28,09	32,59	
6.30.2003	993,40	33,57	21,27	27,70	39,36	
7.1.2003	992,43	33,99	19,72	27,20	34,31	
7.2.2003	992,83	35,29	18,96	27,84	29,78	
7.3.2003	996,06	36,23	20,16	28,70	34,88	
7.4.2003	996,95	36,06	21,29	28,70	46,06	
7.5.2003	992,57	38,83	22,35	30,37	42,67	
7.6.2003	993,63	32,24	22,43	27,65	45,30	
7.7.2003	996,88	31,06	19,66	26,02	42,90	
7.8.2003	994,96	30,38	19,60	25,45	42,89	
7.9.2003	996,23	28,73	19,68	24,96	42,56	
7.10.2003	998,23	30,57	16,84	25,45	37,10	
7.11.2003	997,58	32,91	20,60	27,33	34,46	
7.12.2003	997,87	30,91	21,18	26,00	41,87	
7.13.2003	997,91	32,41	18,28	25,98	34,52	
7.14.2003	995,51	33,30	18,06	26,64	37,15	
7.15.2003	997,16	31,73	20,85	26,57	50,08	
7.16.2003	998,32	31,16	21,49	28,00	34,20	

7.17.2003	998,64	34,53	22,53	28,86	34,60	
7.18.2003	997,25	34,79	22,39	29,19	35,90	
7.19.2003	996,74	32,30	21,40	26,80	45,36	
7.20.2003	996,28	31,83	22,74	26,80	49,60	
7.21.2003	998,40	33,06	22,73	27,08	48,08	
7.22.2003	999,58	33,83	20,65	27,28	42,60	
7.23.2003	999,22	33,94	20,61	27,25	45,65	
7.24.2003	997,42	34,60	20,99	27,84	41,73	
7.25.2003	996,05	32,94	23,34	28,11	43,75	
7.26.2003	999,81	31,56	20,91	25,94	47,18	
7.27.2003	997,68	30,70	20,30	26,08	47,38	
7.28.2003	998,84	31,89	21,00	26,74	45,04	
7.29.2003	998,31	34,13	20,68	27,45	46,02	
7.30.2003	995,83	33,20	21,91	28,30	42,29	
7.31.2003	993,32	33,65	23,84	28,12	47,59	
8.1.2003	993,99	33,65	22,70	28,10	50,10	
8.2.2003	997,67	34,81	23,37	28,97	49,99	
8.3.2003	998,99	34,66	22,51	28,00	53,41	
8.4.2003	998,57	34,38	23,92	28,28	47,97	
8.5.2003	998,73	32,28	23,50	27,23	37,62	
8.6.2003	998,06	31,96	20,34	26,57	49,43	
8.7.2003	996,10	33,49	23,06	27,76	47,78	
8.8.2003	996,90	32,63	22,66	27,21	48,63	
8.9.2003	995,68	31,36	22,18	26,45	51,52	
8.10.2003	994,51	31,59	21,19	26,04	50,24	
8.11.2003	998,12	31,11	21,02	25,77	49,88	
8.12.2003	1003,10	31,83	17,62	25,47	41,79	
8.13.2003	1002,20	32,58	18,25	24,89	36,51	
8.14.2003	999,40	33,62	19,11	26,53	32,25	
8.15.2003	997,49	37,05	19,57	28,97	28,73	
8.16.2003	997,26	37,90	23,68	30,48	27,52	
8.17.2003	999,73	38,57	24,06	30,43	28,91	
8.18.2003	1001,00	35,83	22,43	28,57	44,71	
8.19.2003	999,01	34,02	22,28	27,89	44,81	
8.20.2003	997,63	36,20	20,15	27,58	42,30	
8.21.2003	997,17	35,77	20,52	27,41	44,45	
8.22.2003	998,42	35,46	20,26	27,11	46,49	
8.23.2003	998,42	33,93	21,44	27,39	46,71	
8.24.2003	996,74	37,16	20,57	28,18	38,19	
8.25.2003	993,69	36,98	21,12	28,25	39,28	
8.26.2003	994,03	35,00	22,09	27,81	40,71	
8.27.2003	993,94	36,58	21,14	27,88	40,34	
8.28.2003	994,69	24,01	20,62	27,26	49,91	
8.29.2003	996,86	25,94	25,94	25,94	51,95	
8.30.2003	998,59	35,54	22,20	27,69	57,00	
8.31.2003	995,77	36,31	21,37	27,93	50,68	
9.1.2003	993,32	35,95	21,42	28,41	45,76	
9.2.2003	996,66	34,00	21,82	27,58	51,04	
9.3.2003	999,33	33,64	22,01	26,52	52,26	
9.4.2003	1001,70	23,22	16,17	20,24	64,84	
9.5.2003	1003,80	23,75	13,87	18,82	45,57	

9.6.2003	1005,40	24,95	11,42	19,02	50,49	
9.7.2003	1005,70	26,38	12,55	19,93	47,05	
9.8.2003	1000,90	27,69	14,58	20,95	44,97	
9.9.2003	996,94	30,09	16,94	22,91	40,49	
9.10.2003	997,15	30,53	17,89	24,79	55,61	
9.11.2003	994,07	26,16	16,55	21,68	78,80	
9.12.2003	995,70	27,36	17,00	22,37	75,55	11,48
9.13.2003	996,75	27,53	16,17	21,75	69,95	
9.14.2003	999,99	26,80	17,20	20,70	67,72	
9.15.2003	1004,70	26,21	15,84	20,44	56,65	
9.16.2003	1004,00	24,39	14,60	19,33	53,95	
9.17.2003	1004,00	25,65	16,87	20,38	54,73	
9.18.2003	1005,20	27,66	14,07	21,07	47,33	
9.19.2003	1006,00	26,51	15,24	21,21	49,71	
9.20.2003	1006,90	26,35	13,19	20,88	47,95	
9.21.2003	1006,60	28,39	14,48	21,68	51,19	
9.22.2003	1003,70	30,28	15,17	22,60	50,90	
9.23.2003	1001,10	29,64	16,39	21,81	61,31	
9.24.2003	1001,30	28,42	15,13	21,97	60,62	
9.25.2003	1002,00	27,93	16,17	21,73	59,07	
9.26.2003	1002,30	26,51	18,58	22,02	57,38	
9.27.2003	1002,40	25,44	17,97	21,05	61,17	
9.28.2003	1002,80	27,26	16,77	21,09	61,48	
9.29.2003	999,97	26,43	15,87	20,61	66,19	
9.30.2003	999,60	25,14	15,94	20,32	68,43	
10.1.2003	1000,20	26,46	15,10	20,61	59,35	
10.2.2003	1001,10	26,04	15,88	20,44	56,16	
10.3.2003	1000,90	27,07	13,93	20,59	61,41	
10.4.2003	1000,20	30,04	13,43	22,65	46,87	
10.5.2003	1001,50	30,48	17,29	24,93	43,30	
10.6.2003	1000,30	30,83	16,62	24,38	50,27	
10.7.2003	1000,50	28,13	18,47	22,68	71,73	
10.8.2003	995,26	26,82	15,82	21,28	70,28	
10.9.2003	993,83	23,00	11,70	17,09	60,95	17,00
10.10.2003	1003,50	18,63	8,01	12,11	76,91	
10.11.2003	1007,20	20,73	8,04	14,07	60,80	2,80
10.12.2003	1004,90	23,74	10,91	16,52	50,95	
10.13.2003	1002,90	23,58	12,75	17,58	53,39	
10.14.2003	1004,00	24,30	13,31	18,44	54,55	
10.15.2003	1003,90	23,72	13,43	17,88	52,16	
10.16.2003	1002,10	23,49	12,55	17,28	65,02	
10.17.2003	1001,20	21,96	13,96	17,69	75,02	1,60
10.18.2003	1003,90	23,14	12,75	17,45	71,97	0,40
10.19.2003	1002,40	21,32	12,44	17,17	74,38	0,80
10.20.2003	999,28	27,77	14,89	21,57	69,74	1,00
10.21.2003	1000,40	26,10	20,86	23,11	66,05	
10.22.2003	1003,20	28,64	16,12	23,27	53,13	
10.23.2003	998,88	27,14	23,03	25,00	44,16	
10.24.2003	996,24	25,38	22,13	23,59	64,62	
10.25.2003	997,81	24,61	15,90	21,65	77,27	0,20
10.26.2003	999,82	20,89	11,95	15,99	74,67	1,00

10.27.2003	1000,20	20,91	9,54	15,43	67,08	
10.28.2003	1001,80	20,07	6,92	11,50	67,16	17,20
10.29.2003	1007,40	13,40	2,56	8,01	54,94	
10.30.2003	999,11	10,92	5,05	7,58	86,13	
10.31.2003	995,24	23,60	10,28	17,07	83,18	18,60
11.1.2003	1000,90	23,24	15,29	19,60	74,80	
11.2.2003	1003,60	26,53	13,27	19,22	71,43	
11.3.2003	1002,20	26,79	16,00	20,73	63,98	
11.4.2003	1001,30	27,57	14,43	19,57	72,26	
11.5.2003	1002,20	18,83	13,67	16,47	70,92	
11.6.2003	999,92	14,99	12,24	13,78	80,69	4,20
11.7.2003	1005,40	15,92	10,37	11,89	83,03	
11.8.2003	1008,90	14,79	10,19	12,48	73,95	
11.9.2003	1003,40	12,50	7,90	10,40	65,09	
11.10.2003	1001,60	12,61	6,30	9,00	61,33	
11.11.2003	1007,30	11,12	4,35	6,94	67,18	
11.12.2003	1012,50	12,93	4,06	8,44	62,25	
11.13.2003	1012,60	13,36	2,98	7,37	67,95	
11.14.2003	1011,80	13,23	4,40	8,22	67,91	
11.15.2003	1010,20	14,31	3,56	10,12	72,53	
11.16.2003	1010,50	18,03	5,24	11,21	69,13	
11.17.2003	1011,80	18,28	5,62	11,92	66,08	
11.18.2003	1008,60	18,16	6,91	12,91	76,24	
11.19.2003	1008,20	18,59	8,81	13,01	59,87	
11.20.2003	1007,20	19,24	5,53	12,03	58,91	
11.21.2003	1007,80	22,73	7,52	13,80	62,33	
11.22.2003	1008,30	19,62	8,79	13,54	66,28	
11.23.2003	1006,70	21,02	15,21	8,56	72,78	
11.24.2003	1005,40	19,88	7,08	12,61	75,45	
11.25.2003	1006,30	16,76	6,02	11,31	81,17	
11.26.2003	1008,50	17,50	6,69	10,71	85,19	
11.27.2003	1004,20	18,94	6,61	11,57	78,37	
11.28.2003	1001,60	19,14	7,10	12,45	75,69	0,20
11.29.2003	1002,60	20,21	7,50	13,19	73,86	
11.30.2003	1001,50	19,25	9,31	13,81	72,82	

APPENDIX C

METEOROLOGICAL DATA PART 2

Table C Meteorological data part 2

	Wind speed		Dominant Wind Direction	Evaporation (mm)	Sunshine (min)
DATE	Max	Avg.			
7.1.2001	6,65	3,127			
7.2.2001	8,94	3,121			
7.3.2001	7,89	2,088542			
7.4.2001	6,19	2,079042			
7.5.2001	6,26	2,449375			
7.6.2001	9,75	2,455792			
7.7.2001	8,83	3,435125			
7.8.2001	6,28	2,641792			
7.9.2001	6,71	1,908542			
7.10.2001	6,58	2,428458			
7.11.2001	5,48	2,518133			
7.12.2001	6,73	3,550429			
7.13.2001	8,74	3,950333			
7.14.2001	9,33	3,955667			
7.15.2001	6,33	3,253958			
7.16.2001	6,84	2,936208			
7.17.2001	5,9	2,259375			
7.18.2001	6,24	2,393542			
7.19.2001	9,17	3,69825			
7.20.2001	5,47	2,67275			
7.21.2001	6,28	2,461667			
7.22.2001	6,4	2,650458			
7.23.2001	6,01	2,112125			
7.24.2001	7,24	2,211167			
7.25.2001	8,89	2,466042			
7.26.2001	5,27	2,485458			
7.27.2001	6,65	2,216313			
7.28.2001	6,64	2,42775			
7.29.2001	7,89	3,168042			
7.30.2001	7,81	3,714208			
7.31.2001	11,3	5,165542			

8.1.2001	11	4,711	sw		
8.2.2001	11,1	4,731	sw		
8.3.2001	11,3	5,163	W		
8.4.2001	8,63	3,934	W		
8.5.2001	5,45	3,285	W		
8.6.2001	5,73	2,868	NW		
8.7.2001	7,03	2,940	NW		
8.8.2001	6,41	3,046	NW		
8.9.2001	7,49	3,809	W		
8.10.2001	6,35	3,315	W		
8.11.2001	5,3	2,899	NW		
8.12.2001	7,11	2,875	NW		
8.13.2001	6,64	3,478	W		
8.14.2001	7,65	3,788	W		
8.15.2001	7,45	4,072	W		
8.16.2001	6,57	3,590	W		
8.17.2001	6,93	3,583	W		
8.18.2001	8,16	3,471	W		
8.19.2001	5,24	2,237	W		
8.20.2001	4,86	1,895	W		
8.21.2001	6,49	1,804	W		
8.22.2001	5,79	1,645	W		
8.23.2001	7,99	2,663	W		
8.24.2001	5,82	2,755	W		
8.25.2001	7,65	3,101	W		
8.26.2001	7,97	3,709	W		
8.27.2001	9,55	3,740	W		
8.28.2001	6,03	2,528	W		
8.29.2001	5,98	2,177	NW		
8.30.2001	6,43	2,711	NW		
8.31.2001	6,51	3,035	NW		
9.1.2001	5,34	2,525	NW		
9.2.2001	6,69	1,953	E		
9.3.2001	6,02	2,463	SE		
9.4.2001	6,60	2,157	NW		551
9.5.2001	5,80	1,509	NW		548
9.6.2001	8,10	3,010	E		403
9.7.2001	7,69	2,178	S	4,76	461
9.8.2001	6,53	1,481	NW	4,07	362
9.9.2001	4,68	1,297	NW	5,64	497
9.10.2001	5,17	1,818	NE	5,45	541
9.11.2001	7,34	2,547	NE	4,92	453
9.12.2001	7,00	2,887	N	6,69	531
9.13.2001	5,83	2,620	W	6,60	446
9.14.2001	7,87	3,194	W	7,23	548
9.15.2001	4,87	2,286	NW	5,44	536
9.16.2001	3,40	0,898	NW	4,42	527
9.17.2001	5,27	1,878	NE	5,08	525

9.18.2001	4,29	1,351	NW	5,57	524
9.19.2001	5,66	1,781	NW	6,01	493
9.20.2001	6,55	1,797	W	6,32	501
9.21.2001	5,68	2,966	W	6,40	447
9.22.2001	5,04	2,471	NW	5,66	506
9.23.2001	5,18	2,182	NW	5,72	505
9.24.2001	5,00	1,625	NW	5,70	494
9.25.2001	4,63	1,550	E	5,21	469
9.26.2001	5,03	2,005	NW	5,09	487
9.27.2001	7,63	2,879	NW	6,65	451
9.28.2001	5,96	2,535	W	4,18	491
9.29.2001	5,10	2,574	W	4,75	502
9.30.2001	5,58	2,498	W	5,28	499
10.1.2001	4,75	2,563	W	5,49	470
10.2.2001	6,00	2,392	W	5,00	495
10.3.2001	4,82	2,457	NW	5,50	501
10.4.2001	6,12	2,101	E	4,43	500
10.5.2001	4,22	1,066	E	4,00	498
10.6.2001	3,96	1,363	NW	3,98	488
10.7.2001	5,79	2,305	NW	5,27	357
10.8.2001	6,58	2,975	W	4,34	484
10.9.2001	5,46	2,407	W	4,12	473
10.10.2001	5,35	2,703	W	4,03	
10.11.2001	7,97	3,420	W	6,78	
10.12.2001	9,73	4,269	W	6,45	474
10.13.2001	9,73	5,328	W	6,21	476
10.14.2001	6,87	3,874	W	5,97	463
10.15.2001	8,26	4,189	W	5,05	463
10.16.2001	10,50	4,175	W	5,42	471
10.17.2001	12,10	5,433	W	5,55	467
10.18.2001	7,38	3,385	W	5,06	471
10.19.2001	4,46	2,166	NW	4,01	463
10.20.2001	3,64	1,521	NW	3,72	470
10.21.2001	4,55	1,591	E	3,61	460
10.22.2001	3,57	1,131	NW	3,41	417
10.23.2001	3,85	1,818	NW	3,35	352
10.24.2001	6,68	2,298	W	3,86	266
10.25.2001	13,00	6,162	SW	4,93	446
10.26.2001	8,79	4,364	W	4,84	391
10.27.2001	11,80	3,987	W	4,30	439
10.28.2001	7,68	2,866	W	3,35	388
10.29.2001	8,88	2,687	SW	3,22	436
10.30.2001	2,92	0,759	NW	2,45	288
10.31.2001	4,02	1,607	NW	2,56	300
11.1.2001	4,38	1,574	NW	102,85	418
11.2.2001	5,68	2,229	W	105,22	0
11.3.2001	14,00	6,055	W	104,85	249
11.4.2001	10,60	5,517	SW	108,78	36

11.5.2001	6,24	2,642	W	117,52	7
11.6.2001	4,42	1,783	W	117,37	290
11.7.2001	3,47	0,9	W	117,24	184
11.8.2001	4,45	1,185	W	126,32	21
11.9.2001	4,38	1,131	W	130,26	308
11.10.2001	4,11	0,962	W	129,87	276
11.11.2001	4,76	1,856	NW	128,60	357
11.12.2001	2,61	0,961	NW	127,45	261
11.13.2001	3,98	1,452	NW	125,67	244
11.14.2001	4,35	1,935	NE	127,99	23
11.15.2001	5,87	2,147	W	127,17	358
11.16.2001	6,50	2,49	SW	125,44	310
11.17.2001	9,16	3,764	SW	123,11	373
11.18.2001	5,38	1,961	W	121,24	396
11.19.2001	3,05	1,013	NW	126,23	206
11.20.2001	5,26	1,893	NW	183,91	91
11.21.2001	11,30	3,018	W	185,42	387
11.22.2001	4,45	1,506	NW	184,29	380
11.23.2001	6,34	1,902	NW	186,59	176
11.24.2001	18,40	3,8	WSW	2,50	180
11.25.2001	10,00	1,6	ENE	0,60	240
11.26.2001	4,40	1,2	NE	0,40	54
11.27.2001	3,80	1,6	SW	1,00	408
11.28.2001	3,70	1,9	NE	1,60	372
11.29.2001	3,40	0,9	NE	0,20	0
11.30.2001	6,00	3,1	NE	1,50	180
12.1.2001	10,6	4,100	ENE		
12.2.2001	16,2	6,200	ENE		
12.3.2001	16,6	6,900	ENE		
12.4.2001	11,6	4,700	NE		
12.5.2001	10,1	4,500	NE		
12.6.2001	10,1	3,600	ENE		
12.7.2001	14,1	5,400	ENE		
12.8.2001	19,9	7,200	ENE		
12.9.2001	16,3	4,300	ENE		
12.10.2001	10,4	4,300	ENE		
12.11.2001	10,6	3,700	ENE		
12.12.2001	7,1	3,400	ENE		
12.13.2001	7,5	3,000	ENE		
12.14.2001	11,1	4,100	ENE		
12.15.2001	7,7	2,900	NE		
12.16.2001	5,5	1,900	NE		
12.17.2001	6,4	2,400	ENE		
12.18.2001	10,1	3,200	ENE		
12.19.2001	6,3	2,300	ENE		
12.20.2001					
12.21.2001					
12.22.2001					

12.23.2001		0,400			
12.24.2001		2,500	WSW		
12.25.2001		2,600	WSW		
12.26.2001		1,200	NNE		
12.27.2001		1,400	NE		
12.28.2001					
12.29.2001					
12.30.2001					
12.31.2001					
1.1.2002	12,8	5,4	WSW		
1.2.2002	12,2	4,1	E		432
1.3.2002	4,6	2	NE		150
1.4.2002	16,6	6	ENE		
1.5.2002	10,4	5	NE		360
1.6.2002	11,5	3,7	NE		240
1.7.2002	8,4	1,6	NE		456
1.8.2002	5,3	1,9	E		300
1.9.2002	11,4	3,7	ENE		174
1.10.2002	10,2	4,5	NE		372
1.11.2002	6,9	3,2	E		492
1.12.2002	5,4	2,5	NE		492
1.13.2002	4,6	2,8	NE		468
1.14.2002	5,2	2,6	ENE		66
1.15.2002	7	3,3	NE		210
1.16.2002	3,3	1,3	NE		342
1.17.2002	3,5	1,2	NE		156
1.18.2002	2,9	1,8	NE		
1.19.2002	6,3	1	ENE		84
1.20.2002	5,7	1,9	NE		252
1.21.2002	4,3	0,8	NE		474
1.22.2002	3	1	E		420
1.23.2002	3,1	1,3	NE		504
1.24.2002	2,2	0,8	E		186
1.25.2002	4	1	NE		186
1.26.2002	2,9	1,1	ENE		144
1.27.2002	4	1,2	WSW		492
1.28.2002	2,1	1,2	NE		432
1.29.2002	2,8	0,8	NE		510
1.30.2002	4,2	1,5	SW		498
1.31.2002	2,8	1,3	WSW		510
2.1.2002	5,5	1,40	WSW		498
2.2.2002	6,3	2,30	ENE		498
2.3.2002	6,8	3,10	ENE		504
2.4.2002	4,3	1,10	ENE		516
2.5.2002	2,1	1,10	NE		84
2.6.2002	6,5	1,90	WSW		384
2.7.2002	2,8	1,80	NE		516
2.8.2002	3,8	1,20	SES		372

2.9.2002	2,6	1,20	SW		462
2.10.2002	3,8	1,90	E		174
2.11.2002	11,1	4,00	ENE		72
2.12.2002	11,4	2,70	E		534
2.13.2002	4	1,20	WSW		540
2.14.2002	6,8	2,80	SW		540
2.15.2002	6,7	3,30	ENE		150
2.16.2002	8,2	3,60	ENE		522
2.17.2002	9,5	3,00	ENE		546
2.18.2002	3,3	1,00	ENE		534
2.19.2002	8,4	2,70	WSW		270
2.20.2002	9,8	2,10	WSW		
2.21.2002	3,8	1,30	WSW		174
2.22.2002	2,8	1,80	NE		552
2.23.2002	4,7	1,60	NNE		126
2.24.2002	5,9	2,40	WSW		366
2.25.2002	11,1	3,50	W		252
2.26.2002	5,4	1,70	SW		576
2.27.2002	4,8	2,50	WSW		270
2.28.2002	5,1	1,50	WSW		6
3.1.2002	6,10	1,90	WSW		540
3.2.2002	6,30	1,80	WSW		588
3.3.2002	5,60	1,70	ENE		606
3.4.2002	2,70	1,00	NE		324
3.5.2002	4,80	2,40	NE		318
3.6.2002	4,90	1,30	SW		462
3.7.2002	5,60	1,50	SW		402
3.8.2002	5,10	1,70	NE		252
3.9.2002	6,90	3,20	NE		342
3.10.2002	3,70	1,40	NE		96
3.11.2002	8,70	3,70	NE		
3.12.2002	4,20	1,50	NNE		
3.13.2002	4,90	1,80	NE		72
3.14.2002	4,00	0,70	ENE		582
3.15.2002	4,80	0,80	ENE		570
3.16.2002	8,80	3,10	NE		618
3.17.2002	12,00	6,00	NE		546
3.18.2002	9,70	5,10	NE		384
3.19.2002	6,50	1,40	NE		576
3.20.2002	3,90	1,60	WSW		
3.21.2002	5,10	1,70	ENE		456
3.22.2002	3,10	1,00	ENE		168
3.23.2002	6,10	1,00	ENE		
3.24.2002	11,10	4,30	WE		192
3.25.2002	7,40	1,20	WSW		
3.26.2002	4,50	0,90	ESE		6
3.27.2002	7,00	4,40	NE		288
3.28.2002	6,60	3,20	E		444

3.29.2002	5,70	2,50	E		498
3.30.2002	5,50	2,60	ENE		558
3.31.2002	6,40	2,40	NE		252
4.1.2002	6,80	3,60	ENE	2,00	
4.2.2002	5,20	2,00	ENE	3,70	396
4.3.2002	3,30	1,30	E	3,30	480
4.4.2002	4,60	2,20	NE	2,10	48
4.5.2002	9,60	3,10	SW	1,30	48
4.6.2002	5,40	1,30	NE	1,80	186
4.7.2002	8,10	1,90	WSW	2,60	582
4.8.2002	7,60	2,10	ENE	4,20	702
4.9.2002	3,30	1,90	NE	4,60	558
4.10.2002	3,30	2,20	NE	4,90	558
4.11.2002	4,40	2,50	E	4,10	510
4.12.2002	3,80	1,80	ENE	2,60	90
4.13.2002	1,80	0,90	ENE	1,80	12
4.14.2002	5,10	1,80	WSW	3,80	588
4.15.2002	5,50	1,70	WSW	3,30	258
4.16.2002	5,80	2,50	NE	1,90	6
4.17.2002	6,40	3,30	ENE	2,70	144
4.18.2002	1,80	1,60	W	1,00	
4.19.2002	4,60	1,90	ENE	1,30	60
4.20.2002	4,60	1,90	E	1,80	18
4.21.2002	8,70	4,10	ENE	3,40	156
4.22.2002	11,50	4,10	ENE	4,90	570
4.23.2002	4,80	2,00	E	4,70	714
4.24.2002	5,70	2,20	ENE	4,70	630
4.25.2002	5,20	1,70	NE	3,70	714
4.26.2002	3,80	1,90	ENE	4,00	678
4.27.2002	5,00	2,00	W	4,20	708
4.28.2002	5,90	2,20	WSW	3,60	648
4.29.2002	4,70	3,40	WSW	3,40	534
4.30.2002	3,90	1,80	WSW	4,10	606
5.1.2002	6,20	2,00	ENE	5,50	360
5.2.2002	6,50	3,60	NE	6,50	720
5.3.2002	4,50	2,60	NE	6,20	720
5.4.2002	6,60	3,60	ENE	6,90	738
5.5.2002	6,50	3,30	NNE	7,40	720
5.6.2002	4,90	2,40	NNE	5,80	696
5.7.2002	7,50	3,10	NNE	7,40	672
5.8.2002	6,30	3,30	NE	6,10	462
5.9.2002	6,20	3,20	NNE	6,00	144
5.10.2002	6,20	3,00	NE	7,00	750
5.11.2002	5,40	2,10	SW	5,30	720
5.12.2002	4,20	1,30	NW	5,60	666
5.13.2002	6,00	2,50	NNE	4,00	438
5.14.2002	8,70	3,70	NNE	4,70	468
5.15.2002	8,40	3,40	NNE	7,80	738

5.16.2002	8,30	2,60	NNE	9,00	732
5.17.2002	5,80	2,40	N	9,10	726
5.18.2002	5,90	2,80	SW	7,90	756
5.19.2002	4,80	2,300	SSW	7,70	744
5.20.2002	5,40	1,400	SSW	7,30	744
5.21.2002	5,90	2,04	NE	7,00	624
5.22.2002	8,70	3,90	NE	5,60	690
5.23.2002	8,40	4,10	NE	6,70	582
5.24.2002	4,50	1,60	NE	7,30	738
5.25.2002	6,00	1,40	SSE	7,30	576
5.26.2002	5,60	1,300	WNW	5,90	270
5.27.2002	5,90	1,400	NNE	5,10	636
5.28.2002	6,60	2,800	S	5,50	720
5.29.2002	6,10	2,400	SSE	5,70	678
5.30.2002	6,10	3,200	S	5,50	714
5.31.2002	6,10	2,900	NNE	4,50	288
6.1.2002	4,90	1,90	NNE	6,10	606
6.2.2002	5,30	1,40	NE	5,40	702
6.3.2002	5,40	0,70	NNE	3,20	384
6.4.2002	6,00	3,20	SSW	2,60	708
6.5.2002	6,60	2,30	SSW	6,80	654
6.6.2002	5,80	2,50	NNE	7,40	720
6.7.2002	5,70	2,60	NNE	7,60	210
6.8.2002	5,90	1,60	SSW	9,00	426
6.9.2002	5,90	1,80	SSW	10,70	666
6.10.2002	8,80	2,40	S	8,50	624
6.11.2002	6,40	2,60	SSW	6,70	732
6.12.2002	5,90	2,50	NNW	6,10	456
6.13.2002	9,50	5,50	N	8,70	720
6.14.2002	8,90	4,40	NNE	8,70	738
6.15.2002	7,50	3,70	N	12,50	750
6.16.2002	8,80	3,50	ENE	11,10	738
6.17.2002	6,40	3,50	ENE	12,20	744
6.18.2002	9,20	4,60	NE	9,50	720
6.19.2002	9,10	4,50	NE	10,00	750
6.20.2002	8,40	5,10	NE	9,30	750
6.21.2002	11,40	4,40	ENE	10,50	744
6.22.2002	6,70	3,50	ENE	10,40	732
6.23.2002	6,30	4,30	ENE	10,20	738
6.24.2002	5,60	2,90	NE	10,40	750
6.25.2002	5,50	2,90	SW	7,80	726
6.26.2002	7,90	4,60	NE	8,20	726
6.27.2002	11,90	4,30	NE	8,50	726
6.28.2002	5,90	3,60	NE	8,70	732
6.29.2002	5,20	2,60	SW	7,40	732
6.30.2002	5,00	2,80	NE	9,80	708
7.1.2002	5,50	2,90	ENE	8,30	714
7.2.2002	7,00	4,60	NE	8,50	714

7.3.2002	6,20	3,50	E	9,30	726
7.4.2002	4,40	1,40	SW	8,90	696
7.5.2002	6,60	3,20	NE	10,30	708
7.6.2002	4,90	2,70	ENE	8,90	708
7.7.2002	5,40	2,80	ENE	7,60	702
7.8.2002	6,30	2,20	ENE	8,40	726
7.9.2002	8,20	3,60	NE	9,40	702
7.10.2002	4,80	1,90	SW	6,40	474
7.11.2002	4,90	1,80	E	2,80	354
7.12.2002	9,20	2,30	NNE	6,10	558
7.13.2002	5,90	3,30	ENE	8,70	678
7.14.2002	4,90	1,90	NE	8,50	720
7.15.2002	5,20	2,60	ENE	10,60	744
7.16.2002	4,10	1,50	E	10,60	690
7.17.2002	5,00	2,60	SW	10,00	732
7.18.2002	5,40	2,10	SW	9,30	738
7.19.2002	5,40	2,40	SW	8,40	750
7.20.2002	5,00	2,00	SW	8,00	738
7.21.2002	5,30	2,10	E	7,40	468
7.22.2002	6,20	2,00	E	9,10	708
7.23.2002	5,30	1,60	WSW	8,50	696
7.24.2002	5,00	2,50	W	7,60	750
7.25.2002	5,70	2,80	WSW	8,20	606
7.26.2002	5,60	1,900	WSW	9,00	720
7.27.2002	7,50	2,700	WSW	6,70	720
7.28.2002	6,90	2,200	WSW	7,50	396
7.29.2002	5,30	2,200	WSW	10,10	738
7.30.2002	4,80	1,900	SW	8,20	738
7.31.2002	5,50	1,900	WSW	7,60	738
8.1.2002	6,00	2,7	WSW	6,40	738
8.2.2002	4,80	2,2	SW	7,00	564
8.3.2002	4,80	1,2	E	7,10	498
8.4.2002	4,20	1,6	SW	6,60	708
8.5.2002	6,10	2,5	WSW	6,70	696
8.6.2002	5,20	1,70	SW	8,60	714
8.7.2002	6,80	3,60	WSW	8,10	6780
8.8.2002	7,30	2,30	WSW	9,20	738
8.9.2002	5,90	1,40	E	6,40	714
8.10.2002	4,60	1,60	WSW	9,50	732
8.11.2002	3,70	1,50	ENE	6,70	606
8.12.2002	5,50	2,00	WSW	7,80	348
8.13.2002	6,00	2,40	WSW	7,40	696
8.14.2002	4,80	1,70	ENE	8,00	450
8.15.2002	5,80	2,10	WSW	7,40	666
8.16.2002	5,60	1,50	WSW	7,60	612
8.17.2002	5,50	1,30	ENE	5,60	462
8.18.2002	2,90	1,70	NE	5,80	420
8.19.2002	6,60	3,80	SWS	5,00	702

8.20.2002	8,60	3,90	ENE	5,80	666
8.21.2002	6,00	3,20	SWS	6,10	528
8.22.2002	5,30	2,40	EN	6,80	666
8.23.2002	5,20	2,80	ENE	7,00	702
8.24.2002	6,20	3,50	ENE	7,20	678
8.25.2002	8,60	4,30	E	8,00	678
8.26.2002	9,40	4,90	ENE	8,40	684
8.27.2002	6,40	3,40	ENE	7,80	672
8.28.2002	5,80	2,90	E	7,50	666
8.29.2002	6,10	1,50	ENE	8,20	594
8.30.2002	7,90	2,20	SW	7,40	570
8.31.2002	9,10	2,00	ENE	6,30	48
9.1.2002	7,70	1,30	ENE	3,40	312
9.2.2002	5,40	1,50	NE	3,60	360
9.3.2002	7,90	1,40	NE	3,70	450
9.4.2002	8,70	1,60	E	4,00	504
9.5.2002	5,00	1,60	N E	3,10	510
9.6.2002	6,90	1,60	NE	4,30	582
9.7.2002	5,60	1,40	E	5,60	564
9.8.2002	6,20	1,00	E	6,80	594
9.9.2002	6,60	2,00	E	6,50	570
9.10.2002	8,50	1,50	NE	7,00	516
9.11.2002	7,60	1,70	ENE	6,00	552
9.12.2002	7,40	2,30	WSW	6,00	456
9.13.2002	7,50	1,20	ENE	4,80	456
9.14.2002	11,60	2,20	ENE	3,60	186
9.15.2002	4,20	1,70	N	1,90	90
9.16.2002	9,10	1,80	NNE	2,60	372
9.17.2002	6,40	0,70	ENE	3,70	492
9.18.2002	6,50	0,90	NE	5,90	608
9.19.2002	6,80	1,50	E	5,50	606
9.20.2002	8,60	2,10	ENE	6,80	648
9.21.2002	5,90	1,10	ENE	6,30	636
9.22.2002	6,60	1,60	WSW	6,20	630
9.23.2002	9,20	2,60	WSW	6,20	564
9.24.2002	10,20	2,30	WSW	6,70	240
9.25.2002	4,90	1,20	ENE	3,10	114
9.26.2002	11,90	3,00	WSW	5,50	558
9.27.2002	10,20	2,30	WSW	5,90	588
9.28.2002	6,00	1,60	WSW	4,40	378
9.29.2002	3,30	1,00	E	0,80	60
9.30.2002	5,80	1,70	ENE	3,10	588
10.1.2002	8,50	1,60	SW	2,90	468
10.2.2002	8,60	2,20	ENE	2,90	312
10.3.2002	12,10	2,50	ENE	4,10	570
10.4.2002	4,30	1,20	NE	3,20	396
10.5.2002	6,30	1,70	WSW	3,90	612
10.6.2002	8,40	1,40	WSW	3,50	486

10.7.2002	14,40	2,20	WSW	3,50	450
10.8.2002	8,30	2,00	WSW	2,30	462
10.9.2002	3,60	1,60	ENE	2,10	270
10.10.2002	5,20	1,30	WSW	3,10	546
10.11.2002	3,60	1,40	E	3,10	138
10.12.2002	7,60	2,40	WSW	4,00	210
10.13.2002	18,00	1,50	NNE	1,90	240
10.14.2002	10,20	1,60	NE	1,80	42
10.15.2002	11,10	3,50	ENE	3,80	300
10.16.2002	8,90	2,50	NE	3,80	576
10.17.2002	5,70	0,80	ENE	3,10	576
10.18.2002	7,50	1,80	WSW	2,80	552
10.19.2002	6,60	1,60	WSW	2,50	528
10.20.2002	7,20	1,80	E	3,20	444
10.21.2002	7,80	2,10	ENE	4,20	576
10.22.2002	6,80	1,80	NE	4,20	522
10.23.2002	8,10	1,50	WSW	3,80	306
10.24.2002	6,70	2,10	WSW	2,90	348
10.25.2002	7,40	2,10	ENE	3,10	492
10.26.2002	4,40	1,00	NE	3,10	534
10.27.2002	10,70	2,50	NE	3,80	420
10.28.2002	6,50	1,80	E	4,00	540
10.29.2002	10,00	3,20	ENE	5,80	544
10.30.2002	7,10	2,50	NE	4,70	540
10.31.2002	3,80	1,40	E	4,10	544
11.1.2002	6,00	2,00	E	4,00	516
11.2.2002	3,50	1,10	NE	2,70	492
11.3.2002	7,50	1,50	WSW	2,30	300
11.4.2002	5,70	1,60	WSW	2,20	138
11.5.2002	10,00	1,10	WSW	1,20	24
11.6.2002	7,00	2,30	NE	0,40	
11.7.2002	5,30	1,30	ENE	0,90	72
11.8.2002	20,00	2,10	NE	1,40	102
11.9.2002	7,90	1,50	NE	1,40	222
11.10.2002	8,60	2,00	SW	0,90	120
11.11.2002	12,50	3,20	E	2,00	390
11.12.2002	3,50	1,30	ENE	1,60	510
11.13.2002	5,00	1,20	E	2,20	486
11.14.2002	2,90	1,40	SW	2,00	474
11.15.2002	4,60	1,80	WSW	1,90	486
11.16.2002	3,20	1,00	ENE	1,80	480
11.17.2002	2,90	0,80	NE	2,40	498
11.18.2002	4,80	1,10	WSW	2,30	504
11.19.2002	4,70	1,60	WSW	2,80	450
11.20.2002	4,90	1,80	NE	1,70	426
11.21.2002	2,80	1,20	NE	1,10	72
11.22.2002	7,80	1,50	NE	1,40	150
11.23.2002	8,40	1,50	WSW	1,40	300

11.24.2002	4,10	1,10	E	2,10	486
11.25.2002	4,70	1,60	ENE	2,50	420
11.26.2002	5,60	1,80	NE	2,20	402
11.27.2002	6,30	2,50	NE	1,80	288
11.28.2002	4,30	1,60	NE	2,20	342
11.29.2002	4,80	1,20	NE	2,60	480
11.30.2002	2,80	1,20	NE	2,50	366
12.1.2002	4,80	1,60	E	1,90	408
12.2.2002	5,80	1,70	NE	1,80	
12.3.2002	6,60	1,30	NE	1,30	54
12.4.2002	5,10	1,80	NEW	1,70	60
12.5.2002	11,40	2,2	ENE	1,00	12
12.6.2002	4,50	1,20	E	0,90	174
12.7.2002	8,60	2,50	ENE	1,00	
12.8.2002	18,00	4,00	ENE	1,50	
12.9.2002	16,30	6,10	ENE	3,40	
12.10.2002	16,90	4,80	ENE	3,50	486
12.11.2002	9,70	1,80	E		486
12.12.2002	10,60	2,60	ENE		396
12.13.2002	4,60	1,60	ENE		18
12.14.2002	8,10	1,70	ENE		
12.15.2002	11,50	3,10	ENE		48
12.16.2002	5,20	2,20	ENE		252
12.17.2002	9,50	2,50	NE		270
12.18.2002	5,20	2,10	NE		210
12.19.2002	11,70	4,60	ENE		6
12.20.2002	14,70	3,90	ENE		402
12.21.2002	6,50	2,30	E		475
12.22.2002	3,60	1,80	E		486
12.23.2002	3,60	1,80	ENE		312
12.24.2002	8,50	2,40	NE		186
12.25.2002	11,10	2,90	E		288
12.26.2002	12,50	3,60	ENE		468
12.27.2002	5,00	1,40	E		72
12.28.2002	6,00	1,00	SW		198
12.29.2002	16,20	1,70	SW		
12.30.2002	5,10	0,60	ENE		12
12.31.2002	3,90	0,80	ENE		246
1.1.2003	9,70	1,90	WSW		36
1.2.2003	7,30	1,70	ENE		12
1.3.2003	5,20	0,60	E		30
1.4.2003	8,60	1,80	WSW		192
1.5.2003	12,30	3,00	WSW		156
1.6.2003	12,90	2,30	WSW		420
1.7.2003	9,70	2,30	E		222
1.8.2003	10,80	1,90	WSW		240
1.9.2003	2,40	0,50	E		30
1.10.2003	8,60	1,20	WSW		210

1.11.2003	5,00	1,70	ENE		
1.12.2003	12,30	3,40	WSW		156
1.13.2003	12,30	3,00	NE		102
1.14.2003	7,40	1,80	E		216
1.15.2003	3,50	1,10	NNE		492
1.16.2003	3,80	1,20	ENE		492
1.17.2003	10,60	2,90	ENE		372
1.18.2003	8,90	1,80	ENE		210
1.19.2003	6,60	2,60	NE		
1.20.2003	9,70	2,10	ENE		6
1.21.2003	5,50	1,30	E		6
1.22.2003	4,50	1,20	ENE		120
1.23.2003	5,20	1,60	ENE		36
1.24.2003	6,40	2,20	ENE		12
1.25.2003	12,40	4,30	ENE		210
1.26.2003	12,90	4,50	ENE		270
1.27.2003	17,20	5,89	ENE		252
1.28.2003	13,20	3,90	ENE		198
1.29.2003	12,40	3,00	WSW		162
1.30.2003	21,20	4,90	WSW		198
1.31.2003	19,60	2,60	WSW		48
2.1.2003	6,01	1,78	SE		
2.2.2003	9,57	3,12	SE		5
2.3.2003	6,59	2,93	E		
2.4.2003	3,05	1,32	SE		72
2.5.2003	13,70	5,32	S		165
2.6.2003	9,46	4,51	SW		456
2.7.2003	8,51	2,56	E		112
2.8.2003	4,93	2,29	SE		194
2.9.2003	3,98	1,71	SE		59
2.10.2003	8,00	2,97	SE		230
2.11.2003	7,07	4,62	E		
2.12.2003	9,38	4,10	E		
2.13.2003	9,63	4,85	E		
2.14.2003	5,04	3,23	E		55
2.15.2003	5,85	2,35	SE		93
2.16.2003	8,18	4,21	E		15
2.17.2003	8,40	5,01	E		
2.18.2003	13,10	4,27	E		
2.19.2003	10,30	3,92	E		115
2.20.2003	4,77	2,30	SE		227
2.21.2003	8,12	3,10	E		284
2.22.2003	7,66	3,13	E		305
2.23.2003	9,33	3,46	E		289
2.24.2003	5,73	2,11	SE		270
2.25.2003	10,60	3,37	NE		
2.26.2003	9,75	3,91	E		256
2.27.2003	5,66	2,92	SE		326

2.28.2003	3,33	2,07	SE		331
3.1.2003	2,95	1,51	SE		55
3.2.2003	3,36	1,64	SE		131
3.3.2003	5,21	2,64	SE		263
3.4.2003	8,83	4,63	SE		
3.5.2003	6,47	3,94	E		
3.6.2003	6,21	3,30	SE		264
3.7.2003	4,21	2,24	SE		552
3.8.2003	4,52	2,86	SE		766
3.9.2003	5,46	3,08	SE		775
3.10.2003	6,04	3,18	SE		814
3.11.2003	7,76	4,23	E		820
3.12.2003	5,40	2,43	SE		573
3.13.2003	4,35	1,94	SE		307
3.14.2003	5,00	2,93	SE		40
3.15.2003	10,20	3,88	E		577
3.16.2003	10,90	5,62	E		464
3.17.2003	10,50	6,16	E		
3.18.2003	9,77	4,27	E		196
3.19.2003	7,05	2,80	E		434
3.20.2003	4,65	1,79	NW		196
3.21.2003	6,83	2,72	SE		228
3.22.2003	8,06	3,95	E		345
3.23.2003	6,65	3,67	E		542
3.24.2003	14,90	6,00	E		345
3.25.2003	12,40	4,28	SE		373
3.26.2003	5,47	2,57	SE		348
3.27.2003	8,13	3,89	E		347
3.28.2003	4,82	2,99	SE		580
3.29.2003	4,83	2,67	SE		866
3.30.2003	4,36	2,77	SE		853
3.31.2003	6,28	1,89	SE		659
4.1.2003	4,01	4,96	E	0,66	
4.2.2003	2,50	3,73	SE		53
4.3.2003	8,90	6,01	SE	0,43	
4.4.2003	9,50	6,23	E	4,03	45
4.5.2003	9,96	5,21	SE		72
4.6.2003	7,39	2,39	NW	0,57	100
4.7.2003	8,72	3,97	SW		32
4.8.2003	6,35	2,05	NW		
4.9.2003	4,99	2,15	SE	2,57	379
4.10.2003	4,30	1,77	SE	2,66	337
4.11.2003	4,04	1,50	E		34
4.12.2003	4,84	1,75	SE	1,95	364
4.13.2003	6,69	1,65	N	2,10	87
4.14.2003	4,44	2,18	E		
4.15.2003	7,00	3,73	E	3,52	345
4.16.2003	6,69	3,93	E	3,60	324

4.17.2003	9,13	4,10	E		106
4.18.2003	7,62	4,05	E		
4.19.2003	3,83	1,83	SE		
4.20.2003	5,55	2,10	E	1,76	114
4.21.2003	7,15	2,41	E	3,58	349
4.22.2003	3,79	1,97	SE		72
4.23.2003	2,95	1,50	SE		300
4.24.2003	4,81	1,99	SE	1,99	275
4.25.2003	7,32	3,22	E	4,06	299
4.26.2003	6,30	2,39	E	3,73	200
4.27.2003	5,53	2,60	E	6,66	382
4.28.2003	5,23	1,92	SE	4,79	355
4.29.2003	4,89	1,71	SE	4,43	348
4.30.2003	4,89	1,95	SE	3,65	349
5.1.2003	4,69	1,70	SE	4,96	346
5.2.2003	4,30	1,99	SE	4,35	369
5.3.2003	5,07	1,97	SE	5,42	376
5.4.2003	5,12	1,98	SE	5,23	358
5.5.2003	7,12	4,16	SE	6,06	359
5.6.2003	6,61	4,00	E	7,56	390
5.7.2003	6,00	3,90	E	7,73	394
5.8.2003	5,40	3,40	SE	6,99	399
5.9.2003	4,62	4,76	SE	6,89	382
5.10.2003	4,60	2,60	SE	5,08	388
5.11.2003	3,71	2,36	SE	6,62	370
5.12.2003	5,01	2,70	SE	7,12	389
5.13.2003	5,01	2,19	SE	5,94	366
5.14.2003	4,69	1,78	N	5,04	375
5.15.2003	4,26	1,80	N	5,19	296
5.16.2003	4,98	2,18	E	5,38	350
5.17.2003	4,67	2,70	SE	5,52	358
5.18.2003	5,02	3,79	SE	5,94	365
5.19.2003	5,42	3,02	SE	5,44	341
5.20.2003	6,22	3,62	E	5,58	375
5.21.2003	6,17	2,80	SE	6,63	376
5.22.2003	4,94	2,21	W	5,70	391
5.23.2003	4,04	1,81	SE	3,84	22
5.24.2003	3,92	1,53	N		144
5.25.2003	6,15	2,16	NW		389
5.26.2003	5,31	1,97	N	4,41	359
5.27.2003	4,22	1,60	SE	4,31	60
5.28.2003	5,61	1,59	E	2,02	237
5.29.2003	7,88	2,91	E	1,12	353
5.30.2003	12,20	4,50	E	5,78	246
5.31.2003	7,21	3,62	E	5,69	300
6.1.2003	5,43	2,8	SE	5,89	252
6.2.2003	4,87	2,28	SE	6,13	386
6.3.2003	5,48	2,05	SE	7,37	385

6.4.2003	5,62	2,32	SE	7,2	368
6.5.2003	8,09	3,83	SE	9,32	381
6.6.2003	5,10	3,28	SE	7,96	378
6.7.2003	5,59	2,98	SE	8,24	380
6.8.2003	5,27	3,15	SE	8,06	361
6.9.2003	6,23	3,47	SE	7,87	369
6.10.2003	5,78	3,44	SE	8,52	384
6.11.2003	7,95	4,33	E	8,72	381
6.12.2003	9,51	4,56	E	9,23	379
6.13.2003	9,40	3,89	E	9,03	364
6.14.2003	8,38	3,96	E	10,39	397
6.15.2003	5,04	3,18	SE	8,99	372
6.16.2003	5,30	3,04	SE	6,61	363
6.17.2003	6,86	2,92	SE	6,97	257
6.18.2003	8,91	3,43	E	8,04	360
6.19.2003	4,67	2,80	SE	6,65	343
6.20.2003	6,26	3,03	E	6,98	351
6.21.2003	5,98	2,90	E	7,68	356
6.22.2003	5,59	2,69	E	8,19	347
6.23.2003	5,62	2,57	E	7,62	379
6.24.2003	5,19	2,20	E	8,49	350
6.25.2003	6,56	2,40	SE	7,80	340
6.26.2003	6,78	2,55	NE	8,07	286
6.27.2003	7,95	2,76	SE	8,58	338
6.28.2003	7,42	2,51	E	7,57	262
6.29.2003	6,42	2,38	SE	7,71	326
6.30.2003	5,11	2,16	E	4,24	76
7.1.2003	5,91	2,50	SE	3,02	337
7.2.2003	5,65	2,49	SE	7,22	351
7.3.2003	5,10	1,96	N	7,38	353
7.4.2003	7,88	2,52	NW	7,62	357
7.5.2003	6,10	2,17	SE	7,41	329
7.6.2003	6,66	2,63	SE	8,04	199
7.7.2003	8,76	2,73	SE	6,36	203
7.8.2003	6,71	2,35	SE	6,25	153
7.9.2003	10,40	3,09	SE	6,06	239
7.10.2003	7,35	2,69	SE	6,87	335
7.11.2003	6,43	1,98	SE	7,56	300
7.12.2003	6,42	2,83	E	7,00	171
7.13.2003	7,96	3,56	E	5,50	327
7.14.2003	6,53	2,57	SE	7,69	315
7.15.2003	8,92	3,50	SE	7,22	307
7.16.2003	6,30	2,79	E	7,10	310
7.17.2003	5,89	2,15	E	7,53	305
7.18.2003	6,74	2,92	SE	7,60	194
7.19.2003	8,87	3,68	E	7,22	294
7.20.2003	8,09	4,01	E	8,67	278
7.21.2003	9,26	4,18	E	7,99	282

7.22.2003	9,92	4,38	E	8,03	293
7.23.2003	6,98	3,39	E	9,01	259
7.24.2003	6,06	2,72	SE	8,60	281
7.25.2003	5,24	2,86	E	7,64	90
7.26.2003	8,95	3,77	E	4,28	273
7.27.2003	10,90	4,23	E	5,73	248
7.28.2003	9,66	3,84	E	7,06	277
7.29.2003	6,22	2,82	SE	7,59	252
7.30.2003	6,12	2,50	E	7,55	185
7.31.2003	6,51	2,57	SE	7,03	247
8.1.2003	6,51	2,53	SE	7,17	502
8.2.2003	6,20	3,26	SE	7,37	240
8.3.2003	5,25	3,20	SE	7,67	208
8.4.2003	10,40	4,68	E	7,55	236
8.5.2003	13,50	5,72	E	8,63	251
8.6.2003	10,50	5,11	E	9,29	249
8.7.2003	7,90	4,25	E	8,68	234
8.8.2003	7,65	4,35	E	8,31	243
8.9.2003	7,51	3,74	E	7,25	218
8.10.2003	7,94	3,25	E	8,10	205
8.11.2003	7,59	2,57	E	7,74	235
8.12.2003	6,87	2,77	E	7,13	246
8.13.2003	9,34	3,29	E	7,77	244
8.14.2003	6,35	2,89	E	8,03	235
8.15.2003	6,84	2,66	SE	8,24	277
8.16.2003	6,16	2,73	E	7,15	255
8.17.2003	5,95	3,02	E	9,76	199
8.18.2003	6,51	3,35	E	8,49	
8.19.2003	10,20	4,27	E	7,42	
8.20.2003	11,00	4,36	E	8,17	
8.21.2003	10,60	5,24	E	6,97	
8.22.2003	6,69	3,33	E	8,18	
8.23.2003	7,58	3,72	E	7,83	
8.24.2003	10,60	3,83	E	7,73	
8.25.2003	9,77	4,70	E	7,64	
8.26.2003	4,52	2,02	W	5,86	
8.27.2003	5,32	2,08	SE	6,18	
8.28.2003	5,48	1,81	SE	8,26	
8.29.2003	2,13	2,13	SE	7,19	
8.30.2003	6,27	2,69	E	4,90	
8.31.2003	5,13	1,84	NW	5,75	
9.1.2003	6,31	2,31	W	5,84	
9.2.2003	5,49	3,11	SE	6,03	
9.3.2003	5,79	2,86	E	6,24	
9.4.2003	9,95	4,25	E	4,44	
9.5.2003	9,94	4,32	NE	5,24	
9.6.2003	5,74	2,04	SE	5,12	
9.7.2003	6,53	3,05	NE	4,68	

9.8.2003	5,98	2,62	E	5,25	
9.9.2003	4,61	1,92	SE	5,87	
9.10.2003	5,74	1,79	E	3,16	
9.11.2003	13,00	1,89	E	4,25	
9.12.2003	5,84	1,94	W	-	
9.13.2003	5,60	2,26	SE	3,59	
9.14.2003	5,97	2,68	E	3,77	
9.15.2003	5,11	2,36	E	3,86	
9.16.2003	6,19	2,61	E	4,19	
9.17.2003	7,26	2,39	E	3,66	
9.18.2003	6,49	3,00	NE	4,30	
9.19.2003	10,10	4,56	NE	4,25	
9.20.2003	9,13	4,34	NE	5,64	
9.21.2003	8,39	3,57	E	5,40	
9.22.2003	7,74	3,44	E	5,18	
9.23.2003	5,68	3,04	SE	4,99	
9.24.2003	6,51	2,10	SE	5,04	
9.25.2003	9,18	3,75	E	3,16	
9.26.2003	8,23	3,84	E	5,11	
9.27.2003	7,30	2,91	E	3,96	
9.28.2003	7,02	2,11	E	4,20	
9.29.2003	5,97	2,18	E	3,36	
9.30.2003	5,57	2,18	E	4,20	
10.1.2003	4,78	2,216	E	2,39	
10.2.2003	7,77	2,742	E	4,37	
10.3.2003	4,67	1,946	E	3,27	6
10.4.2003	4,27	1,76	SE	3,05	180
10.5.2003	6,75	2,44	NW	3,34	170
10.6.2003	8,55	2,51	NW	6,74	103
10.7.2003	5,53	1,76	W	2,88	118
10.8.2003	8,18	2,73	SW	1,06	45
10.9.2003	18,30	5,48	W		46
10.10.2003	8,91	1,84	SE	3,31	49
10.11.2003	5,51	2,17	E		129
10.12.2003	5,39	2,17	E	3,16	120
10.13.2003	9,55	3,29	E	3,14	119
10.14.2003	8,22	3,44	E	3,76	106
10.15.2003	5,89	3,20	E	4,06	60
10.16.2003	4,86	2,66	E	3,74	12
10.17.2003	5,61	2,05	E	1,14	19
10.18.2003	5,24	2,06	SE	1,73	22
10.19.2003	4,10	2,01	E	2,04	3
10.20.2003	6,82	2,23	SE	0,91	36
10.21.2003	7,23	3,16	SW	2,79	24
10.22.2003	5,25	2,32	NW	2,46	36
10.23.2003	7,85	3,08	SW	3,40	
10.24.2003	8,30	3,78	SW	2,22	
10.25.2003	6,66	2,55	NW	0,85	1

10.26.2003	4,97	2,57	E		1
10.27.2003	4,12	2,27	E	1,86	4
10.28.2003	9,51	4,82	NE		39
10.29.2003	5,54	2,04	NE	2,19	19
10.30.2003	4,74	1,97	SE	2,75	
10.31.2003	4,92	1,89	SE		
11.1.2003	5,46	1,658	N	0,34	21
11.2.2003	3,24	1,6	SE	1,09	
11.3.2003	3,85	1,55	SE		
11.4.2003	6,19	2,30	SE		
11.5.2003	10,70	4,81	E	1,19	
11.6.2003	11,60	3,20	E		
11.7.2003	4,99	1,64	E		2
11.8.2003	8,48	4,35	E	1,24	
11.9.2003	10,20	5,80	NE	2,38	
11.10.2003	9,53	3,24	NE	1,86	3
11.11.2003	6,07	2,16	E	1,74	30
11.12.2003	6,14	2,80	E	1,31	
11.13.2003	5,01	2,34	E	1,83	
11.14.2003	4,26	2,64	E	1,37	
11.15.2003	4,65	1,61	E	1,86	
11.16.2003	3,44	1,28	SE	1,35	
11.17.2003	3,19	1,50	E	0,75	
11.18.2003	3,60	1,24	SE	1,40	
11.19.2003	3,89	1,61	E	1,16	
11.20.2003	3,06	1,69	E	0,32	
11.21.2003	3,83	1,52	E	1,26	
11.22.2003	3,02	1,58	SE	1,31	
11.23.2003	2,52	1,27	E	1,04	
11.24.2003	3,18	1,44	E	0,71	
11.25.2003	4,15	1,57	E	0,57	
11.26.2003	2,59	1,28	E	0,83	
11.27.2003	2,94	1,35	SE	0,20	
11.28.2003	3,27	1,34	E	0,91	
11.29.2003	3,74	1,42	SE	0,82	
11.30.2003	4,74	1,71	SE	1,01	

APPENDIX D

HOURLY WIND DIRECTION DATA ON DAILY BASIS

Table D Hourly wind direction data on daily basis

DATE	N	NE	E	SE	S	SW	W	NW
7.1.01	-	-	-	-	1	4	17	2
7.2.01	1	-	-	-	-	2	20	1
7.3.01	-	-	2	1	2	2	11	6
7.4.01	-	-	-	1	-	6	9	8
7.5.01	1	-	-	-	-	11	6	6
7.6.01	2	-	3	1	2	3	9	4
7.7.01	-	-	-	-	-	9	13	2
7.8.01	3	-	7	1	-	2	5	6
7.9.01	1	-	9	2	1	-	5	6
7.10.01	-	-	-	1	2	3	17	1
7.11.01	1	-	-	-	-	2	8	4
7.12.01	-	-	-	-	-	5	9	-
7.13.01	-	-	-	-	-	6	15	3
7.14.01	-	-	-	-	-	8	12	4
7.15.01	1	-	-	-	1	1	16	5
7.16.01	-	-	2	-	-	8	12	2
7.17.01	1	1	6	3	1	3	5	4
7.18.01	1	-	4	1	1	2	7	8
7.19.01	1	-	-	-	-	6	13	4
7.20.01	-	1	4	-	-	1	14	4
7.21.01	1	2	6	5	-	-	3	7
7.22.01	2	1	5	4	2	-	6	4
7.23.01	2	1	9	-	-	-	10	2
7.24.01	1	-	5	6	4	-	1	7
7.25.01	-	2	4	2	4	3	4	5
7.26.01	1	-	-	-	-	2	12	9
7.27.01	-	-	-	-	-	6	8	2
7.28.01	-	-	-	-	-	7	13	4
7.29.01	1	-	-	-	-	1	17	5
7.30.01	2	-	-	-	-	7	12	3
7.31.01	-	-	-	-	-	9	14	1
8.1.01	-	-	-	-	-	15	8	1
8.2.01	1	-	-	-	-	11	11	1
8.3.01	-	-	-	-	-	9	14	1
8.4.01	-	-	-	-	1	8	13	2

8.5.01	1	-	-	-	-	3	13	7
8.6.01	4	1	-	-	-	2	6	11
8.7.01	1	-	-	-	-	-	11	12
8.8.01	1	-	-	-	-	4	9	10
8.9.01	1	-	-	-	1	2	16	4
8.10.01	-	-	-	-	-	3	14	7
8.11.01	-	1	5	3	-	-	7	8
8.12.01	1	-	-	1	-	2	9	11
8.13.01	2	-	-	-	-	5	13	4
8.14.01	1	-	-	-	-	4	14	-
8.15.01	-	-	-	-	-	5	14	5
8.16.01	-	-	-	-	-	2	17	5
8.17.01	-	-	-	-	-	3	16	5
8.18.01	-	-	-	-	-	9	13	2
8.19.01	-	-	-	-	-	5	17	2
8.20.01	1	3	3	5	-	-	9	3
8.21.01	4	1	2	3	3	1	5	5
8.22.01	2	3	4	1	6	-	5	3
8.23.01	3	-	-	1	3	2	8	7
8.24.01	2	-	1	1	-	3	11	6
8.25.01	1	-	-	-	-	1	20	2
8.26.01	1	-	-	-	-	3	17	3
8.27.01	1	-	-	-	-	7	12	4
8.28.01	-	-	-	-	-	11	7	6
8.29.01	1	1	6	2	1	3	3	7
8.30.01	-	-	1	-	4	-	11	8
8.31.01	1	-	1	1	-	3	8	10
9.1.01	2	-	6	-	3	-	4	9
9.2.01	3	-	7	4	2	-	3	5
9.3.01	2	3	2	10	2	-	2	3
9.4.01	1	-	3	4	3	2	3	8
9.5.01	1	3	4	4	2	-	1	9
9.6.01	3	5	9	5	2	-	-	-
9.7.01	2	1	7	5	9	-	-	-
9.8.01	1	3	2	4	1	2	4	7
9.9.01	3	3	1	3	4	-	7	3
9.10.01	1	10	1	1	4	-	2	5
9.11.01	5	9	-	3	-	-	4	3
9.12.01	8	5	3	2	1	-	3	2
9.13.01	-	-	-	-	2	6	11	5
9.14.01	-	-	-	-	-	6	18	-
9.15.01	-	-	5	6	-	1	6	6
9.16.01	1	7	-	6	3	-	-	7
9.17.01	-	7	4	1	2	1	2	7
9.18.01	-	3	6	3	3	-	3	6
9.19.01	-	-	5	1	4	-	3	11
9.20.01	1	-	1	2	1	1	12	6
9.21.01	-	-	-	-	-	2	17	5

9.22.01	-	1	3	-	-	2	10	8
9.23.01	-	-	5	-	2	-	9	8
9.24.01	1	1	6	5	-	-	4	7
9.25.01	1	1	7	4	2	-	4	5
9.26.01	1	-	2	3	-	1	3	14
9.27.01	1	-	3	7	1	3	4	5
9.28.01	2	-	2	1	-	2	12	5
9.29.01	1	-	-	-	-	1	15	7
9.30.01	1	-	-	-	-	8	12	3
10.1.01	1	-	1	3	-	1	8	10
10.2.01	1	-	2	-	-	4	12	5
10.3.01	4	-	2	-	3	1	9	5
10.4.01	-	2	10	-	1	-	6	5
10.5.01	2	2	11	5	2	-	-	2
10.6.01	-	4	8	-	2	-	4	6
10.7.01	1	-	1	-	-	3	10	9
10.8.01	-	-	-	-	-	6	14	4
10.9.01	1	-	-	-	-	3	18	2
10.10.01	-	-	-	-	-	4	17	3
10.11.01	-	-	-	-	-	5	14	5
10.12.01	-	-	-	-	-	7	13	4
10.13.01	-	-	-	-	-	10	12	2
10.14.01	1	-	-	-	-	6	14	3
10.15.01	-	-	-	-	-	9	12	3
10.16.01	1	-	-	-	-	8	12	3
10.17.01	-	-	-	-	-	7	15	2
10.18.01	-	-	-	-	-	5	15	4
10.19.01	-	-	2	1	1	-	6	14
10.20.01	2	-	5	3	-	2	2	10
10.21.01	1	1	9	-	3	1	3	6
10.22.01	-	1	4	4	3	-	3	9
10.23.01	1	-	2	2	2	1	6	10
10.24.01	1	-	-	-	1	3	14	5
10.25.01	1	-	-	-	1	13	8	1
10.26.01	1	-	-	-	1	9	12	1
10.27.01	-	-	-	-	-	2	20	2
10.28.01	-	-	-	-	-	9	10	5
10.29.01	-	-	-	-	-	15	8	1
10.30.01	1	-	1	1	-	4	7	10
10.31.01	1	-	-	-	1	4	10	8
11.1.01	-	2	2	2	1	1	5	11
11.2.01	-	-	-	-	-	2	14	8
11.3.01	-	-	-	-	-	9	11	4
11.4.01	-	-	-	1	-	13	8	2
11.5.01	1	-	-	-	-	5	9	9
11.6.01	-	-	-	-	1	5	11	7
11.7.01	1	2	5	-	3	2	6	5
11.8.01	11	-	-	-	-	6	-	7

11.9.01	3	2	1	2	4	1	6	5
11.10.01	1	3	2	4	-	4	6	4
11.11.01	-	-	-	-	-	1	12	11
11.12.01	1	-	1	4	2	-	8	8
11.13.01	1	2	3	2	5	-	2	9
11.14.01	2	7	8	5	2	-	-	-
11.15.01	2	1	-	-	4	2	10	5
11.16.01	1	-	-	1	4	9	6	3
11.17.01	-	-	-	-	-	15	9	-
11.18.01	2	-	-	-	-	6	7	9
11.19.01	-	-	2	1	2	2	5	12
11.20.01	2	-	1	1	-	2	7	11
11.21.01	-	-	1	-	-	12	10	1
11.22.01	2	-	-	-	2	5	5	10
11.23.01	4	3	-	1	-	1	6	9
11.24.01	2	2	2	2	-	-	-	-
3.1.03	1	-	6	13	1	-	2	1
3.2.03	-	-	5	13	3	-	-	3
3.3.03	1	2	6	10	5	-	-	-
3.4.03	-	1	14	9	-	-	-	-
3.5.03	-	1	18	4	1	-	-	-
3.6.03	-	-	13	10	1	-	-	-
3.7.03	-	-	6	12	3	2	-	1
3.8.03	-	-	6	18	-	-	-	-
3.9.03	-	-	8	15	1	-	-	-
3.10.03	-	-	11	12	1	-	-	-
3.11.03	-	1	16	6	1	-	-	-
3.12.03	1	3	5	7	1	-	4	3
3.13.03	4		2	9	-	2	3	4
3.14.03	-	-	8	14	2	-	-	-
3.15.03	-	-	23	1	-	-	-	-
3.16.03	-	-	23	1	-	-	-	-
3.17.03	-	-	23	1	-	-	-	-
3.18.03	1	-	12	11	-	-	-	-
3.19.03	-	4	14	6	-	-	-	-
3.20.03	1	-	3	6	2	-	4	8
3.21.03	-	-	8	9	1	-	5	1
3.22.03	-	1	18	5	-	-	-	-
3.23.03	-	3	16	4	1	-	-	-
3.24.03	-	9	15	-	-	-	-	-
3.25.03	-	-	10	14	-	-	-	-
3.26.03	1	1	10	10	1	-	-	1
3.27.03	-	3	13	8	-	-	-	-
3.28.03	-	-	4	14	2	1	-	3
3.29.03	-	1	6	14	-	-	1	2
3.30.03	4	-	1	11	1	-	5	2
3.31.03	3	-	3	7	-	3	5	3
6.1.03	-	1	11	8	1	-	-	3

6.2.03	1	-	4	6	4	-	5	4
6.3.03	4	-	1	10	3	-	3	3
6.4.03	3	-	7	10	1	-	1	2
6.5.03	-	1	12	7	-	-	-	-
6.6.03	-	-	7	16	-	-	-	-
6.7.03	2	-	8	14	-	-	-	-
6.8.03	-	1	11	9	3	-	-	-
6.9.03	-	-	17	7	-	-	-	-
6.10.03	-	-	12	12	-	-	-	-
6.11.03	-	-	19	5	-	-	-	-
6.12.03	-	1	17	6	-	-	-	-
6.13.03	-	1	12	10	1	-	-	-
6.14.03	-	1	14	9	-	-	-	-
6.15.03	-	1	14	9	-	-	-	-
6.16.03	-	1	7	15	-	-	1	-
6.17.03	-	3	13	8	-	-	-	-
6.18.03	-	-	14	10	-	-	-	-
6.19.03	-	-	12	12	-		-	-
6.20.03	-	1	14	8	1	-	-	-
6.21.03	-	-	19	5	-	-	-	-
6.22.03	-	3	12	6	2	-	1	-
6.23.03	3	-	9	6	2	-	2	2
6.24.03	-	2	11	10	1	-	-	-
6.25.03	3	1	7	8	-	-	5	-
6.26.03	1	8	2	8	2	-	2	1
6.27.03	2	1	7	5	5	-	-	4
6.28.03	-	1	13	6	2	-	2	-
6.29.03	2	3	3	9	1	-	1	5
6.30.03	4	1	9	5	2	-	2	1
7.1.03	-	1	8	11	1	2	1	-
7.2.03	3	-	5	5	3	1	2	5
7.3.03	6	4	2	9	2	-	-	1
7.4.03	3	-	1	8	1	2	4	5
7.5.03	5	-	1	7	-	1	6	4
7.6.03	3	1	7	8	4	-	1	-
7.7.03	3	7	-	10	2	-	2	-
7.8.03	5	4	1	12	1	-	-	1
7.9.03	5	3	2	6	1	2	3	2
7.10.03	2	2	2	7	4	-	4	3
7.11.03	2	2	6	8	1	-	3	2
7.12.03	3	-	16	5	-	-	-	-
7.13.03	-	1	17	6	-	-	-	-
7.14.03	-	-	7	8	6	1	1	1
7.15.03	3	2	4	6	2	-	1	6
7.16.03	-	1	15	6	2	-	-	-
7.17.03	-	2	8	5	4	-	4	1
7.18.03	-	2	7	8	5	1	-	1
7.19.03	-	2	11	11	-	-	-	-

7.20.03	-	1	20	3	-	-	-	-
7.21.03	-	1	18	5	-	-	-	-
7.22.03	-	4	17	3	-	-	-	-
7.23.03	-	2	15	6	-	-	1	-
7.24.03	-	-	3	10	1	1	5	-
7.25.03	-	-	12	3	2	2	-	-
7.26.03	-	1	20	3	-	-	-	-
7.27.03	-	-	21	3	-	-	-	-
7.28.03	-	7	16	1	-	-	-	-
7.29.03	-	1	10	12	1	-	-	-
7.30.03	1	-	11	5	2	-	3	2
7.31.03	3	1	-	11	1	2	3	3
8.1.03	-	1	8	9	-	-	2	4
8.2.03	-	2	5	10	3	1	-	3
8.3.03	1	2	12	9	-	-	-	-
8.4.03	-	-	21	3	-	-	-	-
8.5.03	-	4	17	3	-	-	-	-
8.6.03	-	3	18	3	-	-	-	-
8.7.03	-	7	13	4	-	-	-	-
8.8.03	-	6	17	1	-	-	-	-
8.9.03	-	4	20	-	-	-	-	-
8.10.03	-	2	21	1	-	-	-	-
8.11.03	2	3	12	1	-	2	4	-
8.12.03	-	3	17	4	-	-	-	-
8.13.03	-	5	14	5	-	-	-	-
8.14.03	-	6	10	7	1	-	-	-
8.15.03	-	1	9	14	-	-	-	-
8.16.03	-	3	12	9	-	-	-	-
8.17.03	-	-	14	10	-	-	-	-
8.18.03	-	4	15	5	-	-	-	-
8.19.03	-	9	11	4	-	-	-	-
8.20.03	-	4	17	3	-	-	-	-
8.21.03	-	4	19	1	-	-	-	-
8.22.03	-	2	15	7	-	-	-	-
8.23.03	-	12	10	2	-	-	-	-
8.24.03	-	2	12	6	-	1	3	-
8.25.03	2	1	8	4	-	2	4	3
8.26.03	3	1	4	6	-	2	5	3
8.27.03	2	-	5	7	-	2	7	1
8.28.03	2	1	3	6	2	4	2	4
8.29.03	-	3	16	4	-	-	1	-
8.30.03	1	3	6	4	-	4	4	2
8.31.03	3	1	6	3	1	6	1	3
9.1.03	1	-	8	5	1	-	7	2
9.2.03	-	-	7	11	-	3	3	-
9.3.03	-	2	15	7	-	-	-	-
9.4.03	-	8	15	1	-	-	-	-
9.5.03	-	16	8	-	-	-	-	-

9.6.03	1	2	6	8	1	2	4	-
9.7.03	-	7	12	5	-	-	-	-
9.8.03	-	2	10	7	-	1	4	-
9.9.03	2	-	5	9	-	4	2	2
9.10.03	1	-	7	3	1	5	5	2
9.11.03	3	-	9	3	3	3	1	2
9.12.03	5	1	3	2	2	3	4	4
9.13.03	3	-	9	7	-	1	3	1
9.14.03	-	-	11	9	-	1	3	-
9.15.03	1	3	10	8	1	-	1	-
9.16.03	-	3	15	6	-	-	-	-
9.17.03	-	6	15	1	-	-	2	-
9.18.03	1	10	7	5	-	-	-	1
9.19.03	-	11	10	3	-	-	-	-
9.20.03	-	9	13	2	-	-	-	-
9.21.03	-	5	18	1	-	-	-	-
9.22.03	-	7	13	4	-	-	-	-
9.23.03	3	-	3	11	-	2	4	1
9.24.03	2	-	6	9	-	2	5	-
9.25.03	-	8	13	3	-	-	-	-
9.26.03	-	5	18	1	-	-	-	-
9.27.03	1	5	14	4	-	-	-	-
9.28.03	1	5	15	3	-	-	-	-
9.29.03	-	2	11	6	1	1	2	1
9.30.03	-	-	10	6	-	3	5	-
10.1.03	1	5	16	2	-	-	-	-
10.2.03	-	9	14	1	-	-	-	-
10.3.03	2	2	8	5	-	4	2	1
10.4.03	1	3	4	4	1	4	4	3
10.5.03	1	-	1	3	1	2	9	7
10.6.03	1	-	2	6	1	6	4	4
10.7.03	4	-	5	1	2	-	8	4
10.8.03	5	2	4	1	2	8	-	2
10.9.03	2	-	3	1	4	5	8	1
10.10.03	2	2	10	9	1	-	-	-
10.11.03	1	5	14	4	-	-	-	-
10.12.03	-	7	13	4	-	-	-	-
10.13.03	-	6	16	2	-	-	-	-
10.14.03	-	8	13	3	-	-	-	-
10.15.03	-	5	18	1	-	-	-	-
10.16.03	-	4	10	10	-	-	-	-
10.17.03	1	1	12	4	-	1	5	-
10.18.03	-	-	12	8	-	-	2	2
10.19.03	1	-	13	10	-	-	-	-
10.20.03	1	-	3	7	1	6	4	2
10.21.03	-	-	-	-	-	10	8	6
10.22.03	2	-	3	3	-	5	3	8
10.23.03	3	1	-	-	1	9	6	4

10.24.03	3	-	-	-	3	8	7	3
10.25.03	5	-	1	3	-	2	3	10
10.26.03	1	3	13	7	-	-	-	-
10.27.03	-	1	8	4	1	5	1	4
10.28.03	1	12	6	2	-	3	-	-
10.29.03	-	8	8	7	-	1	-	-
10.30.03	-	1	8	15	-	-	-	-
10.31.03	1	-	5	9	1	1	7	-
11.1.03	10	2	2	1	-	5	4	-
11.2.03	-	-	6	10	-	-	-	-
11.3.03	-	-	-	-	-	-	-	-
11.4.03	-	-	-	-	-	-	-	-
11.5.03	-	1	5	-	-	-	-	-
11.6.03	-	5	19	-	-	-	-	-
11.7.03	-	3	18	3	-	-	-	-
11.8.03	-	9	14	1	-	-	-	-
11.9.03	-	15	9	-	-	-	-	-
11.10.03	-	16	3	4	1	-	-	-
11.11.03	5	4	8	5	1	-	1	-
11.12.03	-	5	15	4	-	-	-	-
11.13.03	-	-	18	6	-	-	-	-
11.14.03	-	5	16	3	-	-	-	-
11.15.03	-	4	14	6	-	-	-	-
11.16.03	1	6	8	5	1	-	3	-
11.17.03	3	1	8	5	-	-	5	2
11.18.03	3	-	7	8	1	-	1	4
11.19.03	2	-	11	8	2	-	1	-
11.20.03	3	-	11	6	-	2	2	-
11.21.03	4	-	12	7	-	-	1	-
11.22.03	2	-	10	8	-	-	3	1
11.23.03	-	2	10	8	3	-	1	-
11.24.03	1	3	9	9	-	-	2	-
11.25.03	-	2	11	4	-	-	6	1
11.26.03	1	3	14	4	1	-	-	1
11.27.03	4	-	10	6	-	-	3	1
11.28.03	2	-	11	7	1	1	-	2
11.29.03	2	-	11	11	-	-	-	-
11.30.03	-	1	9	12	1	-	-	1